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Thetford Town OCN Project: Queensway Junior Academy

Report on Geophysical Survey, July 2024

Megan Clements and Neil Linford

Geophysics

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Summary

A Ground Penetrating Radar (GPR) survey was conducted over the playing field (0.62ha) of Queensway Junior Academy, Thetford, Norfolk, as part of the Thetford Town Old County Number (OCN) Project. The aim of the project is to investigate a number of OCN sites within Thetford that will allow Historic England's East of England Regional Team to make decisions regarding the management of the sites. The location of the town's Saxon defensive ditch has been identified, together with possible occupation activity and tentative evidence for a destruction phase deposit.

Contributors

The geophysical fieldwork was conducted by Megan Clements and Neil Linford.

Acknowledgements

The authors are grateful for the assistance of the Historic England East of England Regional Office colleagues for arranging access to the site and Diamond Academy for their permission to conduct the survey on their land. The cover image is an aerial photograph of Queensway Junior Academy and the survey area (photo by Damian Grady 29850/018 20-APR-2016 ©Historic England Archive).

Archive location

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Date of survey

The Ground Penetrating Radar survey was conducted on the 24th of July 2024. The report was completed on the 14th of October 2024.

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Introduction

A Ground Penetrating Radar (GPR) survey was conducted over the playing field of Queensway Junior Academy, Thetford, Norfolk. This survey is part of the wider Thetford Town Old County Number (OCN) Project. The aim of the project and the geophysical surveys is to investigate a number of OCN sites south of the Little Ouse River (Figure 1, see Went 2022; Clements 2024; Clements and Linford 2024a, 2024b). This will enable the East of England Regional Team to have a better understanding of the monuments within the town and to be able to make decisions regarding on-going management and designation. This report concerns the National Heritage List for England (NHLE) Scheduled Monument 1003938, 'Site of Saxon town: primary school grounds, Hilary Road' (Historic England 2024). The current scheduling covers the entirety of the school including the playing field, playground and school buildings.

Excavations conducted in the 1950s immediately south and east of the site revealed burials and roads during the development of a housing estate. In addition, three test holes were excavated in 1957, none over the current playing field, and no details have been published (Rogerson and Dallas 1984, fig 2). In 1963-4, contractors found a number of inhumations under the Academy (Norfolk HER ENF121501). Ahead of an extension to the Queensway Infant Academy in 2010, Norfolk Archaeological Unit conducted an archaeological evaluation which revealed 10th to 11th century pottery and a test pit along the northern edge of the grounds revealed late Saxon gravel surfaces and a rubbish deposit (Hickling 2010; Phelps 2011). A more complete summary of work in the vicinity of the site is provided by (Jecock 2024).

The underlying geology at the Queensway Junior Academy playing field consists of Cretaceous Lewes Nodular Chalk. No superficial deposits are recorded (Geological Survey of Great Britain 2010; British Geological Survey 2024). Soils within Thetford town are unrecorded (Soil Survey of England and Wales 1983), but are provisionally listed on Soilscapes as freely draining, slightly acidic sandy soils in the east of the survey area, and freely draining, sandy Breckland soils in the west (Soilscapes 2024).

The playing field consisted of well-kept grass with football goals within the field. The ground sloped downwards towards the north with a significant drop along the eastern boundary with the playground. The weather was dry but chilly during the July survey dates.

Method

Ground Penetrating Radar

A 3d-Radar (Kontur) 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 was mounted on the GPR antenna array, that together with a second R8s base station was used to provide continuous positional control for the survey collected along the instrument swaths shown on Figure 2. The GNSS base station receiver was adjusted to the National Grid Transformation OSTN15 using the Trimble VRS Now Network RTK delivery service. This uses the Ordnance Survey (OS) GNSS correction network (OSNet) and gives a stated accuracy of 0.01 to 0.015m per point with vertical accuracy being half as precise.

Data were acquired at a 0.075m by 0.075m sample interval across a continuous wave step frequency range from 40MHz to 2.99GHz in 4MHz increments using a dwell time of 2ms. 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 4. 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 0.12m/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 approximately 0.15m intervals from the ground surface, shown as individual greyscale images in Figures 3, 5, 6 and 7. 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 number of pit-type anomalies identified in the near-surface, a semi-automated algorithm has been employed to extract the vector outline shown in Figure 8. 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).

