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Geophysics

Stockton and Darlington Railway, Soho Works, Shildon, County Durham, Report on Geophysical Surveys, June 2021

Neil Linford and Andrew Payne

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STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

REPORT ON GEOPHYSICAL SURVEYS, JUNE 2021

Neil Linford and Andrew Payne

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SUMMARY

Ground Penetrating Radar (GPR), fluxgate gradiometer and earth resistance surveys were conducted over the former Stockton and Darlington Railway Soho Works at Shildon, County Durham to assist with the Historic Architectural Assessment of the Soho Cottages. The aim of the survey was to investigate the below ground survival of Timothy Hackworth's Soho Works, which developed through the 1830s and 1840s, in the area adjacent to the standing Soho Cottages. GPR survey (0.33ha) and fluxgate magnetometer survey (0.39ha) was conducted over the majority of the accessible area, with additional earth resistance (0.24ha) coverage in the vicinity of the former Soho Works buildings. While anomalies were detected by all three techniques it proved difficult to fully interpret these against the footprint of the former buildings and railway infrastructure recorded on the historic Ordnance Survey mapping. This appears to be largely due to the limited access to the location of the former buildings resulting from the demolition and remodelling of the surrounding landscape.

CONTRIBUTORS
The geophysical fieldwork was conducted by Neil Linford and Andrew Payne.

ACKNOWLEDGEMENTS
The authors are grateful to Shildon Town Council for allowing access to the site for the survey to be conducted, and to colleagues from Darlington County Council and the Friends of the Stockton to Darlington Railway for their assistance through the Heritage Action Zone project supported by Historic England.

ARCHIVE LOCATION
Fort Cumberland, Portsmouth.

DATE OF SURVEY
The fieldwork was conducted between 21st to 25th June 2021 and the report completed on 20th September 2021. The cover image shows the fluxgate magnetometer survey in progress over the site with Hackworth House and the Soho Cottages in the background (photograph taken by N Linford).

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CONTENTS

INTRODUCTION

Ground Penetrating Radar (GPR), fluxgate gradiometer and earth resistance surveys were conducted over the former Stockton and Darlington Railway Soho Works at Shildon, County Durham. This work was undertaken as part of the Stockton and Darlington Railway Heritage Action Zone (HAZ) established by Historic England and local partners to help rejuvenate and restore the 26 mile stretch of historic railway in advance of the 2025 bicentenary.

The Stockton and Darlington Railway (SDR) was formally opened on 27 September 1825 and played a pivotal role in the development of the modern railway through its application and development of new areas of engineering, particularly in the use of locomotives over a relatively long, permanent rail infrastructure providing a regular goods and passenger service. In 1825 Shildon became home to the SDR Locomotive and Wagon Works managed by Timothy Hackworth, a pioneering steam-locomotive engineer who established his own engineering works at Shildon known as the Soho Works in 1833. Following Hackworth's death the Soho Works were re-absorbed into the SDR Works (in 1855) and the combined railway works dominated Shildon until it closed in 1984 (Historic England 1986).

The aim of the geophysical survey was to investigate the below ground survival of the Soho Works which developed through the 1830s and 1840s and included workshops, forges and sheds, which lay to the north of Soho House and Cottages where the Hackworth family lived from 1831. The former building footprints and associated railway track infrastructure are recorded on historic Ordnance Survey mapping, but following the demolition of the works in the 1970s all structural traces have been removed and the area extensively relevelled. It was hoped that the survey would assist the historic architectural assessment of Soho House and Cottages (List entries 1160335 and 1121461), conducted by Historic England as part of the HAZ project.

The site, now largely an open grassland amenity area, lies over Pennine Lower Coal Measures Formation Carboniferous sandstone, with superficial deposits of Devensian Till. Slowly permeable seasonally waterlogged fine loamy, fine loamy over clayey and clayey soils of the Brickfield 3 (713g) Association are recorded, although the near-surface deposits are more likely to be dominated by the building rubble and made-ground used to level the site (Geological Survey of Great Britain 1969; Soil Survey of England and Wales 1983). Surface conditions were generally down to short, mown grass with the survey conducted during a period of hot, dry weather throughout and immediately proceeding the field work.

METHOD

Ground Penetrating Radar survey

A 3d-Radar MkIV GeoScope Continuous Wave Step Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a multi-element DXG1820 vehicle towed, ground coupled antenna array (Linford *et al.* 2010; Eide *et al.* 2018). A roving Trimble R8s Global Navigation Satellite System (GNSS) receiver, together with a second R8s base station receiver established using the Ordnance Survey VRS Now correction service, was mounted on the GPR antenna array to provide continuous positional control for the survey collected along the instrument swaths shown on Figure 1. Data were acquired at a 0.075m x 0.075m sample interval across a continuous wave stepped frequency range from 40MHz to 2.99GHz in 4MHz increments using a dwell time of 3ms. A single antenna element was monitored continuously to ensure data quality during acquisition together with automated processing software to produce real time amplitude time slice representations of the data as each successive instrument swath was recorded in the field (Linford 2013).

Post-acquisition processing involved conversion of the raw data to time-domain profiles (through a time window of 0 to 75ns), adjustment of time-zero to coincide with the true ground surface, background and noise removal, and the application of a suitable gain function to enhance late arrivals. Representative profiles from the full GPR survey data set are shown on Figure 6. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 2.5ns (two-way travel time) windows (e.g. Linford 2004). An average sub-surface velocity of 0.114m/ns was assumed following constant velocity tests on the data and was used as the velocity field for the time to estimated depth conversion. Each of the resulting time slices therefore represents the variation of reflection strength through successive ~0.14m intervals from the ground surface, shown as individual greyscale images in Figures 2, 7 and 8. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

Due to the size of the resultant data set a semi-automated algorithm has been employed to extract the vector outline of significant anomalies shown on Figure 11. The algorithm uses edge detection to identify bounded regions followed by a morphological classification based on the size and shape of the extracted anomalies. For example, the location of possible pits is made by selecting small, sub circular anomalies from the data set (Linford and Linford 2017).

Magnetometer survey

Measurements were recorded over a series of 30m grids (Figure 3) established with a Trimble R8s GNSS using a Bartington Grad 601 dual fluxgate gradiometer. Readings were taken at 0.25 m intervals along parallel traverses separated by 1.0 m. Post-acquisition, the median value of each traverse was subtracted from all measurements on that traverse (Zero Median Traverse) to correct for heading errors and instrument drift. A linear greyscale image of the magnetometer data is presented in Figure 4 superimposed on the OS base map. Figure 9 shows a trace plot and linear greyscale image of the raw magnetic readings, together with a trace plot and histogram normalised images of the minimally processed data.

Earth resistance survey

Measurements were recorded over a series of 30m grids established with a Trimble R8s GNSS (Figure 3) using a Geoscan RM85 resistance meter, internal multiplexer, and a PA5 electrode frame in the Twin-Electrode configuration, to allow two separate surveys, with electrode separations of 0.5m and 1.0m, to be collected simultaneously. The 0.5m electrode separation coverage was designed to detect near-surface anomalies in the upper 0.5m of the subsurface whilst the 1.0m separation survey allowed anomalies to a depth of about 1-1.25m to be detected. For the 0.5m electrode separation survey readings were taken at a density of 0.5m x 1.0m whilst for the 1.0m separation survey they were taken at a density of 1.0m x 1.0m.

Extreme values caused by high contact resistance were suppressed using an adaptive thresholding median filter with radius 1m (Scollar et al. 1990), and the data was further processed using a high-pass filter to enhance linear anomalies 1-2m in width while simultaneously suppressing measurement noise. The results for the near-surface 0.5m electrode separation survey are depicted as a linear greyscale image in Figures 5 superimposed on the base OS map data. Figure 10 shows the minimally processed data from both the 0.5m and 1.0m electrode separation data, presented as trace plots and normalised greyscale images, together with linear greyscale images of the processed datasets following the application of a high-pass filter.

RESULTS

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies, [**gpr1-12**] discussed in the following text, superimposed on the base OS historic map data, is provided in Figure 11.

The very near-surface data between 0 and 2.5ns (0.0 to 0.14m) shows the location of modern service inspection covers [**gpr1**] and a high amplitude linear anomaly [**gpr2**] between 0.0 and 7.5ns (0.0 to 0.29m). Anomaly [**gpr2**] continues as a low amplitude response between 10.0 and 30.0ns (0.57 to 1.71m) on a north-south alignment parallel to the east wall of the Soho Cottages, suggesting this may represent an infilled ditch or robbed out wall associated with this phase of the site. A less well defined ditch-type response [**gpr3**] is also found broadly parallel and to the west of [**gpr2**], but it is difficult to determine whether this is related to either the Soho works or the group of anomalies immediately to the north at [**gpr4**].

A series of linear anomalies [**gpr5**] perhaps indicate erosion gullies in the steep slope to the north of the site. The down slope orientation of [**gpr5**] appears to follow the remodelling of the site following the demolition of the Soho workshops in the 1970s, rather than the original topography surrounding the former reservoir shown by hachuring on the historic mapping (OS Historic County Mapping Series: Durham 1897 Epoch 2). A linear anomaly [**gpr6**] passes through the inspection covers [**gpr1**] at the foot of the slope beneath [**gpr5**] and most likely represents a service heading towards the Wylam Close bungalows. Although the historic mapping indicates railway tracks in this area they do not appear to correlate with the orientation of [**gpr6**]. A second service [**gpr7**] is found to the south of the survey following the line of the footpath, perhaps an electricity supply for the street lamps.

