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Silchester Roman Town, Hampshire Report on geophysical surveys, June 2009, March 2014 and July 2015

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SILCHESTER ROMAN TOWN, HAMPSHIRE

REPORT ON GEOPHYSICAL SURVEYS, JUNE 2009, MARCH 2014 AND JULY 2015

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SUMMARY

Trial Ground Penetrating Radar (GPR) and caesium magnetometer surveys were conducted at Silchester Roman town, Hampshire, to assess the response of prototype instrumentation against previous results collected at the site. Whilst the original motivation for the surveys was to test newly developed prototype equipment, recent excavation by the University of Reading has renewed interest in the geophysical coverage over Insula III of the Roman town. Both the GPR (8.4ha) and magnetic (9.1ha) surveys produced a good response to the street pattern and detail of the buildings to complement the existing data sets. Some additional coverage, using both techniques, was collected in July 2015 in the vicinity of the amphitheatre and is also included in this report.

CONTRIBUTORS

The geophysical fieldwork in June 2009 and July 2015 was conducted by Neil Linford, Paul Linford and Andrew Payne, together with Louise Martin, Sam Cheyney (University of Leicester) and Dr Egil Eide (3d-radar) during the 2009 survey. The March 2014 survey was conducted by Neil Linford, Zoe Edwards (Historic England Placement) and Jacopo Sala (3d-radar).

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ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The fieldwork was conducted between 22nd to 26th June 2009, 4th to 5th March 2014 and 20th, 22nd and 24th July 2015. The report was completed on 1st October 2019. The cover image shows a prototype ground coupled antenna array under field test during March 2014, with the South Gate of the town visible in the background.

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INTRODUCTION

Ground Penetrating Radar (GPR) and caesium magnetometer surveys were conducted at Silchester Roman town, Hampshire (Calleva Atrebatum, NMR 24336) to test and calibrate prototype GPR equipment against established ground based and aerial survey results (Martin 2000; Linford 2001; Linford *et al*. 2010; Creighton and Fry 2016). Whilst the primary aim of the surveys was to assess the prototype GPR, recent excavation by the University of Reading has renewed interest in the geophysical coverage over Insula III of the Roman town where the majority of the field tests were conducted. Stone foundations of a large number of buildings and the road network across the whole town were recorded by the Society of Antiquaries between 1890-1909, together with extensive aerial photographic mapping, and more recent excavations by the University of Reading (RCHME 1995; Fulford 2002).

The June 2009 GPR survey was conducted to test a prototype air-launched V1821 multi channel array, with data acquired over Insula III and the forum basilica in Insula IV, together with the environs of the Romano-Celtic temple in Insula VII and the adjacent Insula XVII. Complementary caesium magnetometer survey was conducted over a similar area within the town and also covered part of the Roman cemetery immediately beyond the west entrance gate, for comparison with the existing fluxgate gradiometer data sets. Less extensive coverage was undertaken during the trial of a GX1922 ground coupled multi channel GPR array in March 2014, concentrating mainly on the area surrounding the Romano-Celtic temple. Additional vehicle towed caesium magnetometer and GPR survey included in this report was conducted at Chitty Farm, adjacent to the amphitheatre immediately north of the Roman town, in the vicinity of a coping stone reportedly found in an area of lower lying ground (Figure 1).

The site lies on fine loamy soils of the Wickham 4 association developed over Plateau gravel (Geological Survey of Great Britain 1946; Soil Survey of England and Wales 1983). All the sites were under grass and used for pasture at the time of the surveys. Weather conditions were warm and dry during the June 2009 field work, and cold and fine in March 2014. The July 2015 survey was initially conducted through a period of very warm and sunny weather, however the field work was curtailed by subsequent heavy rain which was detrimental to the GPR results.

METHOD

Ground Penetrating Radar survey

A 3d-Radar MkIII GeoScope Continuous Wave Step-Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the June 2009 survey collecting data with a prototype multi-element V1821 vehicle towed, air launched antenna array (Linford *et al.* 2010). The March 2014 field work was conducted with a MkIV GeoScope and prototype GX1922 ground coupled antenna array, and the July 2015 survey used a MkIV GeoScope with a DXG1820 ground coupled antenna array. A roving Trimble 4700 Global Positioning System (GPS) receiver was mounted on the GPR antenna array, together with a Trimble 4800 base station GPS receiver established at the site, to provide continuous positional control for the June 2009 and March 2014 surveys collected along the instrument swaths shown on Figure 2. Trimble R8 Global Navigation Satellite System (GNSS) receivers were used for the July 2015 survey, with the location of the base station receiver established using the Ordnance Survey VRS Now correction service.

Data were acquired at a 0.075m x 0.075m sample interval across a continuous wave step frequency range from 50MHz to 1250MHz in 2MHz increments using a dwell time of 2.5ms for the June 2009 survey, and at the same sample density from between 60MHz to 2.9GHz in 2MHz increments using a dwell time of 2ms in March 2014 and from between 60MHz to 2.9GHz in 4MHz increments using a dwell time of 2ms in July 2015. 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 50ns), 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 GPR survey are shown on Figure 13. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 1.2ns (two-way travel time) windows for the June 2009 and March 2014 surveys, and 2.4ns (two-way travel time) windows for the July 2015 survey (e.g. Linford 2004). Average sub-surface velocities of 0.1m/ns for June 2009, 0.0768m/ns for March 2014 and 0.117m/ns for July 2015 were assumed following constant velocity tests on the respective data sets, and were used as the velocity fields for the time to estimated depth conversion. Each of the resulting time slices, shown as individual greyscale images, therefore represents the variation of reflection strength through successive ~0.06m intervals from the ground surface in Figures 4, 14, 15, 16, 17 and 18, and ~0.14m intervals in Figures 8, 19 and 20. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

Magnetic survey

The June 2009 caesium magnetometer survey was conducted over a series of 60m x 100m grids established using a Trimble 4700/4800 series GPS (Figure 2), using an array of four specially modified high sensitivity Scintrex SM4 caesium vapour magnetometer sensors mounted on a non-magnetic cart system (Linford *et al.* 2005). Readings were collected at intervals of 0.5m x 0.125m along 100m long traverses orientated N-S.

The median value of each 100m traverse was adjusted to zero to correct for the slight biases added to the measurements owing to directional sensitivity of the sensors. Extreme readings with absolute magnitudes greater than 50nT were then attenuated so that no value had an absolute magnitude greater than 100nT using an algorithm similar to that described by Scollar *et al.* (1990, p504) but employing the hyperbolic tangent function for the non-linear reduction of the data. The resulting dataset was converted to its Fourier transform which was then reduced to the pole and transformed to the equivalent values that would have been measured using a 0.5m vertical gradiometer (Blakely 1996). The Fourier domain operations enhance the visibility of small discrete pit-like anomalies where they occur in close proximity.