Results

Ground Penetrating Radar

A graphical summary of the significant GPR anomalies, [**gpr1-19**] discussed in the following text, superimposed on the base OS mapping data, is provided in Figure 8.

Scattered across the survey area and within the near-surface between 2.5 and 12.5ns (0.15 to 0.75m), are numerous discrete high-amplitude anomalies. These anomalies could possibly be of geological origin, but as they appear to overlie archaeological responses, they may be more significant and possibly related to destruction deposits.

A high-amplitude anomaly [**gpr1**] found in the west of the survey area is comprised of segmented, dipping anomalies that narrow further down through the time slices (Figures 5, 6 and 7), with a low-amplitude band [**gpr2**] separating the two sides of what seems likely to represent the approximately 8m wide 'V' shaped main defensive town ditch (see profile shown on Figure 4). Low-amplitude linear anomalies [**gpr3**] together with the curvilinear response [**gpr4**], visible between 20.0 and 30.0ns (1.20 to 1.80m), could possibly be enclosure ditches associated with occupation activity and are likely to be contemporary with the main defensive ditch, [**gpr1**] and [**gpr2**], as they share a similar orientation.

Areas of diffuse high-amplitude response [**gpr5**] and [**gpr6**] in the centre and east of the survey area could represent a compacted occupation surface or more recent material deliberately introduced to level the playing field. The curvilinear high-amplitude anomaly [**gpr7**] within [**gpr6**] is of unknown origin.

Two circular anomalies within [**gpr5**], one displaying a high [**gpr8**] and the other a low [**gpr9**] amplitude of response, are likely to represent ditches associated with occupation activity, possibly ring-gullies or small enclosures. The sub-circular anomaly [**gpr10**] appears to be bisected by the eastern extent of [**gpr3**], and could also represent a ring-gully or enclosure.

Two short linear anomalies [**gpr11**] and [**gpr12**] are on the same orientation as the other ditch-type responses [**gpr1-4**], suggesting they may be a continuation of the wider ditch or enclosure network. However, both [**gpr11**] and [**gpr12**] have a high-amplitude of response compared to the other linear ditch-type anomalies in the data set, suggesting they may, perhaps, be in-filled with gravel. The right-angled high-amplitude anomaly [**gpr13**], while having a lower amplitude of response than [**gpr12**], has an orientation that suggests it could be associated with [**gpr12**].

Several linear anomalies [**gpr14**] have also been detected on an orthogonal orientation compared to ditches [**gpr1-4**]. It is possible [**gpr14**] may be related to the use and function of both the large ditch [**gpr1**] and [**gpr2**] to the west, and the series of enclosure ditches [**gpr3**] and [**gpr4**] to the east. The varying amplitude of response from [**gpr14**] may be due to differing composition of material, with some cut-features having perhaps been in-filled with gravel. The differing amplitude of response between [**gpr13**] and [**gpr14**] suggests it is unlikely the two anomalies were part of the same feature or are instead possibly related to different phases of activity.

There are also a number of subtle low-amplitude anomalies [**gpr15**] approximately 3m to 5m in diameter that have similar dimensions to early medieval sunken feature buildings recorded during excavation work throughout the town. Additional areas of high-amplitude response [**gpr16**] could indicate compacted surfaces or layers of archaeological origin related to the possible sunken feature buildings [**gpr15**]. Two discrete high-amplitude anomalies [**gpr17**] have been identified between 7.5 and 30ns (0.45 to 1.80m) that may suggest a modern intervention, but a more significant origin cannot be entirely ruled out.

A low-amplitude band of response [**gpr18**], shown most clearly between 27.5 and 32.5ns (1.65 to 1.95m), could be associated with the ditches [**gpr1-3**]. Parallel to [**gpr18**] is a scatter of both linear and diffuse high-amplitude responses [**gpr19**] found between 7.5 and 30ns (0.45 to 1.80m). Due to the proximity of [**gpr19**] to the school buildings, it is difficult to ascertain whether the anomalies are associated with archaeological or more recent construction activity.