To the north of the Soho cottages there is little evidence for the demolished works buildings in the GPR data beyond a scatter of amorphous rubble [**gpr8**] possibly indicating the east entrance, but the larger workshop to the east appears to be partially replicated as a rectilinear anomaly [**gpr9**] between 12.5 and 25.0ns (0.71 to 1.43m). The extent of [**gpr9**] is considerably less than the building footprint shown on the historic mapping but shares a common orientation (OS Historic County Mapping Series: Durham 1897 Epoch 2). Some further, fragmented anomalies immediately to the east [**gpr10**] may, possibly, be associated with the former structural remains within the footprint of the workshop buildings here too.

Further fragmented anomalies [**gpr11**] are found to the east over the site of the former gas works and a dipping linear response [**gpr12**] may well represent the graded slope surrounding a possible circular gas holder shown on the later historic mapping (OS Historic County Mapping Series: Durham 1920 Epoch 3).

Magnetometer survey

A graphical summary of significant magnetic anomalies [**m1-15**] discussed in the following text superimposed on the base OS historic map data is provided in Figure 12.

A linear zone of intense magnetic disturbance [**m1-5**] seems likely to reflect demolition debris from the former railway tracks or related infrastructure, shown on a similar SE-NW orientation on the historic mapping (OS Historic County Mapping Series: Durham 1897 Epoch 2). The magnetic disturbance [**m1-5**] is also concentrated alongside the frontage of the larger Soho workshop, shown as a substantial rectilinear building in this area on the historic mapping. The footprint of the building contains a scatter of intense possibly ferrous or thermoremanent anomalies [**m6-8**] together with a lower magnitude response [**m9**], compatible with former industrial activity on the site.

A similar scatter of strong localised positive magnetic anomalies [**m10-14**] are found to the north of the Soho cottages, although the limited area available for survey here and modern ferrous interference precludes any confident interpretation in relation to the original workshop building known from the historic mapping (OS Historic County Mapping Series: Durham 1876 Epoch 1). Further magnetic disturbance at [**m15**] may be associated with the graded slope (OS Historic County Mapping Series: Durham 1876 Epoch 1) and possible circular gas holder (OS Historic County Mapping Series: Durham 1920 Epoch 3 and 1939 Epoch 4) shown on the historic mapping (cf [**gpr11**] and [**gpr12**]). No further significant magnetic anomalies are found to the east of [**m15**] compatible with the historic mapping evidence showing a series of small fields, paddocks or allotment plots.

Earth resistance survey

A graphical summary of significant earth resistance anomalies [**r1-13**] discussed in the following text superimposed on the base OS historic map data is provided in Figure 13.

Intermittent linear responses [**r1**] correlate with the west face of the large Soho workshop and some internal structure may survive in a rectilinear anomaly at [**r2**]. Further high resistance responses [**r3-5**] are less well defined but may be

related to further demolition debris and rubble deposits derived from the former buildings and railway tracks in this area.

A high resistance anomaly [**r6**] adjacent to the boundary wall of the Soho Cottages is suggestive of structural remains of unknown significance. A narrow linear response [**r7**] to the south east of [**r6**] may relate to a former buried service pipe conduit or drain, together with further more recent services at [**r8**] and [**r9**], although it is also possible that [**r9**] is associated with a section of buried track bed joining with the railway line to the west shown on the historic mapping (OS Historic County Mapping Series: Durham 1897 Epoch 2).

The rectilinear arrangement of high resistance anomalies [**r10-13**] may be associated with the location of the workshop immediately to the north of the Soho Cottages. However, this interpretation is tentative due to the limited extent of the survey coverage and possible confusion with modern services associated with the Wylam Close bungalows.

CONCLUSIONS

All three techniques have recorded geophysical anomalies across the site, although the survey coverage has been constrained by the presence of standing buildings, modern fences, steep heavily vegetated embankment and areas of tree cover. The demolition of the Soho workshop buildings in the 1970s and landscaping of the surviving public amenity space has further hampered the interpretation of the geophysical data in relation to the structures known from the historic mapping. However, the larger Soho workshop has, in part, been replicated by GPR, magnetic and earth resistance anomalies that appear to follow the alignment along the former west face of the building. While the geophysical survey has only identified fragments of the demolished workshop buildings it has confirmed the fidelity of historic mapping.

LIST OF ENCLOSED FIGURES

Figure 12 Graphical summary of significant magnetic anomalies from the superimposed over the OS Historic County Mapping Series: Durham 1897 Epoch 2 (1:1000).

Figure 13 Graphical summary of significant earth resistance anomalies superimposed over the OS Historic County Mapping Series: Durham 1897 Epoch 2 (1:1000).

REFERENCES

Eide, E, Linford, N, Persico, R and Sala, J 2018 'Advanced SFCW GPR systems' *in* Persico, R, Piro, S and Linford, N (eds), *Innovation in Near-Surface Geophysics Instrumentation, Application, and Data Processing Methods* Amsterdam: Elsevier, 253-285.

Geological Survey of Great Britain 1969 Barnard Castle, Geological Survey of England and Wales, Sheet 32. Drift Edition Drift. Southampton, The Director General of the Ordnance Survey.

Historic England 1986. "Soho House." Retrieved 1st October, 2021, from https://historicengland.org.uk/listing/the-list/list-entry/1160335.

Linford, N 2004 'From Hypocaust to Hyperbola: Ground Penetrating Radar surveys over mainly Roman remains in the U.K.'. *Archaeological Prospection*, **11** (4), 237-246.

Linford, N 2013. *Rapid processing of GPR time slices for data visualisation during field acquisition*. In Neubauer, W, Trinks, I, Salisbury, R and Einwogerer, C (Editors), Archaeological Prospection, Proceedings of the 10th International Conference, May 29th - June 2nd 2013 2013 (Vienna: Austrian Academy of Sciences Press). 176-78.

Linford, N and Linford, P 2017. *The application of semi-automated vector identification to large scale archaeological data sets considering anomaly morphology*. In Jennings, B, Gaffney, C, Sparrow, T and Gaffney, S (Editors), 12th International Conference of Archaeological Prospection, 12-16th September 2017 2017 (Bradford: Archaeopress Archaeology). 138-9.

Linford, N, Linford, P, Martin, L and Payne, A 2010 'Stepped-frequency GPR survey with a multi-element array antenna: Results from field application on archaeological sites'. *Archaeological Prospection*, **17** (3), 187-198.

Sala, J and Linford, N 2012 ' Processing stepped frequency continuous wave GPR systems to obtain maximum value from archaeological data sets '. *Near Surface Geophysics*, **10** (1), 3-10.

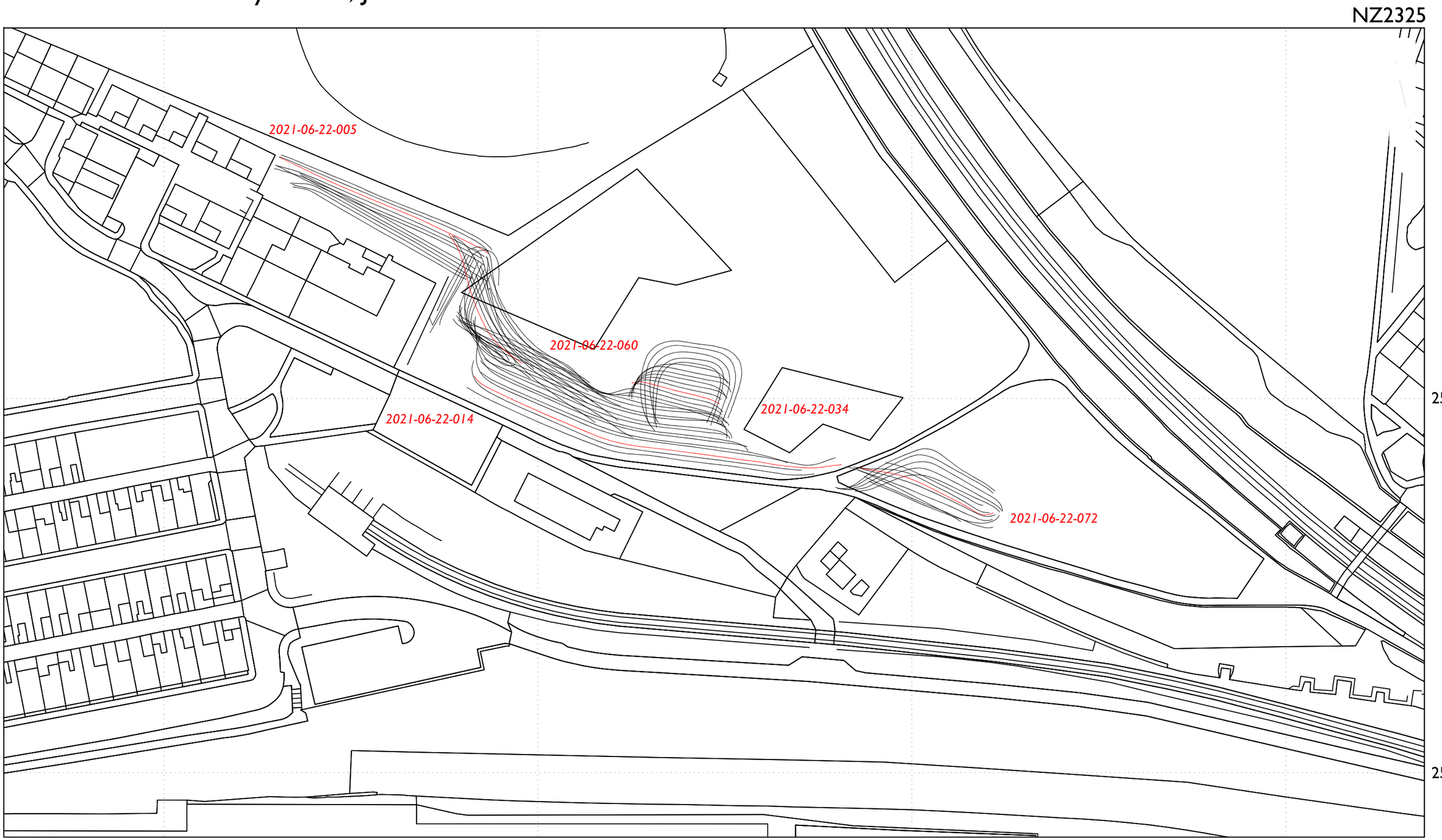
Scollar, I, Tabbagh, A, Hesse, A and Herzog, I 1990 *Archaeological Prospecting and Remote Sensing*. Topics in Remote Sensing. Cambridge, Cambridge University Press.