An array of six Geometrics G862 caesium vapour sensors were used for the July 2015 survey mounted on a non-magnetic sledge (Linford *et al.* 2015) towed behind a low-impact All-Terrain Vehicle (ATV) which housed the power supply and data logging electronics along the swaths shown on Figure 7. Five sensors were mounted 0.5m apart in a linear array transverse to the direction of travel and, vertically, ~0.25m above the ground surface. The sixth was fixed 1.0m directly above the centre of this array to act as a gradient sensor. The sensors were sampled at a rate of 25Hz resulting in an along-line sample density of ~0.15m given typical ATV travel speeds of 3.5-4.0m/s. As the five non-gradient sensors were 0.5m apart, successive survey swaths were separated by approximately 2.5m to maintain a consistent traverse separation of 0.5m. Navigation and positional control were achieved using a Trimble R8 Global Navigation Satellite System (GNSS) receiver mounted on the sensor platform 1.65m in front of the central sensor and a second R8 base station receiver established using the Ordnance Survey VRS Now correction service. Sensor output and survey location were continuously monitored during acquisition to ensure data quality and minimise the risk of gaps in the coverage.

After data collection the corresponding readings from the gradient sensor were subtracted from the measurements made by the other five magnetometers to remove any transient magnetic field effects caused by the towing ATV or other nearby vehicles. The median value of each instrument traverse was then adjusted to zero by subtracting a running median value calculated over a 50m 1D window (see for instance Mauring *et al.* 2002). This operation corrects for biases added to the measurements owing to the diurnal variation of the Earth's magnetic field and any slight directional sensitivity of the sensors.

Linear greyscale images of the combined magnetic data are shown superimposed over the base Ordnance Survey (OS) mapping in Figures 3, 6 and 8 for the Insula III, West Gate Cemetery and Chitty Farm sites respectively. Minimally processed versions of the range truncated data ($\pm$150nT) are shown as trace plots and a histogram normalised greyscale images in Figures 9, 10, 11 and 12.

RESULTS

Magnetic survey Insula III

A graphical summary of the significant magnetic anomalies, [**m1-7**], discussed in the following text, are shown superimposed on the base OS map data on Figure 21.

As would be expected from the previous fluxgate gradiometer coverage of this area, a good response has been recorded by the caesium magnetometer survey with the majority of wall footings from the Roman buildings being replicated as low magnitude (negative) anomalies compared to the surrounding topsoil (cf Martin 2000; Creighton and Fry 2016). The current survey benefits from an increased sample density and lower noise level of the total field caesium sensors, which has made it suitable for more detailed analysis through, for example, magnetic inversion (Cheyney *et al.* 2015).

Areas of magnetic disturbance, [**m1**], are found throughout the site and seem likely, as has been noted in previous reports, to be associated with back-filled excavation trenches from the 1980s over the forum basilica. Despite this disturbance the regular network of streets through the insulae are represented by negative magnetic anomalies [**m2**] with the main road leading to the west gate resolved most clearly against the enhanced background response in this area of the site. These areas of enhancement appear to be associated with some of the buildings and enclosures fronting the road [**m3**], perhaps indicating a concentration of burnt deposits derived from semi industrial activity here.

The forum basilica to the south of the road in Insula IV is clearly delineated as a series of rectilinear negative anomalies [**m4**], partially obscured to the west by the magnetic disturbance [**m1**]. Individual room divisions are visible within [**m4**], perhaps with a slightly greater degree of clarity than could be resolved from the original 1m line spacing fluxgate gradiometer survey although similar to the subsequent higher sample density data collected throughout the whole Roman town. Linear negative anomalies throughout the survey area correlate with both the known buildings recorded through the Victorian excavations and aerial photographic evidence, together with the additional anomalies revealed by the previous geophysical results (RCHME 1995; Creighton and Fry 2016). Numerous large, discrete positive anomalies are also found throughout the area but are difficult to more fully interpret and are likely to represent a combination of significant pit-type responses, variation in the underlying gravel deposits and previous antiquarian excavations.

The concentric walls of the Romano-Celtic temple [**m5**] are reproduced as negative anomalies with some variation in response around the circuit, perhaps due to the Victorian excavation or robbing of the near-surface stone. Inversion of the caesium data to model the subsurface magnetic contrast suggests some further variation in the survival of the walls, with depth extents in good agreement with corresponding radar surveys (cf Cheyney *et al.* 2015, Figure 16).

A series of linear negative anomalies [**m6**] on a NW-SE orientation are found immediately to the west of the forum basilica and seem likely to represent Victorian excavation trenches (cf [**gpr5**]). Other linear positive anomalies [**m7**] to the south of the survey area follow a similar alignment to [**m6**], and these seem unlikely to be due to ploughing and are, perhaps, more suggestive of underlying ditches.

Ground Penetrating Radar survey Insula III

A graphical summary of the significant GPR anomalies, [**gpr1-21**], discussed in the following text, are shown superimposed on the base OS map data on Figure 22.

Significant reflections have been recorded to approximately 35ns in all of the GPR surveys reported here with some deeper responses found over the wall footings of the forum basilica and the Romano-Celtic temple. The depth of penetration is consistent with the results from the original impulse GPR survey and seems largely independent of the antenna type and influence of seasonality on soil moisture levels, perhaps due to the relatively free draining gravel geology (Linford *et al.* 2010, Figure 5).

The very near-surface data contains a number of linear anomalies associated with the micro-topography of the site which are particularly evident in the air-launched V1821 antenna array data. These include tracks made by grazing animals [**gpr1**] and a number of circular responses likely to be due to cattle feeders [**gpr2**]. Anomalies due to the grid of streets between the insulae [**gpr3**] become evident from between 4.8 and 28.8ns (0.24 to 1.44m) and the partial correlation with [**gpr1**] over the road to the west gate may well be due to firmer ground conditions found over the archaeological remains (cf Linford 2018). One linear anomaly [**gpr4**] appears to share a similar north-south orientation parallel to the main street plan passing through the centre of insula XVII until it meets the road to the west gate found in the north of the survey area. Although [**gpr4**] appears similar in response to the other roads it does not extend to the same depth and passes through a number of buildings, perhaps suggesting a later track or road way from the south gate.

A series of parallel, low amplitude anomalies spaced approximately 3m apart are visible between 7.2 and 19.2ns (0.36 to 0.96m) on two different alignments [**gpr5**] and [**gpr6**]. The group of anomalies to the south [**gpr6**] appear to partially correlate with a series of high amplitude responses [**gpr7**] from 12.0ns (0.6m) onwards resulting in potential confusion with more significant building remains. From the orientation of [**gpr5**] it seems most likely that these anomalies represent the Victorian trial trenching to locate building remains (Fulford *et al.* 2014), apparently concentrated within insula III and insula XVII, although some similar, more fragmented linear anomalies [**gpr8**] are found to the north in insula II.

The first indication of wall footings becomes visible from 6ns (0.3m) onwards and extend to approximately 36ns (1.86m), although this appears to be only for the more substantial buildings. Perhaps the most prominent response is found over the forum basilica [**gpr9**] where both external walls and the interior room divisions are visible with some considerable degree of detail, including apsidal walls within the individual cells of the building. Much of this detail replicates the combined information from the Victorian excavation records and the aerial photography, some internal details possibly drainage gullies and a metalled surface are evident in the centre of the forum. Correlation with the known buildings beyond the forum basilica appears more varied, with some only partially replicated in the data, although there are several GPR anomalies that suggest additional structural remains that have not, necessarily, been recorded before, for example [**gpr10-15**].

To the south of the survey area the 2014 coverage with the prototype ground coupled antenna array has recorded considerable detail over the Romano-Celtic temple [**gpr16**] between approximately 6.0 and 40.8ns (0.23 to 1.57m). The incomplete circuit of the inner temple wall shown in the magnetic data is replicated in the varying response with depth suggested by the corresponding radar anomaly between 8.4 and 20.4ns (0.32 to 0.78m), perhaps indicating some variation in survival within the near-surface.