Conclusions

The Ground Penetrating Radar survey has successfully identified the possible location of the town's defensive ditch. Other anomalies such as ditches, sunken feature buildings, enclosures and or ring-gullies that are likely associated with occupation activity, have also been located and appear to respect the orientation of the defensive ditch. The scatter of high-amplitude responses across the survey area seem to post-date the underlying archaeology, perhaps suggesting a destruction deposit or deliberate introduction of later material.

List of Enclosed Figures

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THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

Location of current geophysical survey areas within the Thetford Town OCN Project

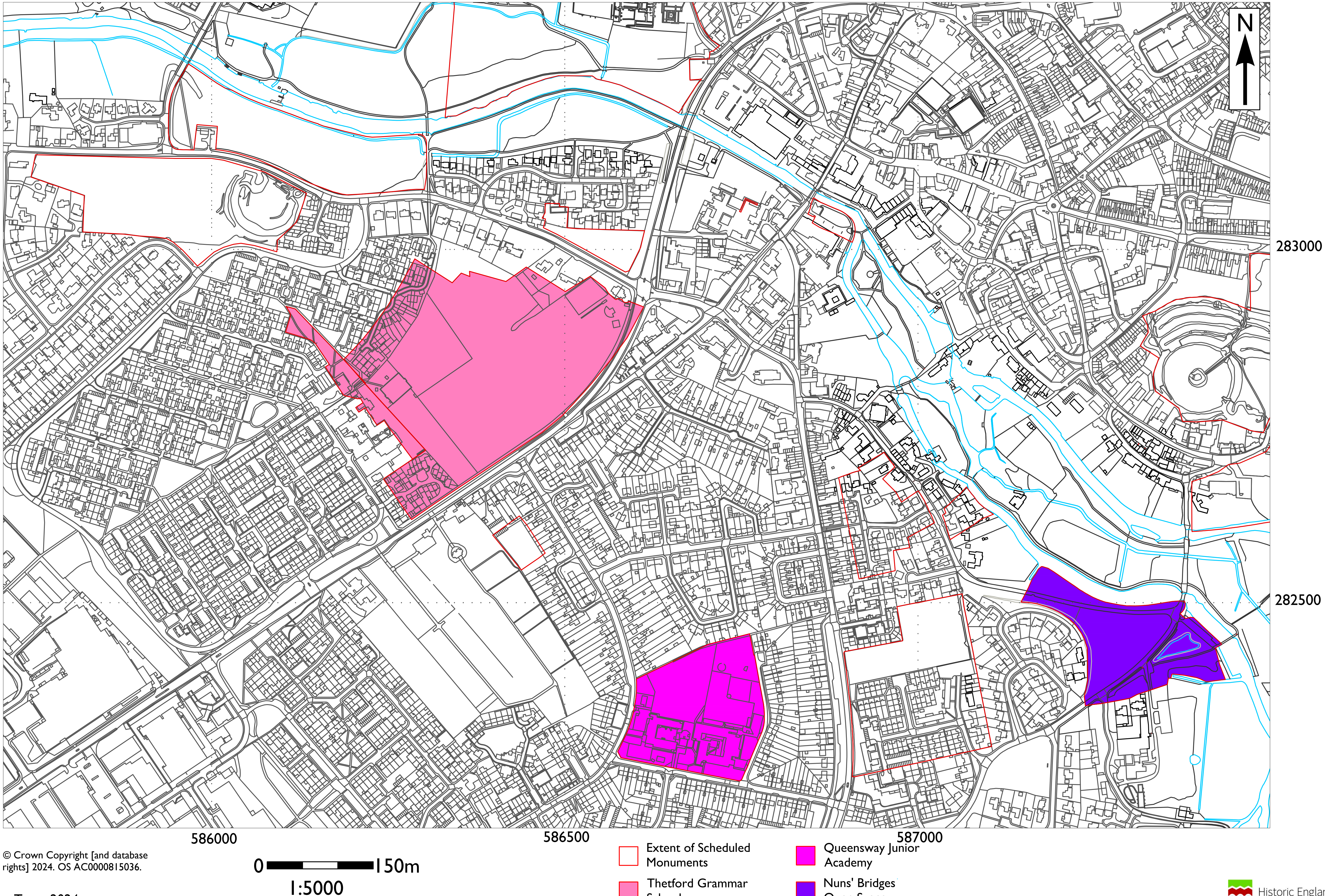

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Figure 2

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

Location of GPR instrument survey swaths, July 2024

0 30m
1:500

Ground Penetrating Radar survey swaths

Extent of Scheduled Monument

2024-05-14-001 Location of selected GPR profiles shown on Figure 4

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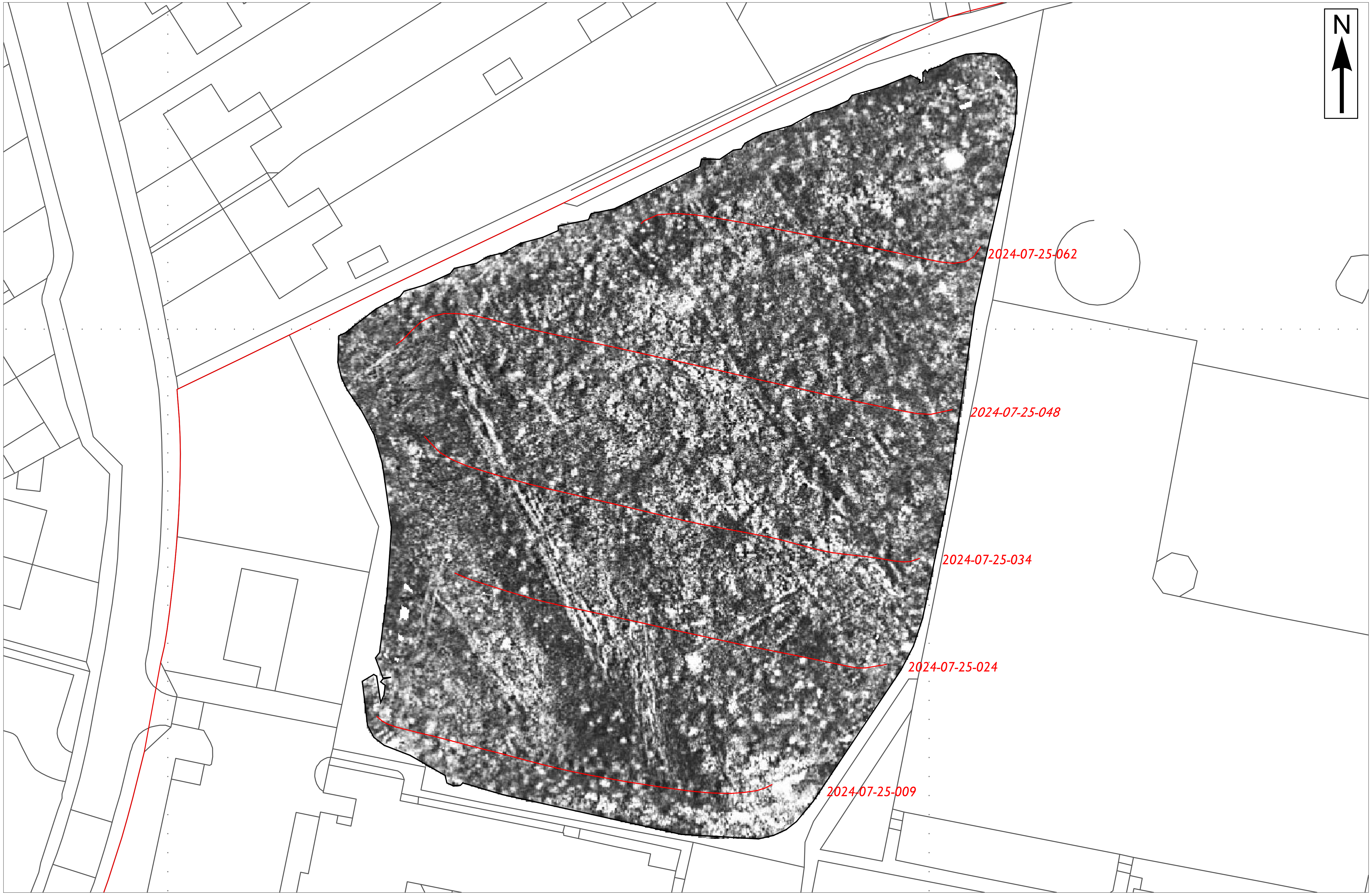
Figure 3