Soil Survey of England and Wales 1983 Soils of England and Wales, Sheet 1 - Northern England, 1:250,000 scale soil map, Lawes Agricultural Trust, Harpenden.

Figure 1

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Location of GPR survey swaths, June 2021



0 60m

1:1000

2021-06-22-001 Location of selected GPR profiles shown on Figure 6

Ground Penetrating Radar survey swaths

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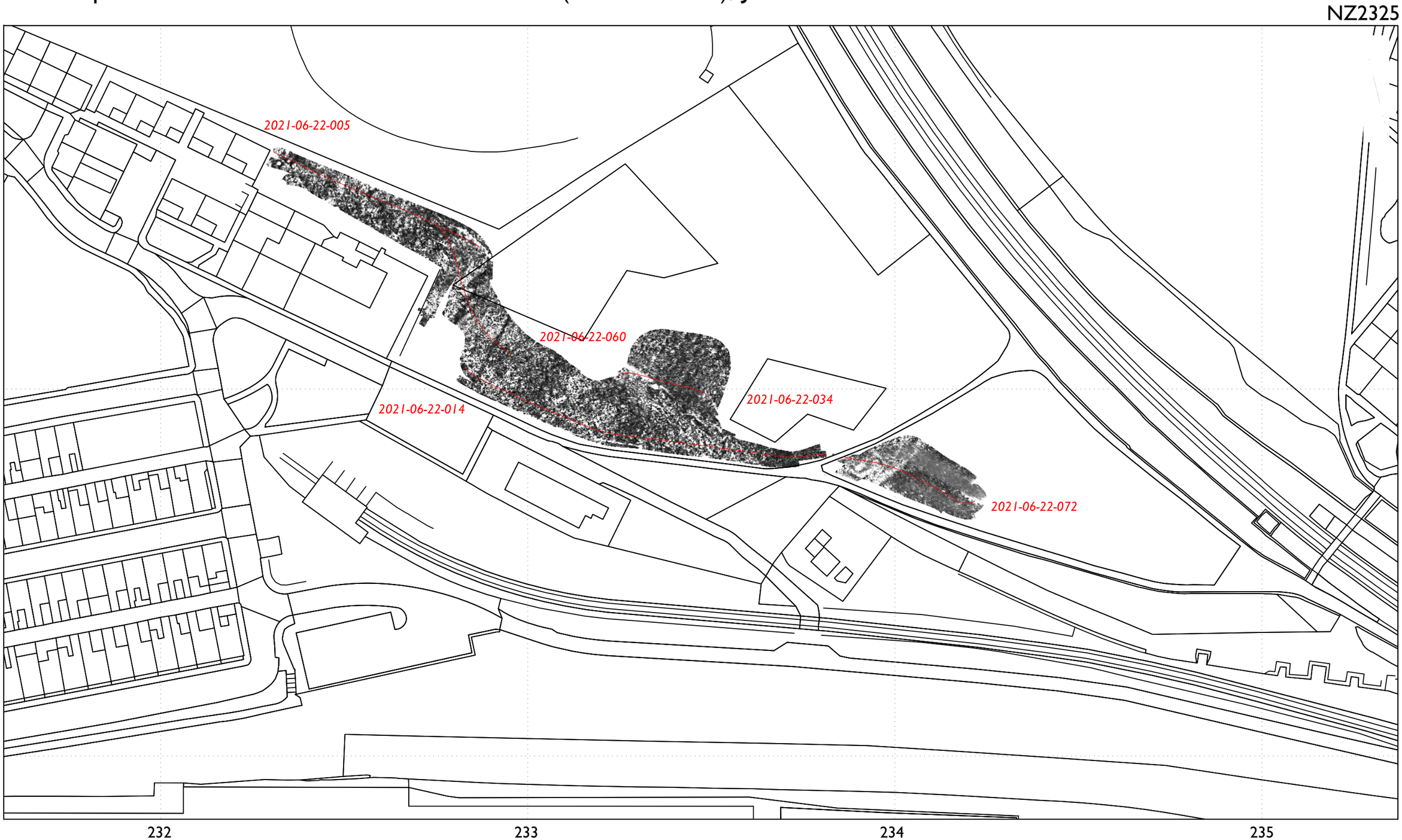
Figure 2

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

GPR amplitude time slice between 12.5 and 15.0ns (0.71 to 0.86m), June 2021



0 60m

1:1000

2021-06-22-001 Location of selected GPR profiles shown on Figure 6

Low *High*
relative reflector strength

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Figure 3

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Location of fluxgate magnetometer and earth resistance surveys, June 2021

0 60m

1:1000

Magnetometer survey area

Earth resistance survey area

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Figure 4

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Location of fluxgate magnetometer survey, June 2021

0 60m

1:1000

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Figure 5

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Location of earth resistance survey, June 2021

0 60m

1:1000

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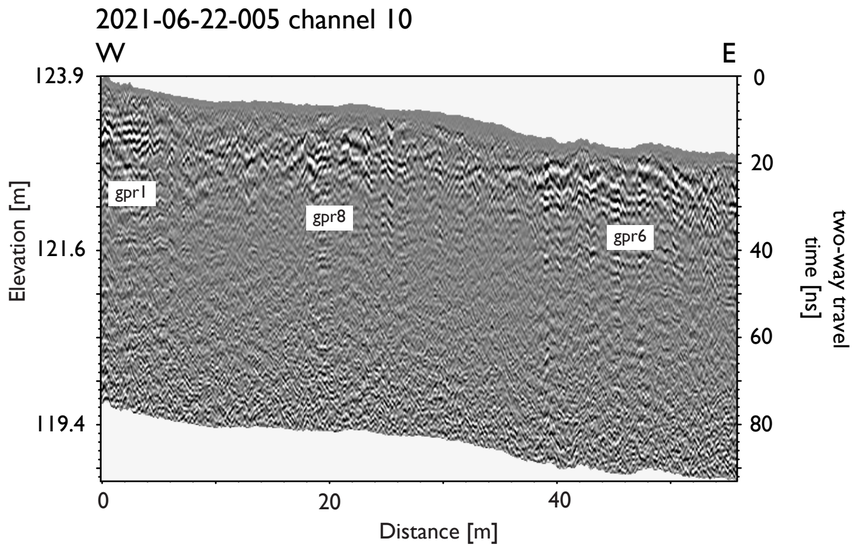
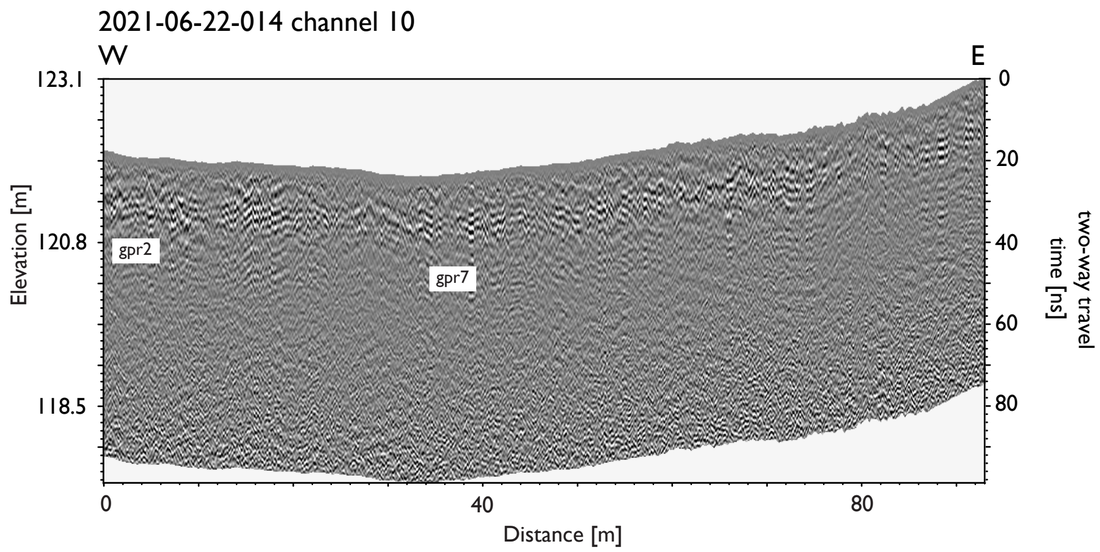
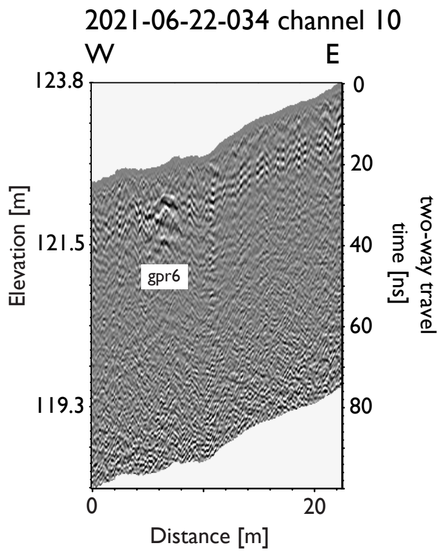
STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