A number of previously recognised buildings are found in the vicinity of the temple, although the majority of the area within the precinct wall appears to be empty. The response to the precinct wall correlates with the known location from the Victorian plan, although the GPR data suggests an additional north-south orientated wall [**gpr17**] dividing the enclosure. A rectilinear anomaly [**gpr18**], approximately 3m across, is found immediately to the south east of the temple between 10.8 and 38.4ns (0.41 to 1.47m) and could, perhaps, represent a small shrine or well (cf Linford and Linford 2015). There are potentially some spreads of rubble surrounding [**gpr18**] in the near-surface data and several weak linear anomalies, but these are not necessarily suggestive of further structural remains. Some of the rubble forms a rectilinear response surrounding [**gpr16**] between 7.2 and 16.8ns (0.28 to 0.65m), possibly representing the original Victorian excavation trench opened to expose the Romano-Celtic temple.

A further range of buildings [**gpr19**] to the south of the 2014 coverage shows individual rooms arranged around a central courtyard, fronting on to the east-west road. The south of this building range is of interest with one room showing a clear exterior apsidal wall [**gpr20**] facing south which adjoins a small, square room immediately to the east [**gpr21**]. A series buttresses are arranged around the interior of [**gpr21**] evident between 14.4 and 33.6ns (0.55 to 1.39m) and are suggestive of deeper structural foundations than the surrounding external walls. This could, perhaps, represent foundations for an upper storey or even a tower structure particularly given the alignment of [**gpr21**] with the south gate of the town (cf Linford 2015, [gpr2] and [gpr3] on Figure 6).

Magnetic survey West Cemetery

A graphical summary of the significant magnetic anomalies, [**m8-12**], discussed in the following text, are shown superimposed on the base OS map data on Figure 23.

The trial caesium magnetometer survey correlates well with the results from the wide area fluxgate coverage and shows an approximately east-west aligned series of ditch-type anomalies [**m8**], possibly a track or road way from the west gate with partially described enclosures mainly to the south. A number of more discrete, high magnitude responses [**m9**] within the enclosures seem likely to represent semi-industrial thermoremanent anomalies, perhaps pottery kilns or hearths, deliberately situated outside of the town. A single linear ditch [**m10**] heads north with a spur to the west, passing a group of three sub-rectangular anomalies [**m11**], possibly small mortuary enclosures, with two apparently containing a central pit-type response. Within the scatter of, presumably modern, near-surface ferrous detritus there is also an amorphous band of pit-type anomalies [**m12**] which is difficult to fully interpret as it is suggestive of either a natural response to the underlying sand and gravel or, perhaps, more significant discrete pits associated with the Roman cemetery.

Magnetic survey Chitty Farm

A graphical summary of the significant magnetic anomalies, [**m13-17**], discussed in the following text, are shown superimposed on the base OS map data on Figure 24.

This small area of vehicle towed caesium magnetometer data was conducted as an instrument test and, given the extensive fluxgate coverage here, is shown for comparison only. Beyond a scatter of near-surface ferrous litter there is evidence for a former north-south orientated plough pattern [**m13**] and the course of a previous fence line and field boundary [**m14**]. Perhaps the most significant response is a short length of ditch [**m15**] on a similar east-west alignment to [**m14**], following the approximate location of the outer earthworks associated with Calleva Atrebatum (AMIE Monument HOB UID 241183), with a series of possible pit-type anomalies [**m16**] found immediately to the south. The area between [**m14**] and [**m15**] reveals a mottled magnetic response [**m17**], perhaps reflecting the underlying geomorphology. It is of interest to note that [**m15**] is found approximately 50m to the south of the outer earthwork indicated by aerial photography, although this may well indicate a more complex defensive linear monument.

Ground Penetrating Radar survey Chitty Farm

A graphical summary of the significant magnetic anomalies, [**gpr22-35**], discussed in the following text, are shown superimposed on the base OS map data on Figure 24.

The GPR survey was conducted immediately to the west of the amphitheatre, just beyond the town walls, in the vicinity of a lower lying area of ground where a coping stone was discovered believed to be associated with a near-by Roman well. Heavy rain-fall during the survey, following a period of very dry weather, restricted the acquisition of useable data and changed the response markedly.

The near-surface response appears to be largely due to the surface topography associated with former fence lines [**gpr22**] and marginal vegetation [**gpr23**] established on the lower lying ground at the bottom of the slope. Some rabbit burrows are also evident between 0.0 and 4.8ns (0.0 to 0.27m) and following the heavy rain a strong response is evident from vehicle ruts across the survey area to the west.

From 7.2ns (0.41m) onwards the response to the edge of the gravel plateau is apparent with rapid signal attenuation evident in the lower lying soils to the north. Two linear pipes [**gpr24**] and [**gpr25**] appear to be associated with the well head marked on the historic mapping (OS Historic County Mapping Series:

Hampshire 1874 Epoch 1), and a third, perhaps more recent service [**gpr26**], follows Wall Lane to the south of the survey.

A low amplitude, 'L' shaped ditch anomaly [**gpr27**] is cut into the gravel between 9.6 and 28.8ns (0.54 to 1.63m), possibly an enclosure partially described within the survey area. Some discrete pit-type responses [**gpr28**] are found within [**gpr27**] through a similar depth range although these may, perhaps, also represent natural variation in the underlying gravel. Creighton and Fry (2016) revealed a series of thermoremanent anomalies in the fluxgate data immediately beyond [**gpr27**] to the east, no doubt the response to possible Roman kilns suggested by field walking (AMIE Monument HOB UID 241222). There is also a short ditch-type anomaly [**gpr29**] which correlates with a similar response in the fluxgate gradiometer survey, although it is possible this may represent another service run. The outer earthwork to the Roman town also appears as a broad linear anomaly [**gpr30**] on the edge of the slope (cf [**m15**]), but the response to this is attenuated quite heavily to the west in the data collected following the heavy rainfall. A number of additional ditch-type anomalies [**gpr31**] are also evident that largely correlate with the fluxgate gradiometer data, together with a number of short linear high amplitude responses [**gpr35**] although some of these are only partially described in the GPR survey area.

CONCLUSIONS

Both the caesium magnetometer and Ground Penetrating Radar (GPR) surveys have produced successful data over sites within and immediately beyond the Roman town walls. Whilst the majority of this work was conducted as instrument tests the results went on to inform the methodology used to support the Silchester Environs Project through a programme of geophysical investigation using these techniques (Linford *et al.* 2016b, 2016a, 2017, 2019a, 2019b, 2019c; Linford *et al.* 2019d, 2019e). All of the survey areas reported here fall within the detailed fluxgate magnetometer coverage collected by the University of Reading (Creighton and Fry 2016) which, together with the location of structural remains known from the Victorian excavation records and parch marks, provided a useful comparative data set for the current report. To this end the interpretation of the data presented here has concentrated on either new evidence of significant anomalies or where these complement the existing surveys. The GPR survey has been most useful in this regard and, for example, suggests some more deeply buried structural anomalies within a known building that may, perhaps, indicate foundations for a more substantial upper storey or tower. At Chitty Farm the GPR data was adversely affected by heavy rain fall during the survey, although the results largely correlate the existing fluxgate magnetometer coverage

LIST OF ENCLOSED FIGURES

Figure 1 Location of the geophysical surveys in relation to (A) the University of Reading core Silchester Environs Project study area (1:100,000) and (B) detail centred on Calleva Roman town (1:25,000).