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

GPR amplitude time slice between 12.5 and 15.0ns (0.75 to 0.90m), July 2024



0 30m
1:500

Low High
relative reflector strength

Extent of Scheduled Monument

2024-07-25-001 Location of selected GPR profiles shown on Figure 4

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THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

Representative topographically corrected GPR profiles, July 2024

Figure 4

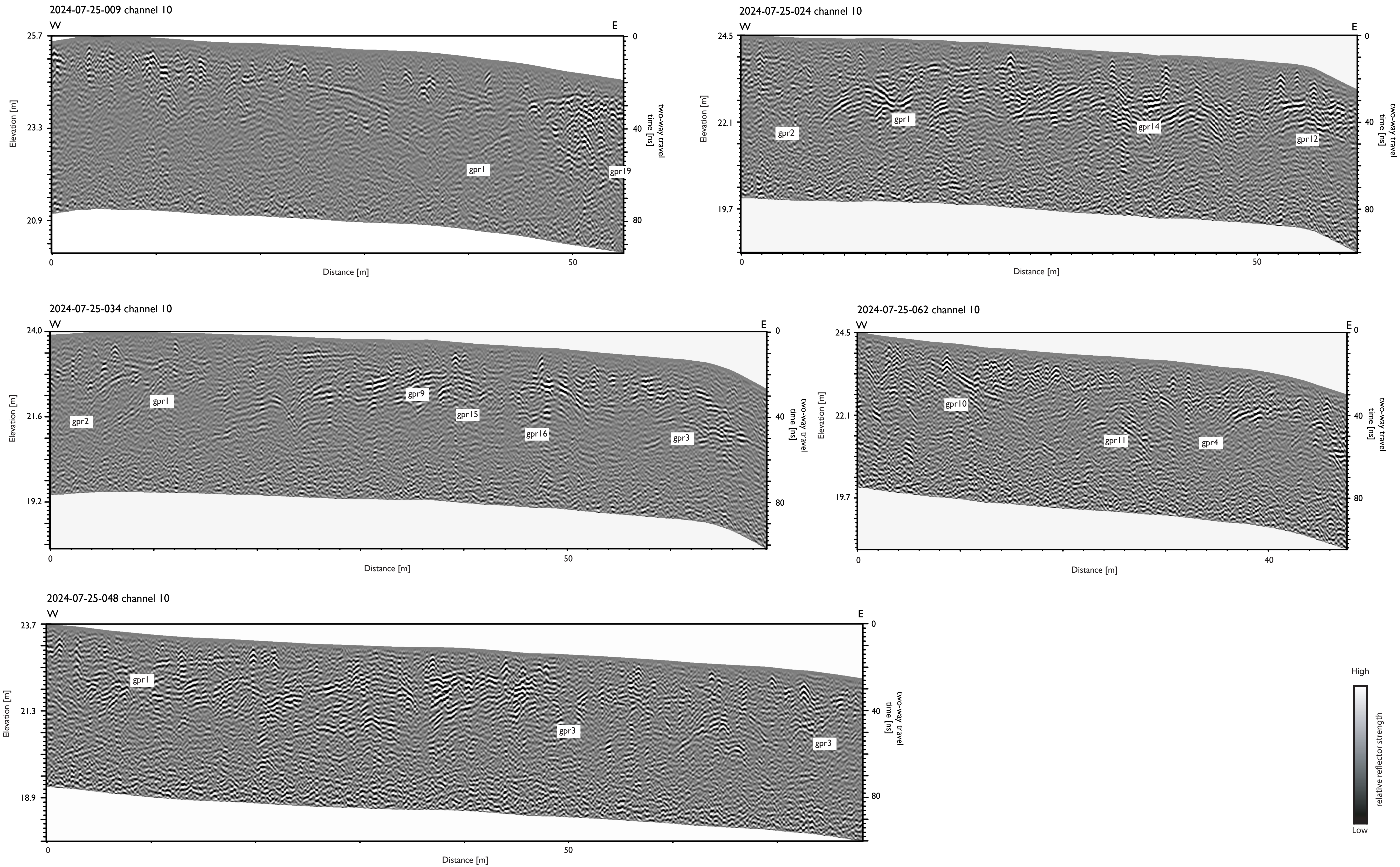

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Figure 5

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK
GPR amplitude time slice between 0.0 and 15.0ns (0.0 to 0.90m), July 2024