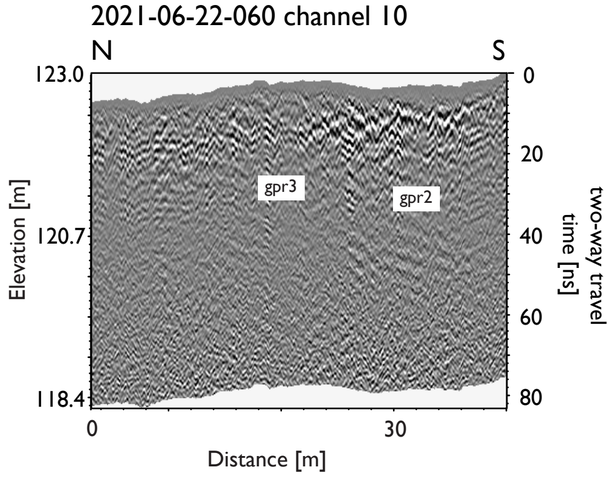
Figure 6

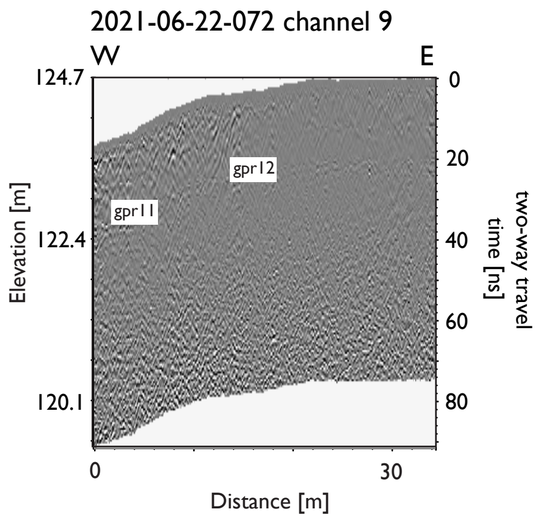
Topographically corrected GPR profiles, June 2021











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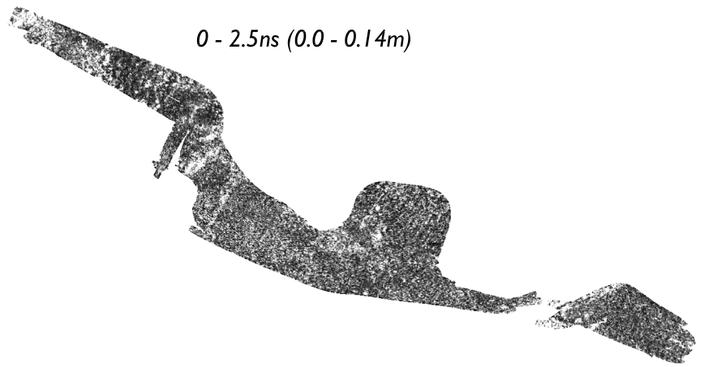
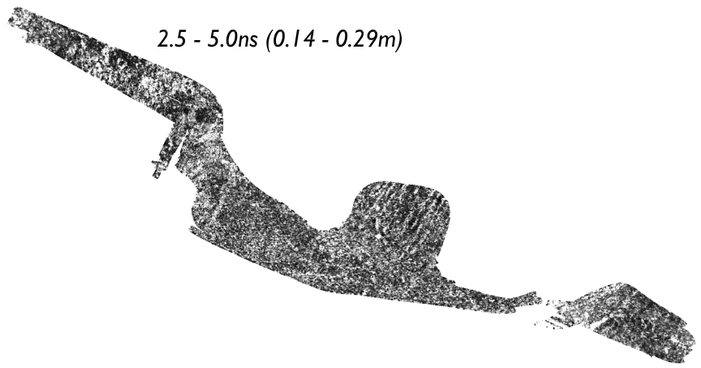
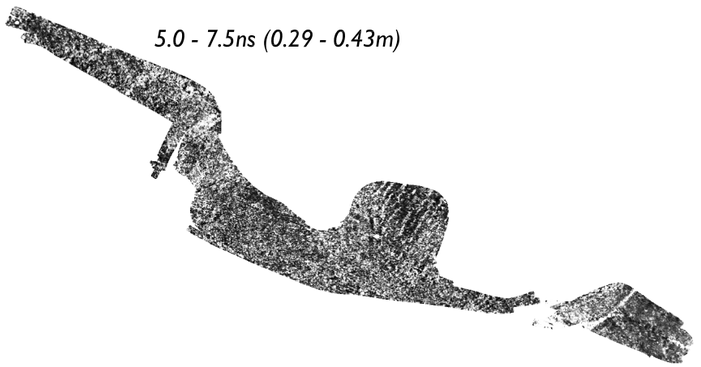
STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

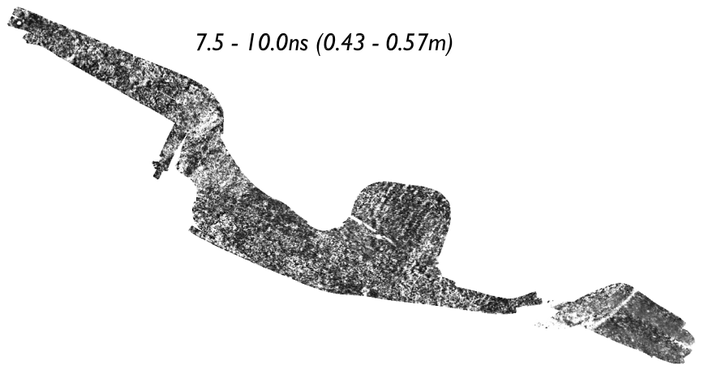
Figure 7

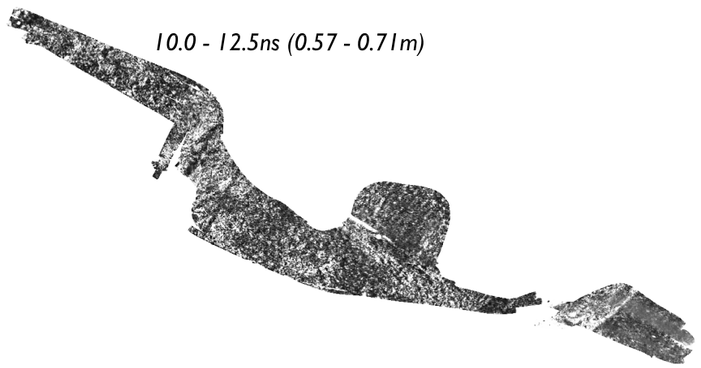
GPR amplitude time slices between 0.0 - 30.0ns (0.0 - 1.71m), June 2021