Figure 2 Location of the caesium magnetometer survey grid and GPR instrument swaths, Insula III, superimposed over the base OS mapping data (1:2500).

Figure 3 Linear greyscale image of the caesium magnetometer data, Insula III, superimposed over the base OS mapping (1:2500).

Figure 4 Greyscale image of the GPR amplitude time slice from between 12.8 and 16.0ns (0.55-0.73m), Insula III, superimposed over the base OS mapping data. The location of the GPR profiles shown on Figure 8 are also indicated (1:2500).

Figure 5 Location of the caesium magnetometer survey, West Gate Cemetery, superimposed over the base OS mapping data (1:1250).

Figure 6 Linear greyscale image of the caesium magnetometer data, West Gate Cemetery, superimposed over the base OS mapping (1:1250).

Figure 7 Location of the caesium magnetometer and GPR instrument swaths, Chitty Farm, superimposed over the base OS mapping data (1:2500).

Figure 8 Linear greyscale image of the caesium magnetometer data together with a greyscale image of the GPR amplitude time slice from between 12.8 and 16.0ns (0.55-0.73m), Chitty Farm, superimposed over the base OS mapping (1:2500).

Figure 9 Trace plot of the minimally processed caesium magnetometer data from Insula III (1:1000).

Figure 10 Histogram normalised greyscale image of the minimally processed caesium magnetometer data from Insula III (1:1000).

Figure 11 (A) trace plot and (B) histogram normalised greyscale image of the minimally processed caesium magnetometer data from West Gate Cemetery (1:750).

Figure 12 (A) trace plot and (B) histogram normalised greyscale image of the minimally processed caesium magnetometer data from Chitty Farm (1:750).

Figure 13 Topographically corrected profiles from the GPR survey shown as greyscale images with annotation denoting significant anomalies. The location of the selected profiles can be found on Figures 2, 4 and 5.

Figure 14 GPR amplitude time slices between 0.0 and 14.4ns (0.0 to 0.72m), Insula III, June 2009 (1:4000).

Figure 15 GPR amplitude time slices between 14.4 and 28.8ns (0.72 to 1.44m), Insula III, June 2009 (1:4000).

Figure 16 GPR amplitude time slices between 28.8 and 36.0ns (1.44 to 1.86m), Insula III, June 2009 (1:4000).

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Figure 18 GPR amplitude time slices between 21.6 and 43.2ns (0.83 to 1.66m), Insula III, March 2014 (1:2500).

Figure 19 GPR amplitude time slices between 0.0 and 24.0ns (0.0 to 1.36m), Chitty Farm, July 2015 (1:1250).

Figure 20 GPR amplitude time slices between 24.0 and 48.0ns (1.36 to 2.71m), Chitty Farm, July 2015 (1:1250).

Figure 21 Graphical summary of significant magnetic anomalies, Insula III, superimposed over the base OS mapping (1:2500).

Figure 22 Graphical summary of significant GPR anomalies, Insula III, superimposed over the base OS mapping (1:2500).

Figure 23 Graphical summary of significant magnetic, West Gate Cemetery, superimposed over the base OS mapping (1:1250).

Figure 24 Graphical summary of significant magnetic and GPR anomalies, Chitty Farm, superimposed over the base OS mapping (1:2500).

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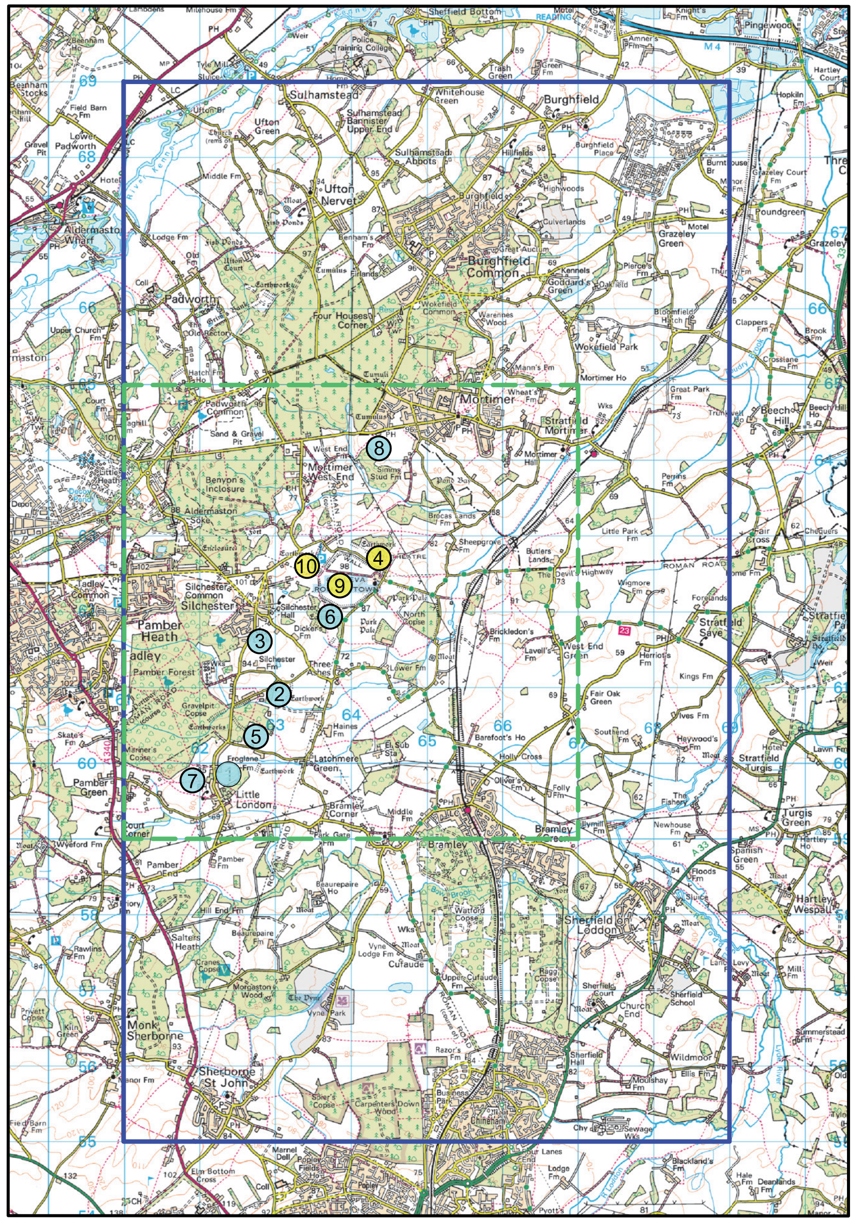
Figure 1

SILCHESTER ROMAN TOWN, SILCHESTER, HAMPSHIRE
Location of surveys, June 2009, March 2014 and July 2015

(A)



Silchester Environs project area

Detailed OS mapping area (B)