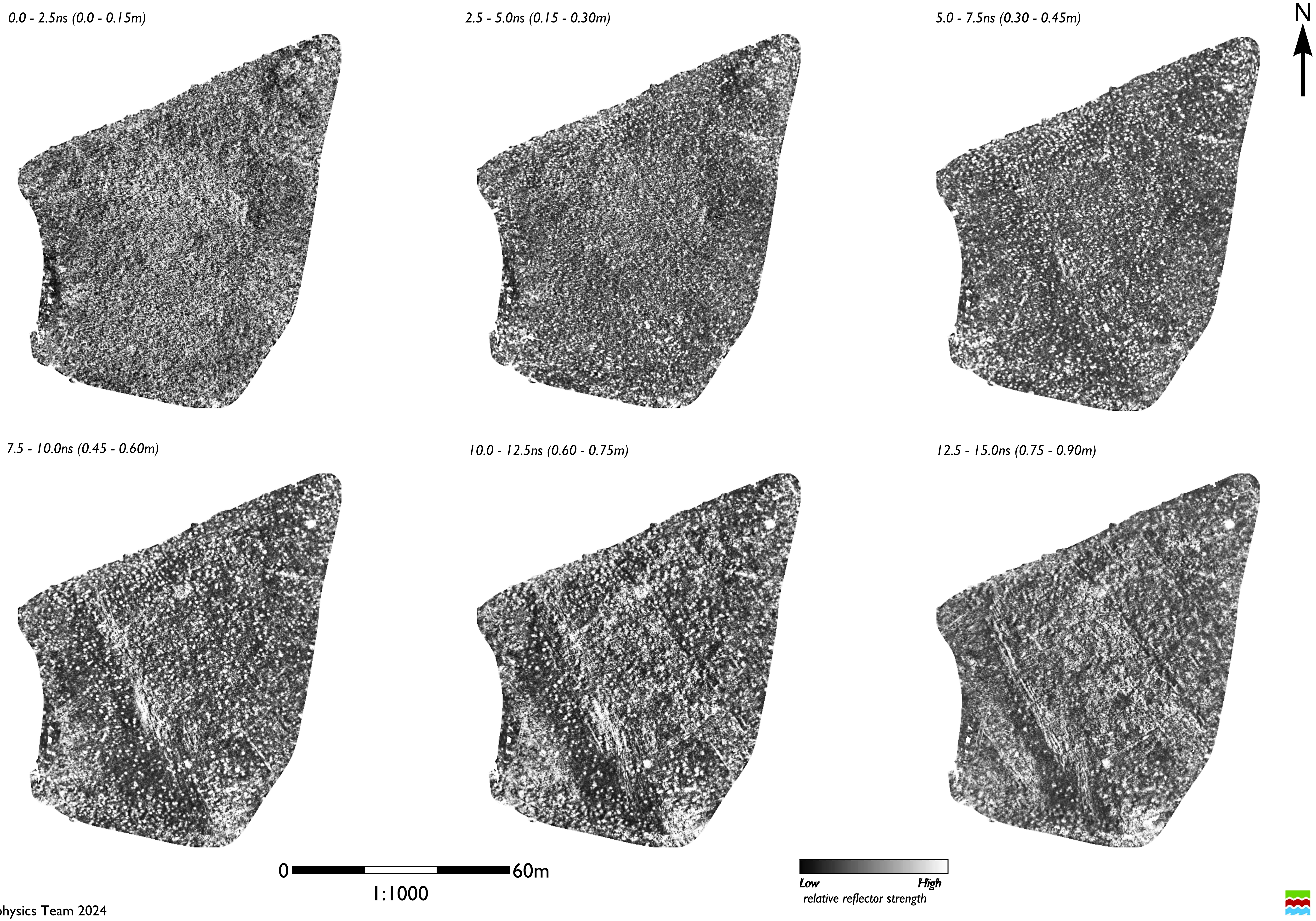

Figure 6

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

GPR amplitude time slice between 15.0 and 30.0ns (0.90 to 1.80m), July 2024

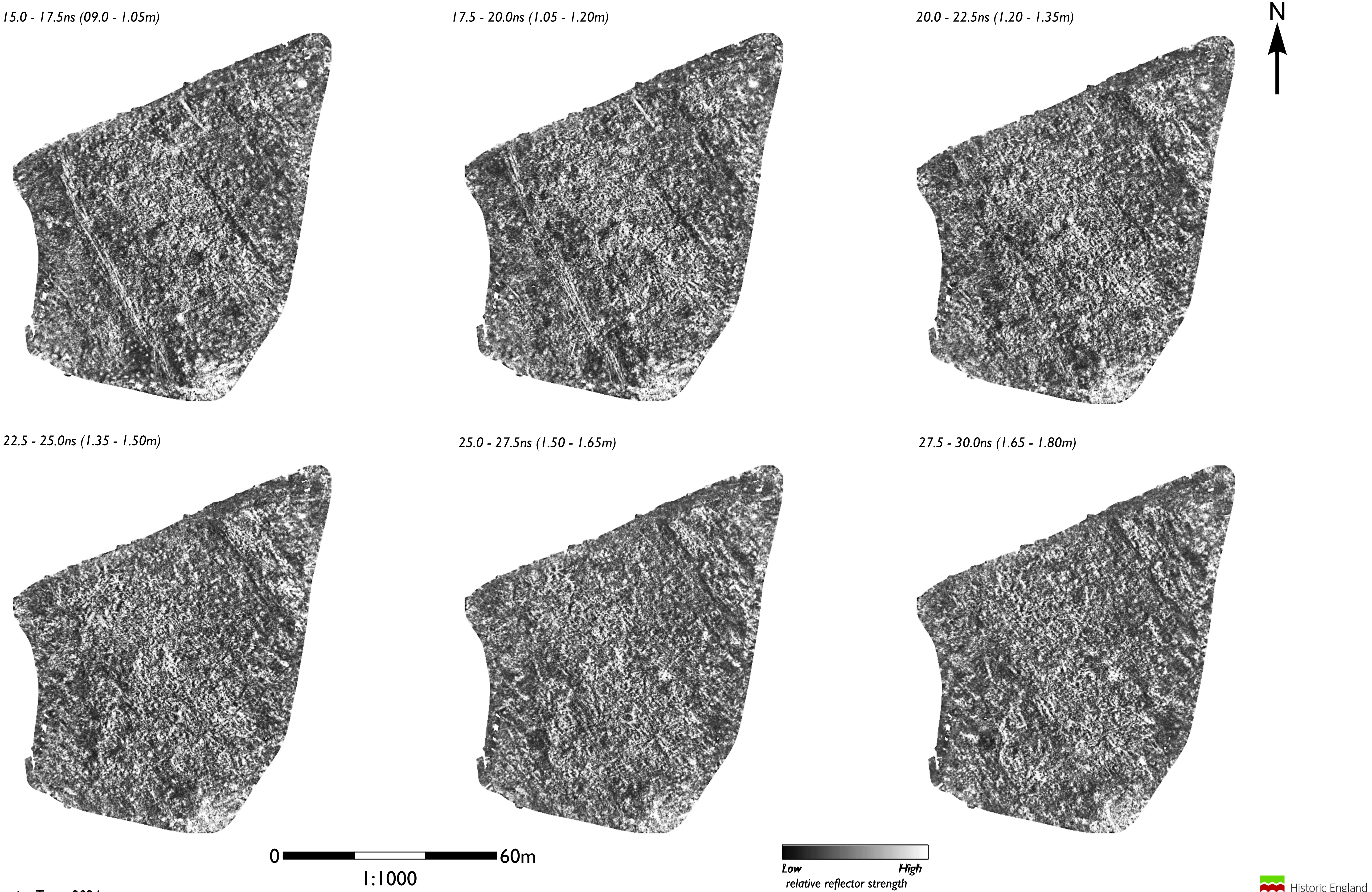

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Figure 7