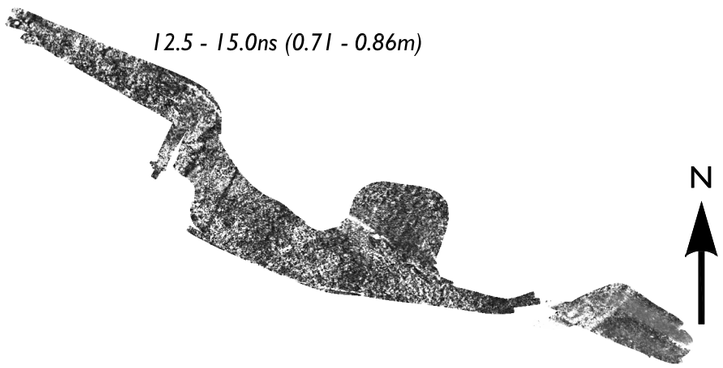


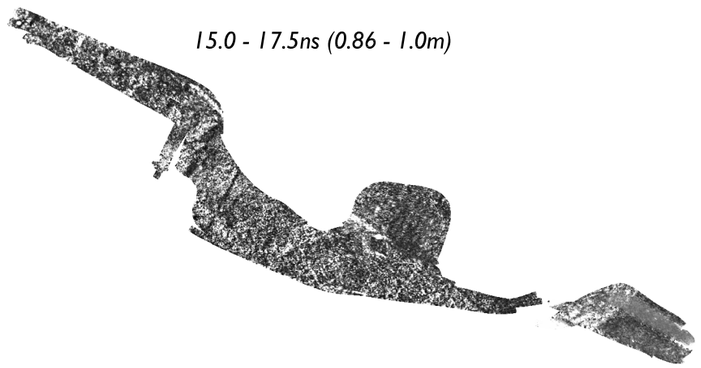


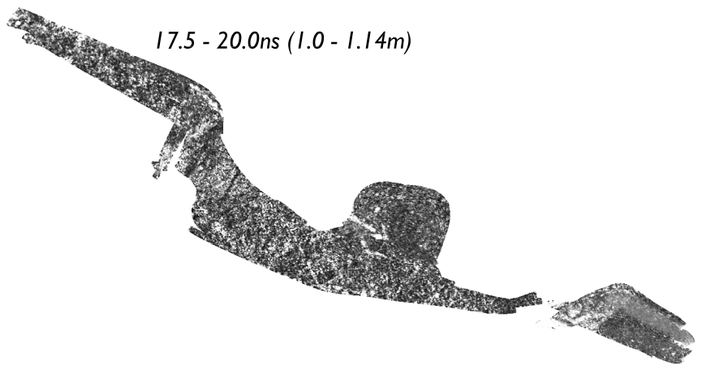


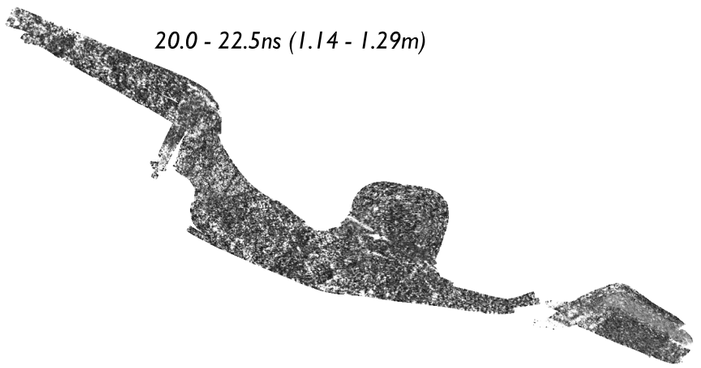


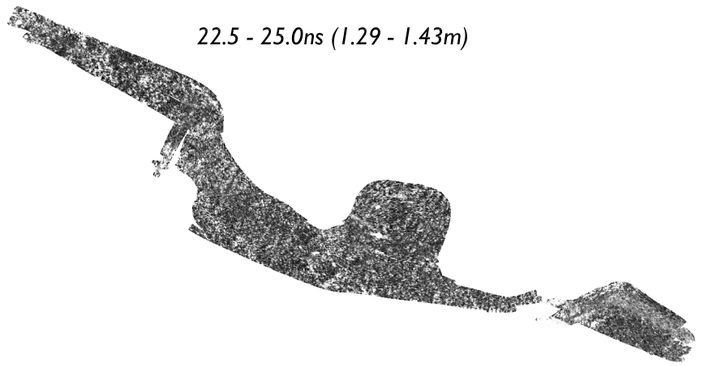


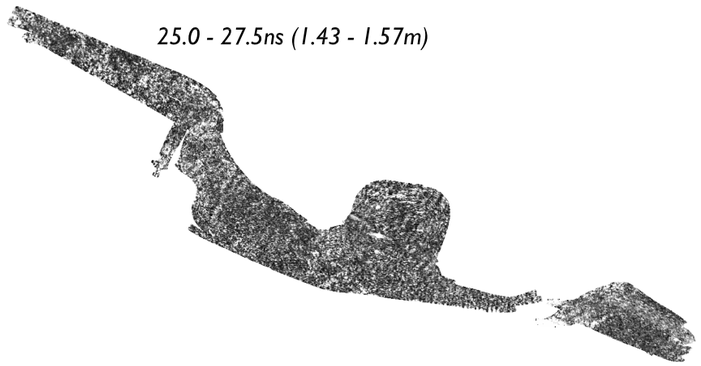


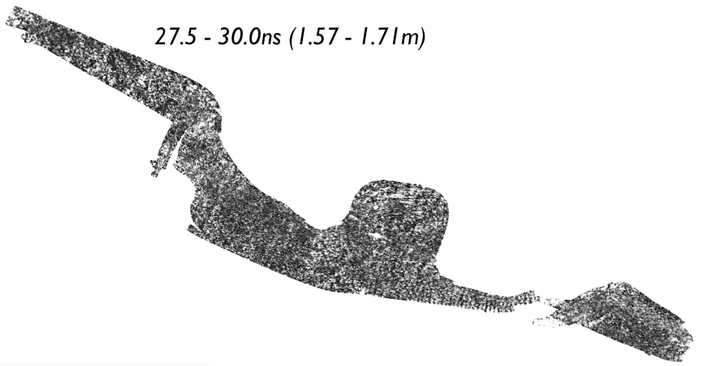












N

0 90m

1:1750

Low High

relative reflector strength

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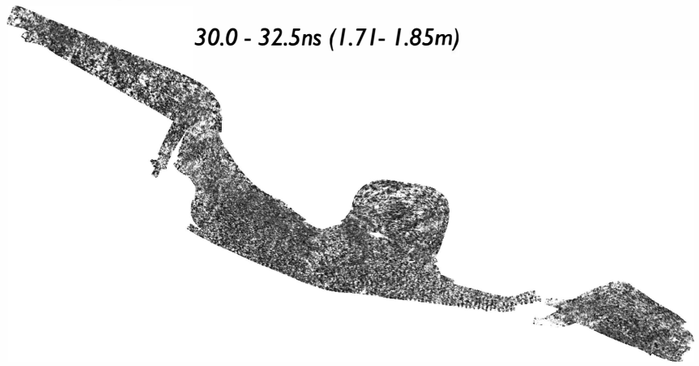
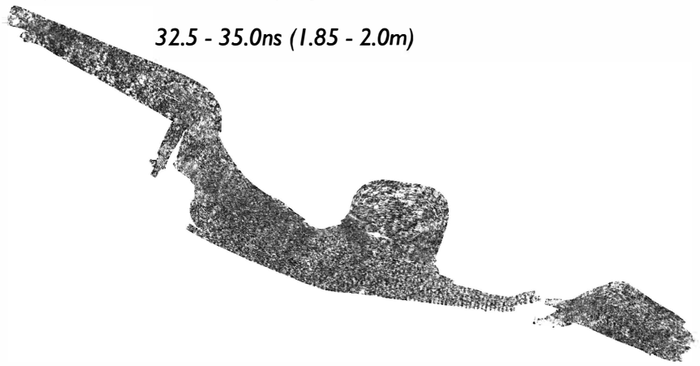
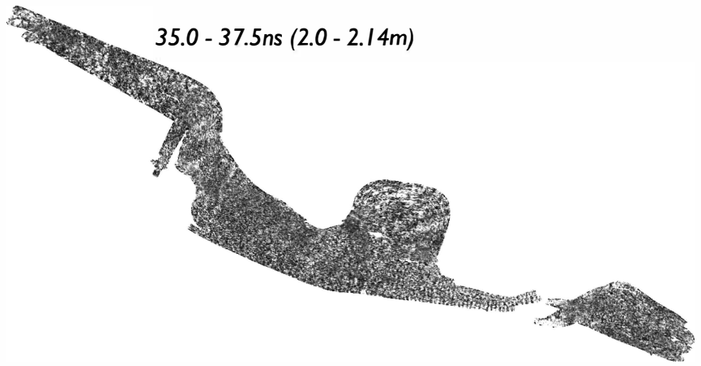
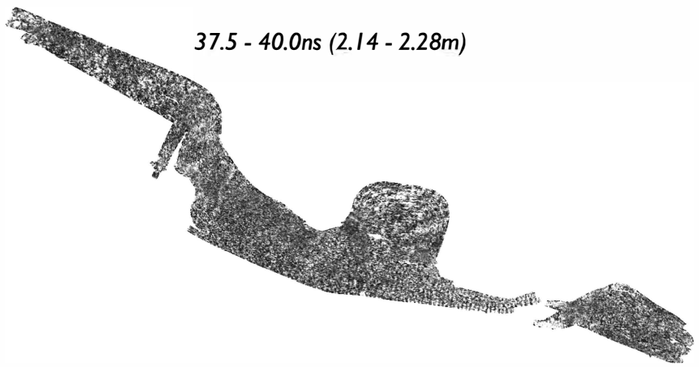
Figure 8