0 — 3km
1:100000

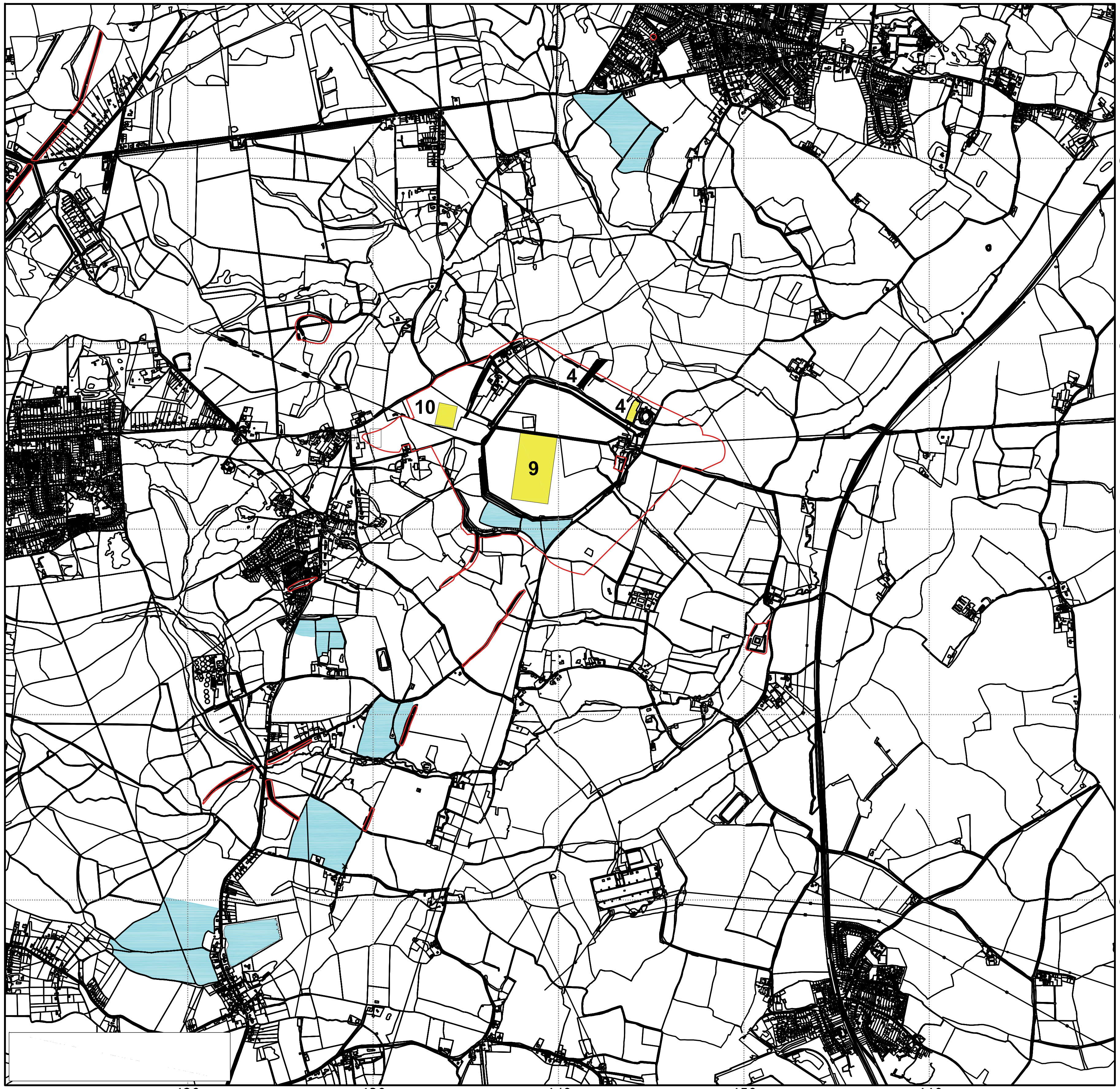
HE geophysical survey locations:

1. Little London Roman tilery
2. Woods Farm Dyke
3. Silchester Farm
4. Chitty Farm
5. Bridle's Copse
6. Rampier Copse
7. King's Hogsty Copse
8. Simms's Copse
9. Silchester Roman Town Insula III
10. West Gate Cemetery

Yellow shaded areas (4, 9 and 10) included in this report

(B)

SU6159



0 — 1500m
1:25000

4 Chitty Farm survey areas

9 Silchester Insula III

10 West Gate Cemetery

geophysical surveys undertaken for Silchester Environs Project

Scheduled areas

Historic England

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Figure 2

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
Location of caesium magnetometer survey and GPR survey swaths, June 2009 and March 2014