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

GPR amplitude time slice between 30.0 and 45.0ns (1.80 to 2.70m), July 2024

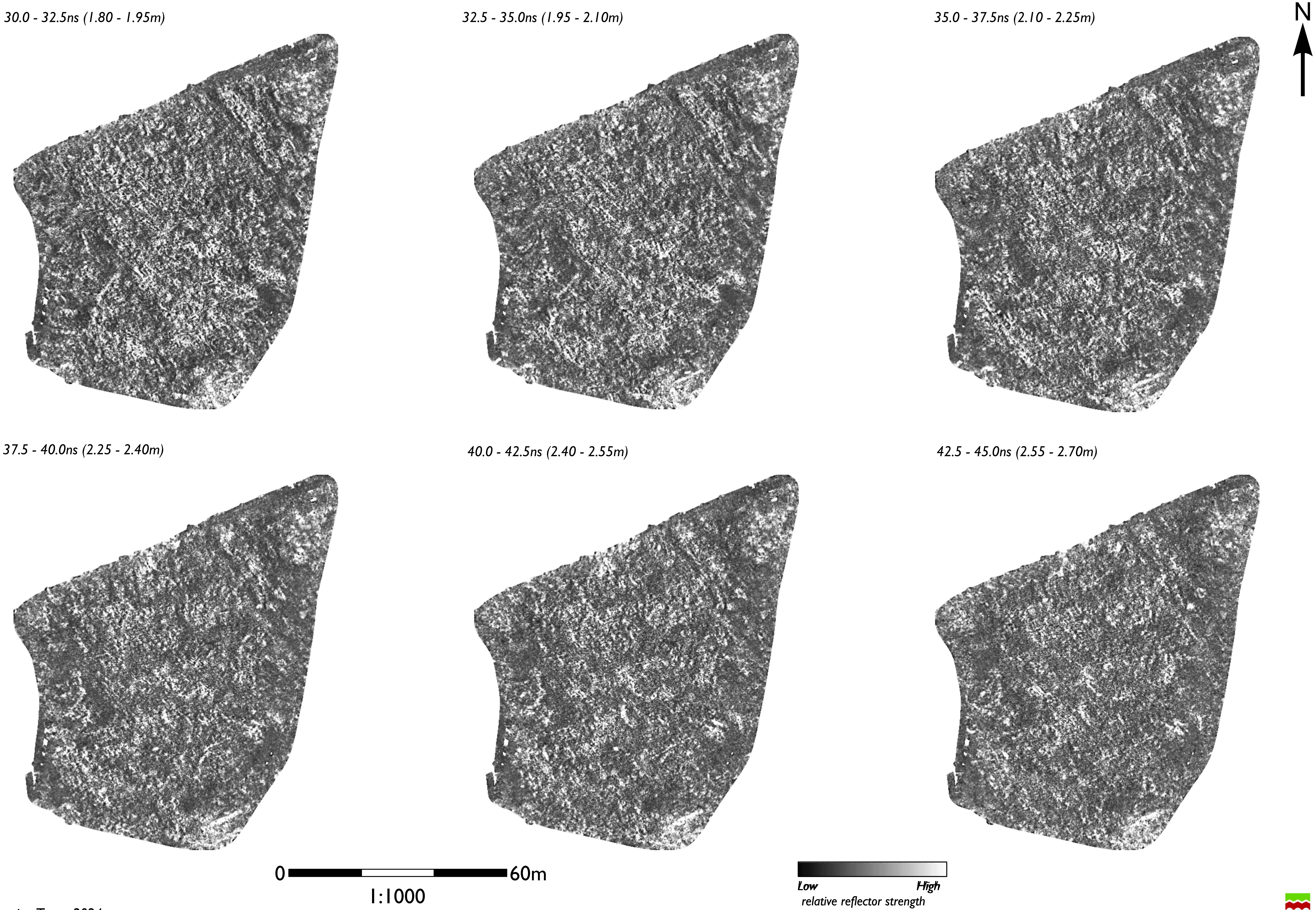

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Figure 8

THETFORD TOWN OCN PROJECT: QUEENSWAY JUNIOR ACADEMY, THETFORD, NORFOLK

Graphical summary of significant GPR anomalies, July 2024

0 30m
1:500

Low amplitude reflectors
High amplitude reflectors
discrete high amplitude anomalies
Extent of Scheduled Monument
2024-07-25-001 Location of selected GPR profiles shown on Figure 4

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