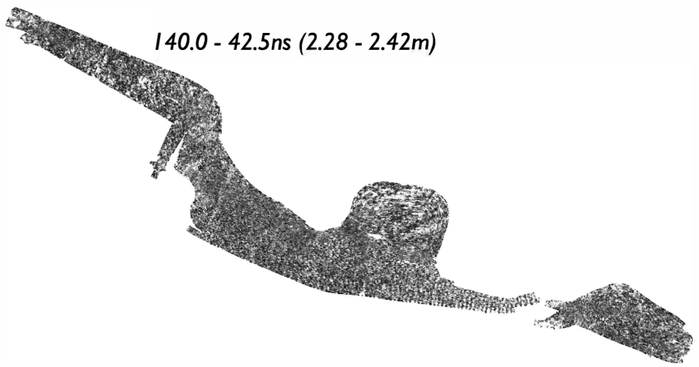
GPR amplitude time slices between 30.0 - 60.0ns (1.71 - 3.42m), June 2021

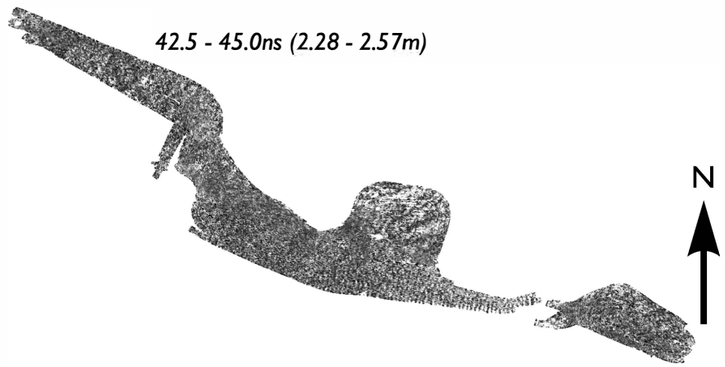












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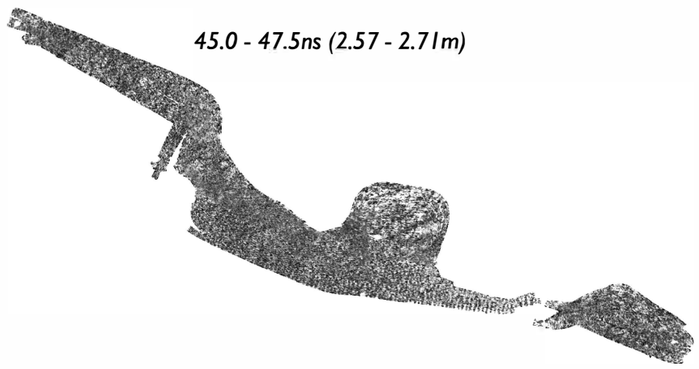

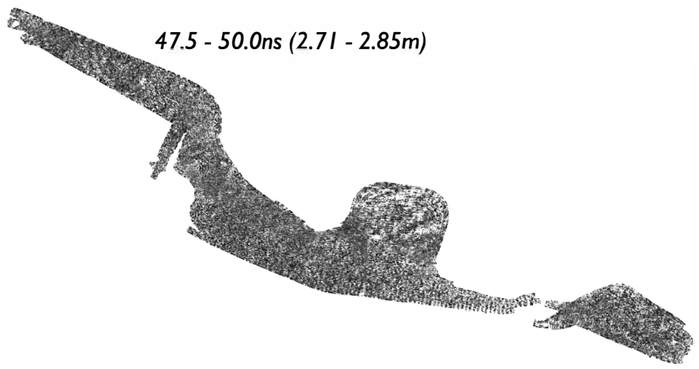

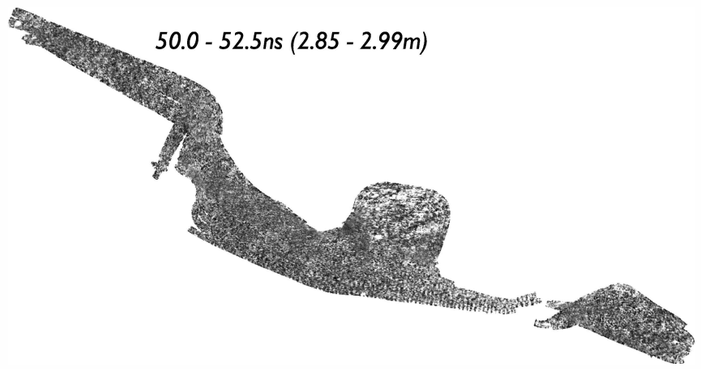

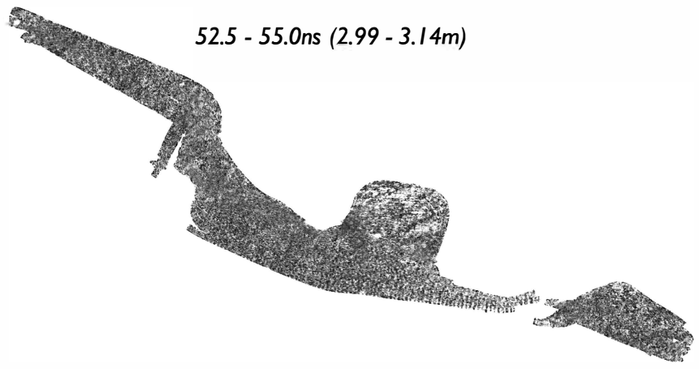

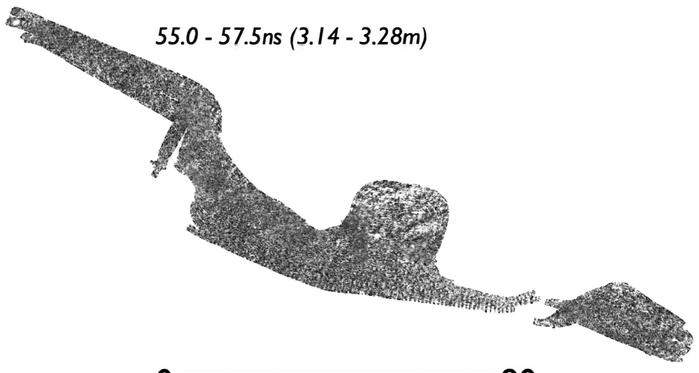

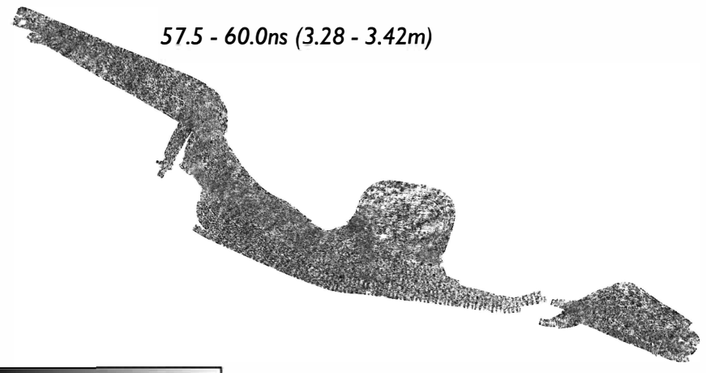

0 90m

1:1750

Low High

relative reflector strength

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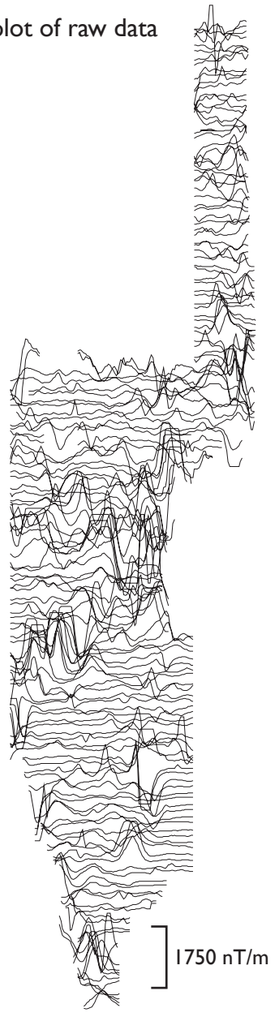
Figure 9

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

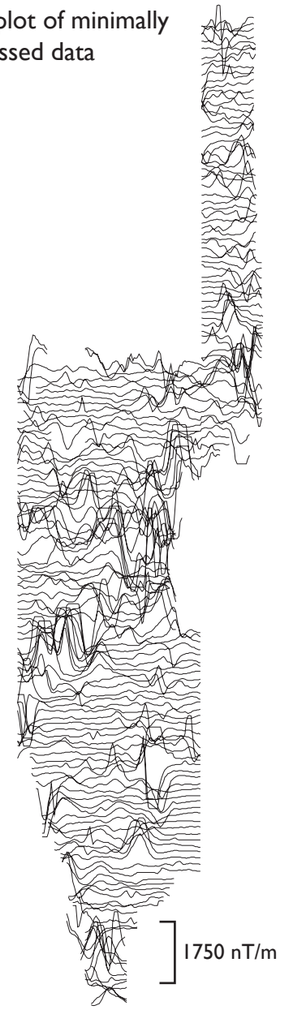
Fluxgate magnetometer survey, June 2021

(A) Trace plot of raw data



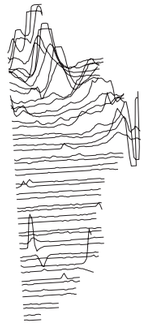
(B) Linear greyscale image of raw data

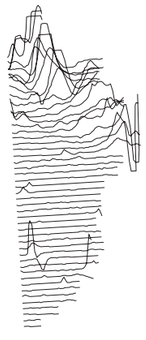
(C) Trace plot of minimally processed data