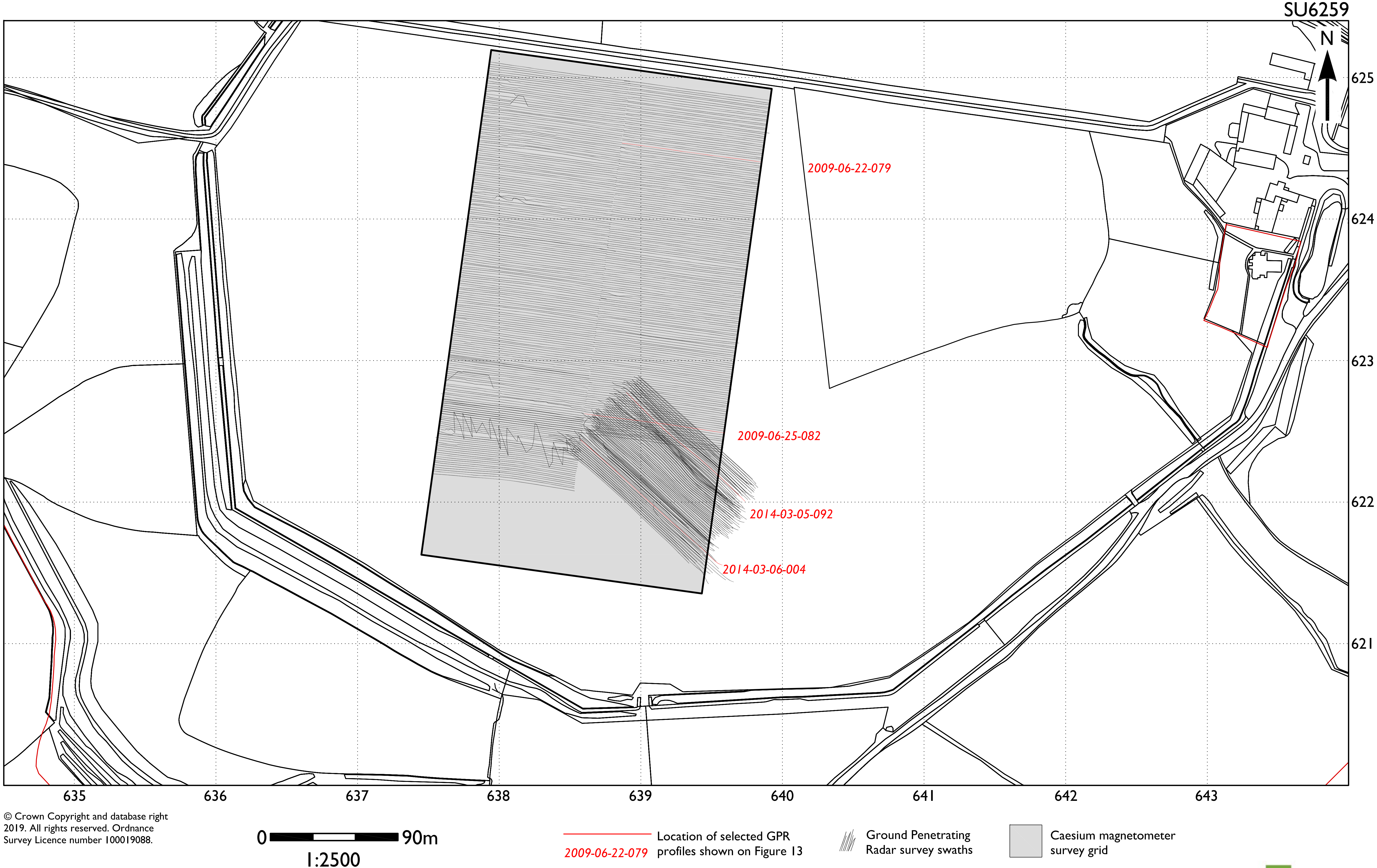

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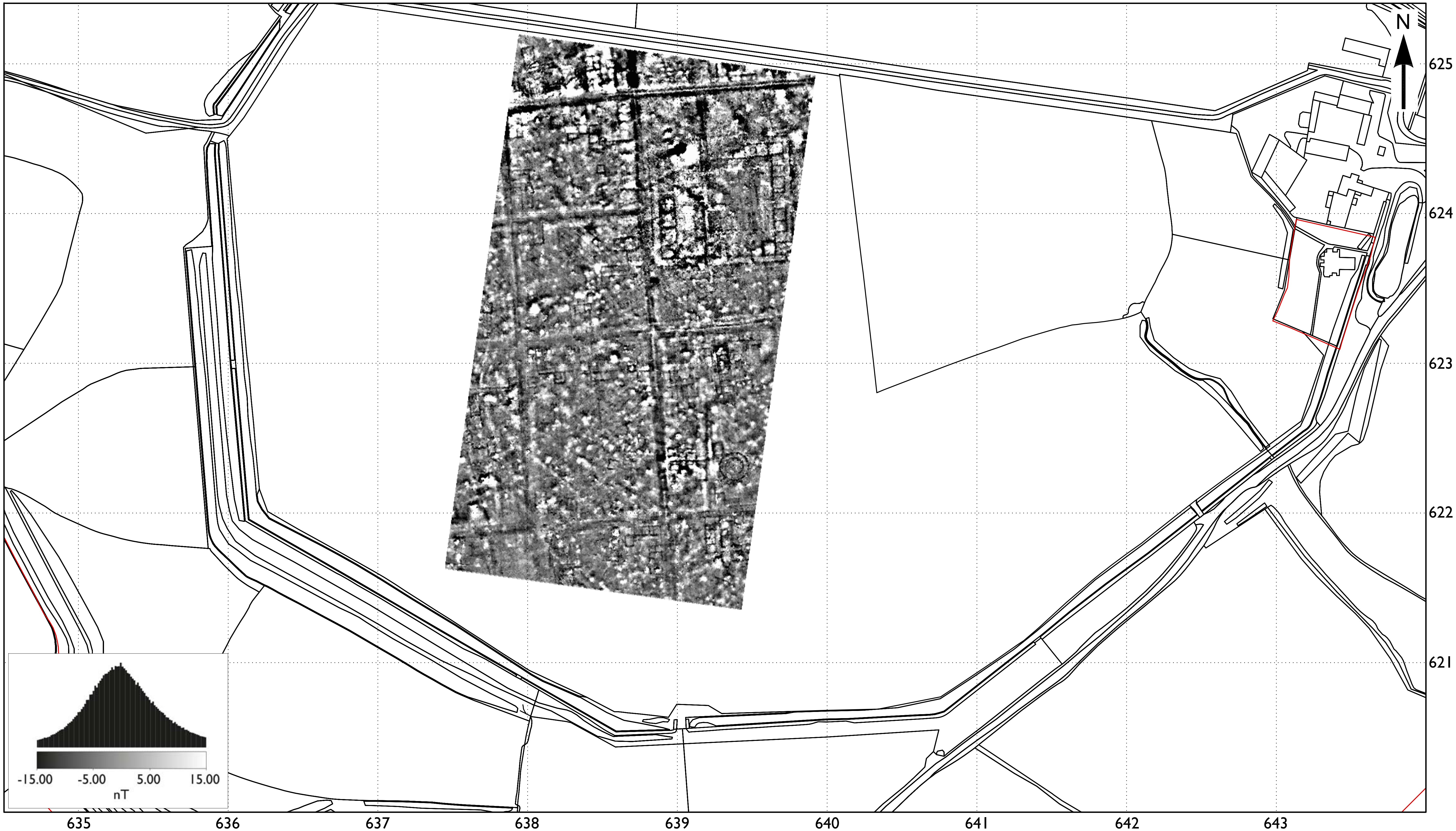
Figure 3

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE

Caesium magnetometer survey, June 2009



0 90m

1:2500

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Figure 4

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slice between 10.8 and 12.0ns (0.54 - 0.6m), June 2009 and March 2014

0 90m
1:2500

2009-06-22-079 Location of selected GPR profiles shown on Figure 13

Low High
relative reflector strength

Historic England

Geophysics Team 2019

Figure 5

SILCHESTER ROMAN TOWN, WEST GATE CEMETERY, SILCHESTER, HAMPSHIRE
Location of caesium magnetometer survey, June 2009

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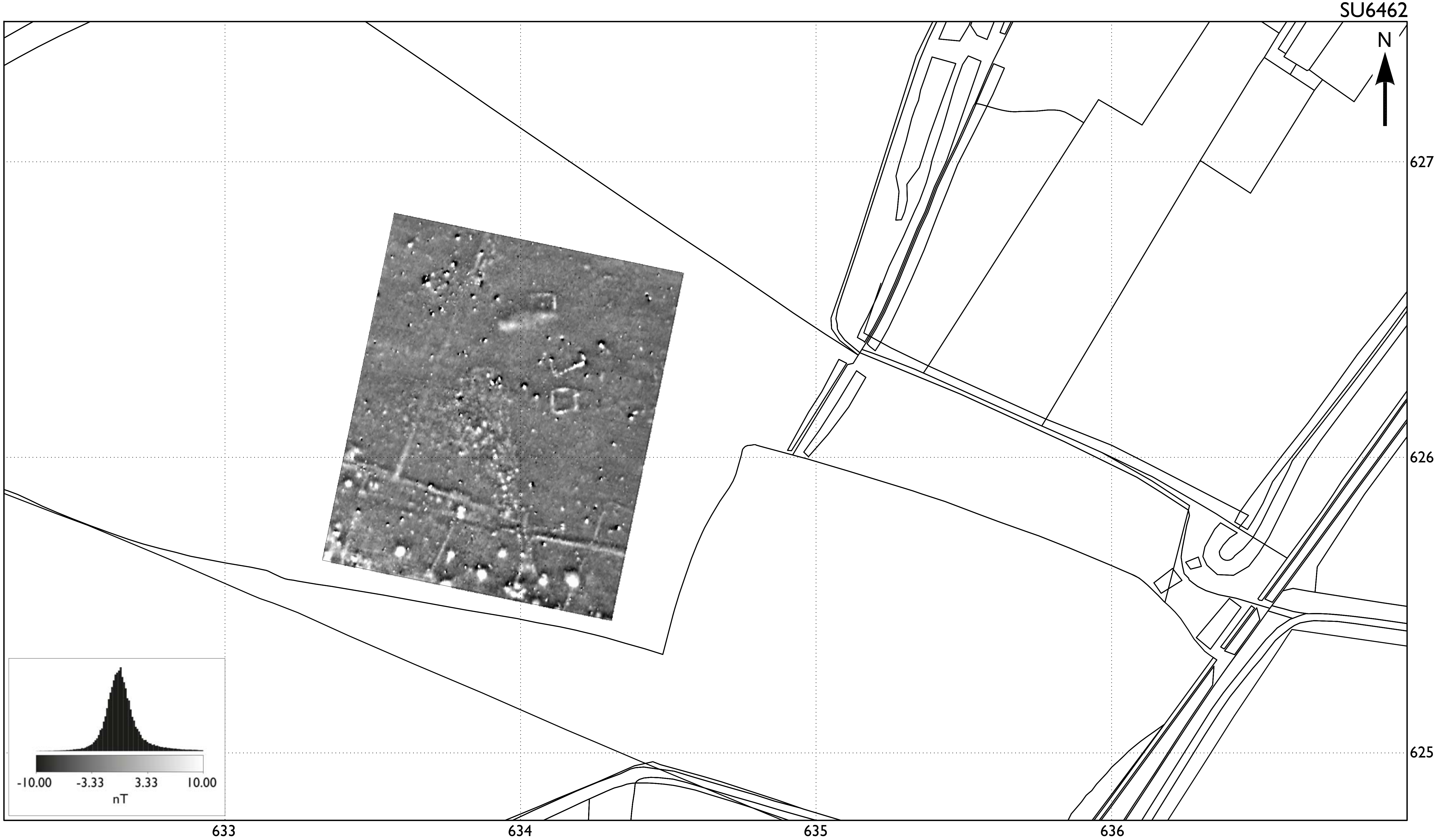
Historic England

Figure 6

SILCHESTER ROMAN TOWN, WEST GATE CEMETERY, SILCHESTER, HAMPSHIRE
Caesium magnetometer survey, June 2009



0 60m
1:1250

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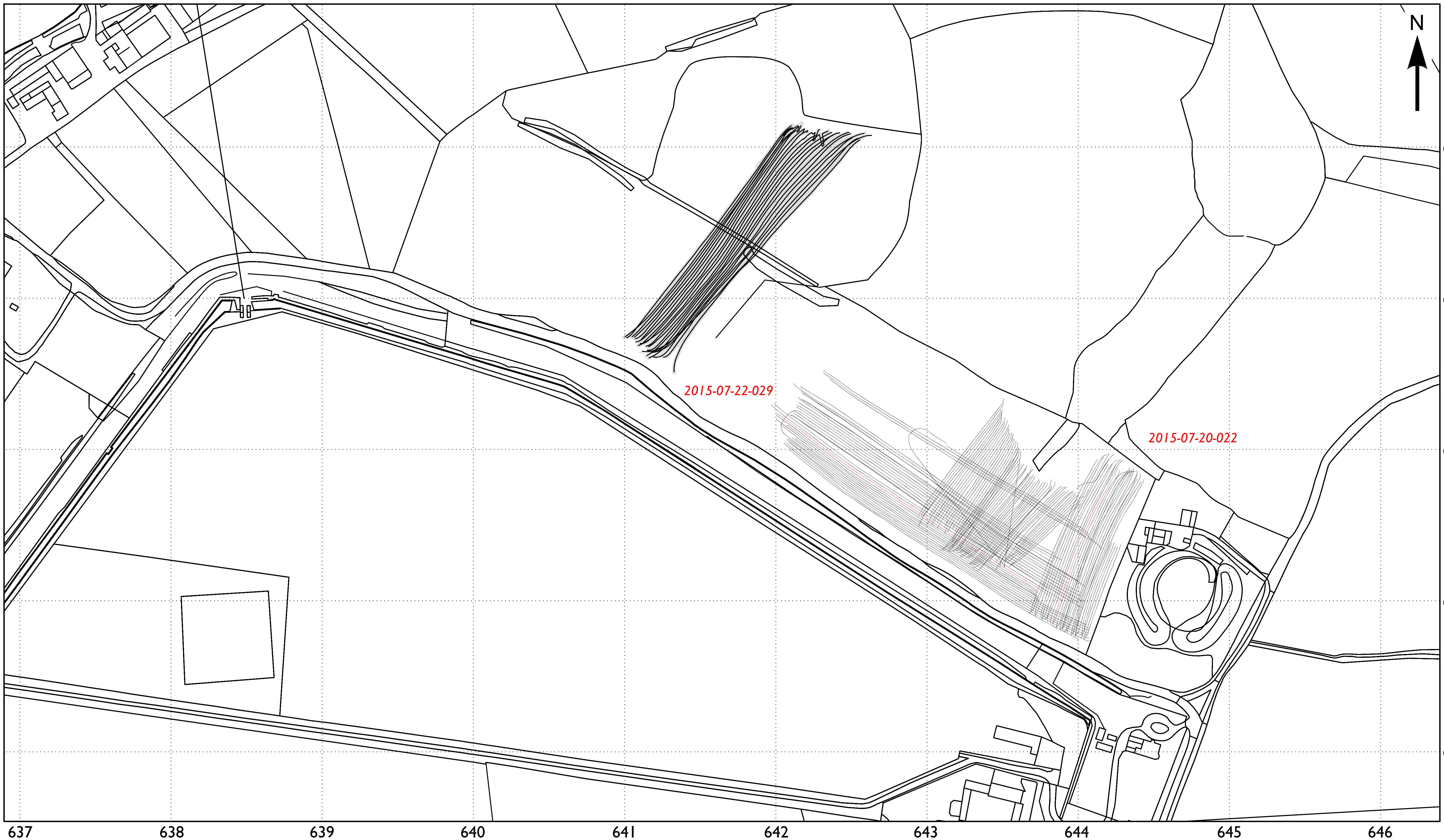
Historic England

Figure 7

SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE
Location of caesium magnetometer and GPR instrument swaths, July 2015



0 90m
1:2500

2015-07-20-022 Location of selected GPR profiles shown on Figure 13

Ground Penetrating Radar survey swaths

Caesium magnetometer survey swaths

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Historic England

Figure 8

SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE

Caesium magnetometer survey and GPR amplitude time slice between 9.6 and 12.0ns (0.54 - 0.68m), July 2015

0 90m

1:2500

2015-07-20-022 Location of selected GPR profiles shown on Figure 13

Low High
relative reflector strength

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Historic England

Figure 9

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
Trace plot of minimally processed caesium magnetometer data, June 2009

Geophysics Team 2019

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE

Histogram normalised greyscale image of despiked caesium magnetometer data, June 2009