(D) Histogram normalised greyscale image of minimally processed data

N





0 90m

1:1000

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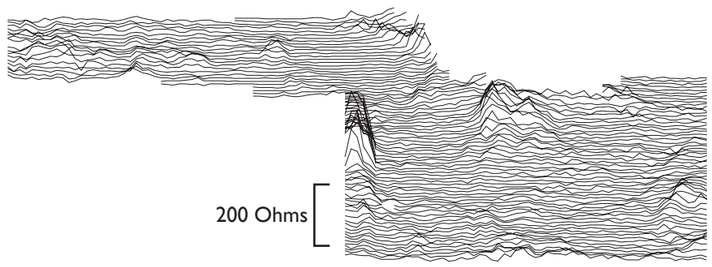
Figure 10

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM
Earth resistance survey, June 2021

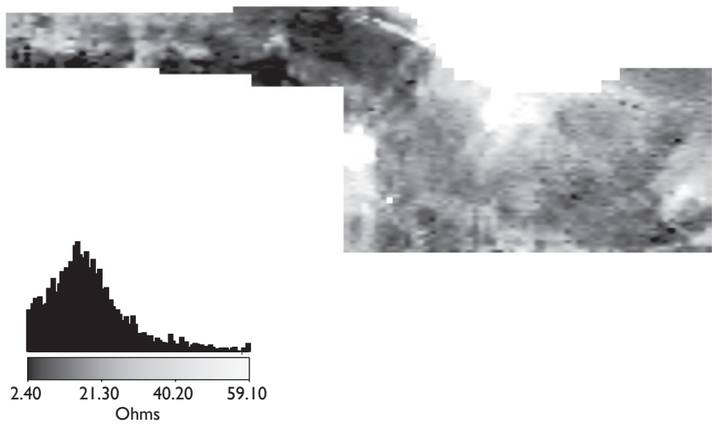
N

0.5m mobile probe separation data

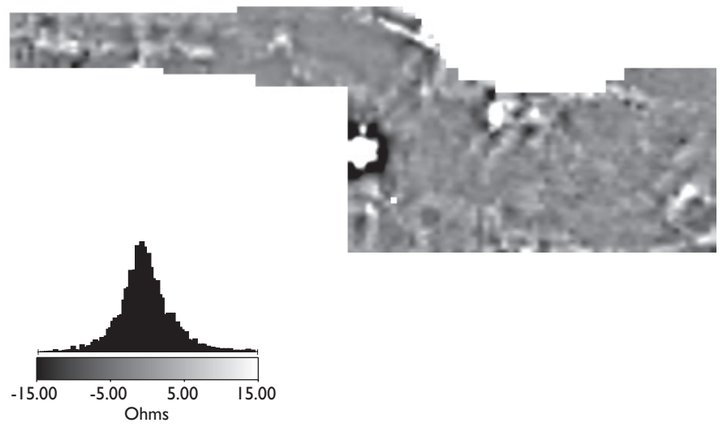
(A) Trace plot of minimally processed data



(B) Histogram normalised greyscale image of minimally processed data

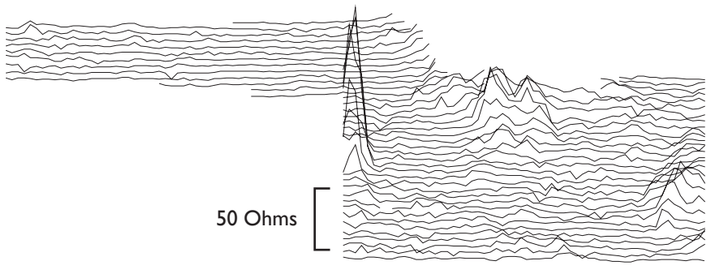


(C) Linear greyscale image of high-pass filtered data

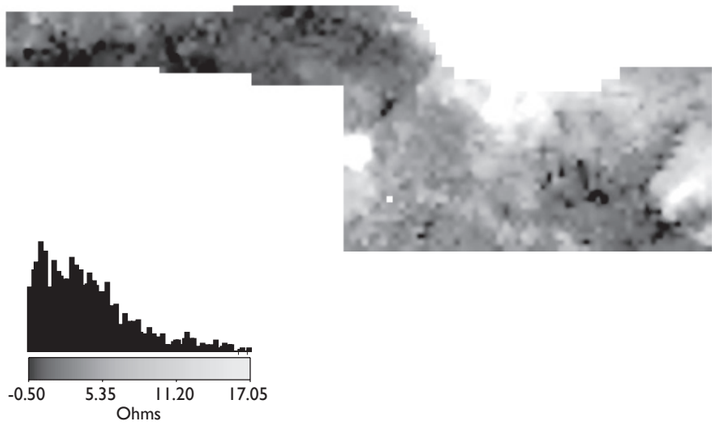


1.0m mobile probe separation data

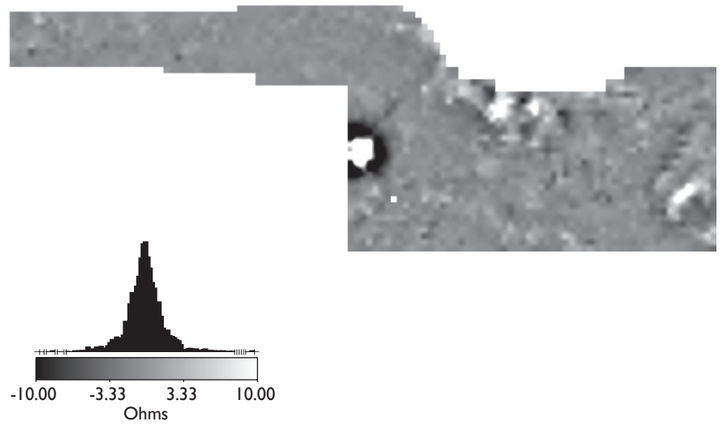
(D) Trace plot of minimally processed data



(E) Histogram normalised greyscale image of minimally processed data



(F) Linear greyscale image of high-pass filtered data



0 90m

1:1000

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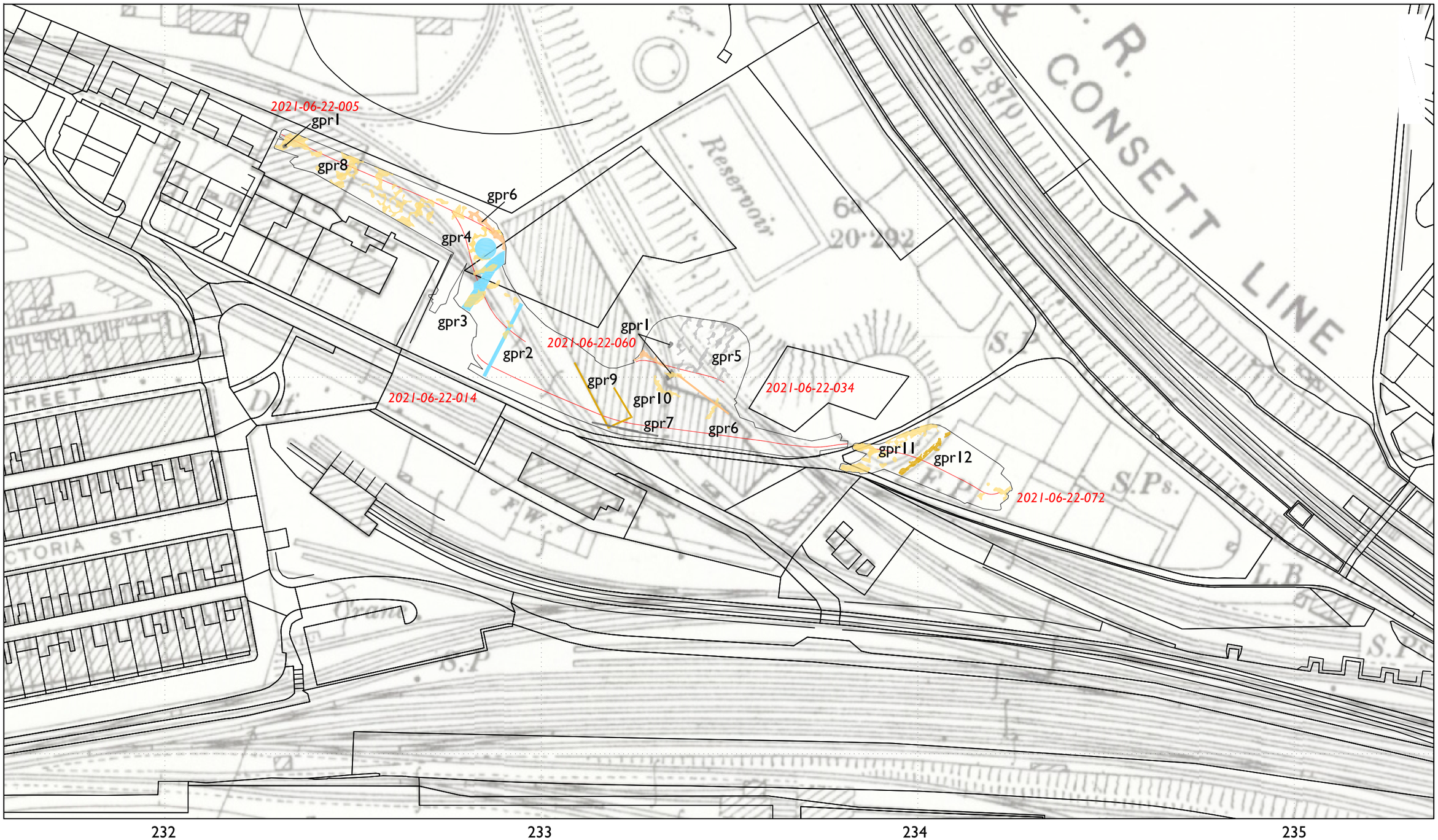
Figure 11

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Graphical summary of significant GPR anomalies superimposed over historic mapping, June 2021

NZ2325



0 60m

1:1000

2021-06-22-001 Location of selected GPR profiles shown on Figure 6

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

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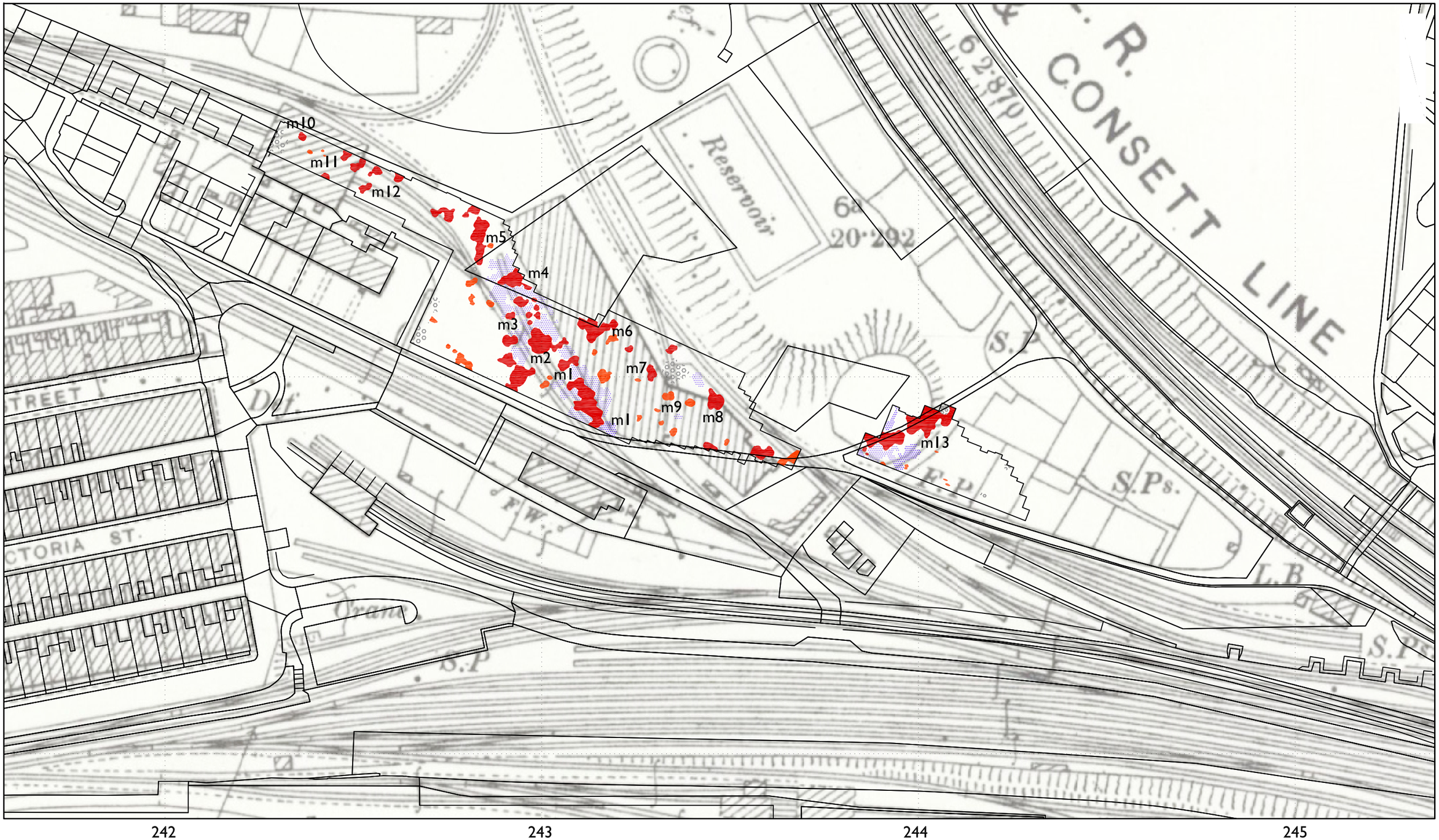
Figure 12

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Graphical summary of significant magnetic anomalies superimposed over historic mapping, June 2021

NZ2425



0 60m

1:1000

strong positive magnetic | positive magnetic | negative magnetic | magnetic noise

buildings indicated on historic mapping

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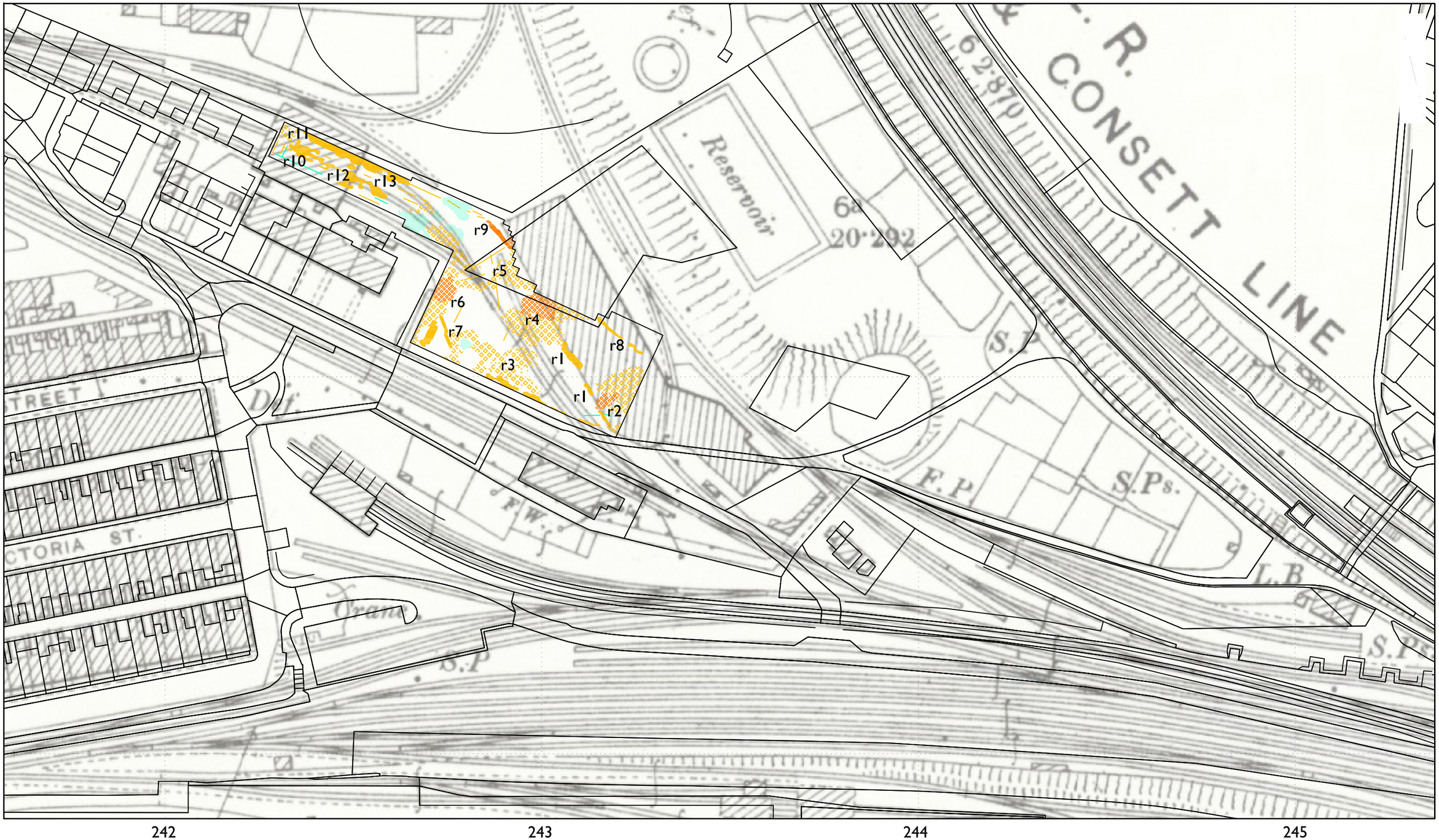
Figure 13

STOCKTON AND DARLINGTON RAILWAY, SOHO WORKS, SHILDON, COUNTY DURHAM

Graphical summary of significant earth resistance anomalies superimposed over historic mapping, June 2021

NZ2425



0 60m

1:1000

very high resistance | high resistance | low resistance

buildings indicated on historic mapping

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Historic England

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