Figure 10

1:1000

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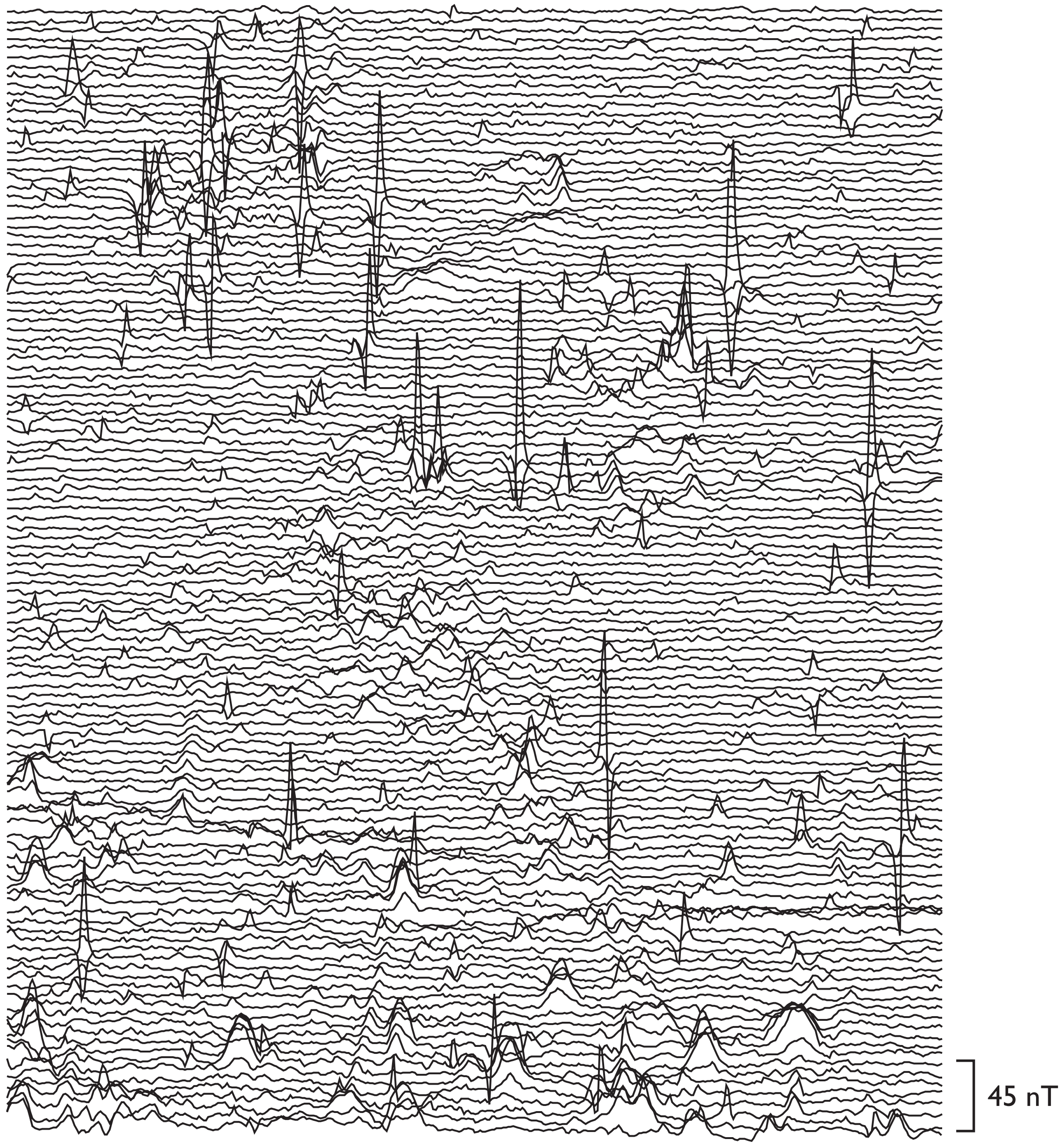
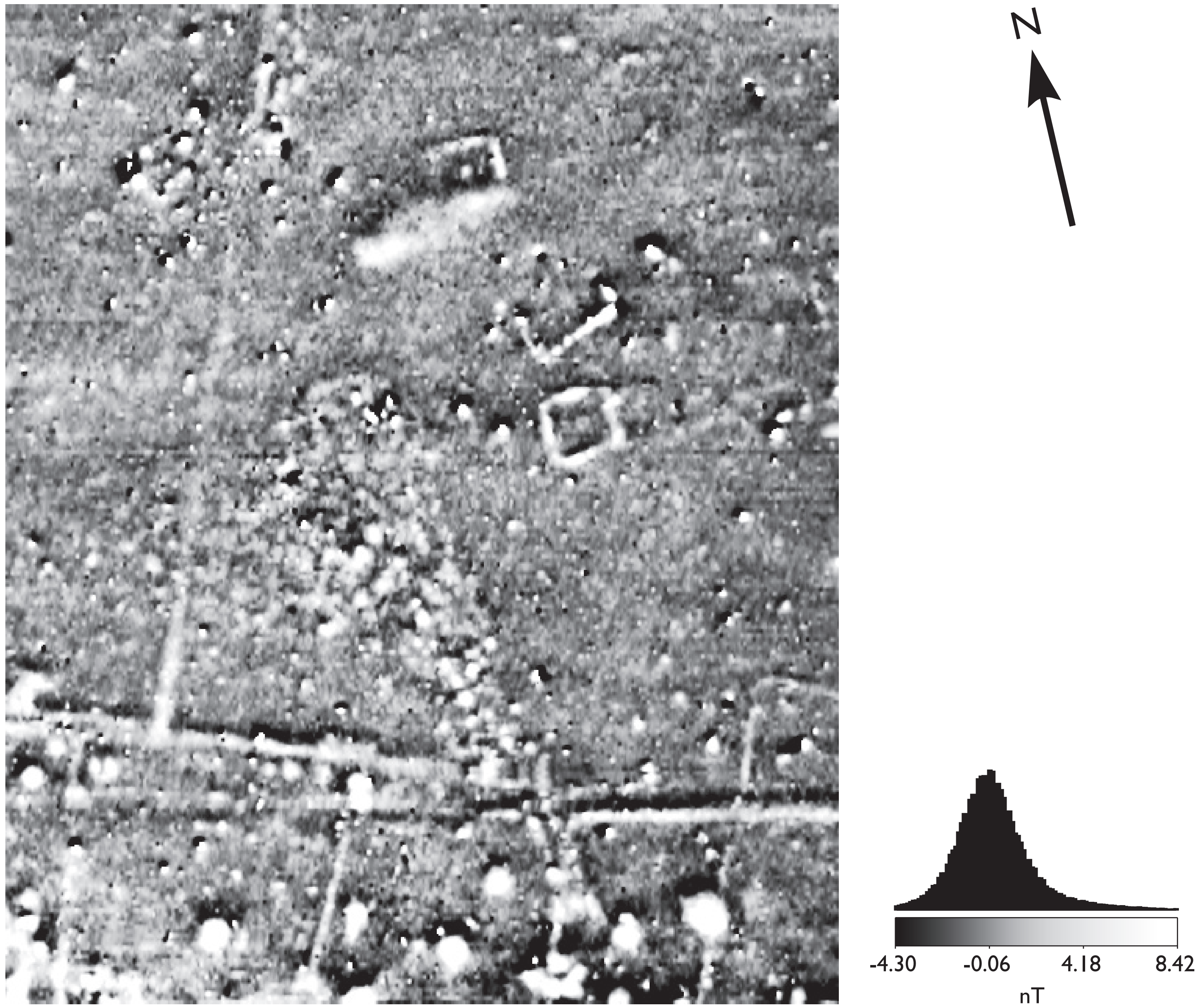
SILCHESTER ROMAN TOWN, WEST GATE CEMETERY, SILCHESTER, HAMPSHIRE
Caesium magnetometer survey, June 2009

Figure 11

(A) Trace plot of minimally processed data



(B) Histogram normalised greyscale image of minimally processed data

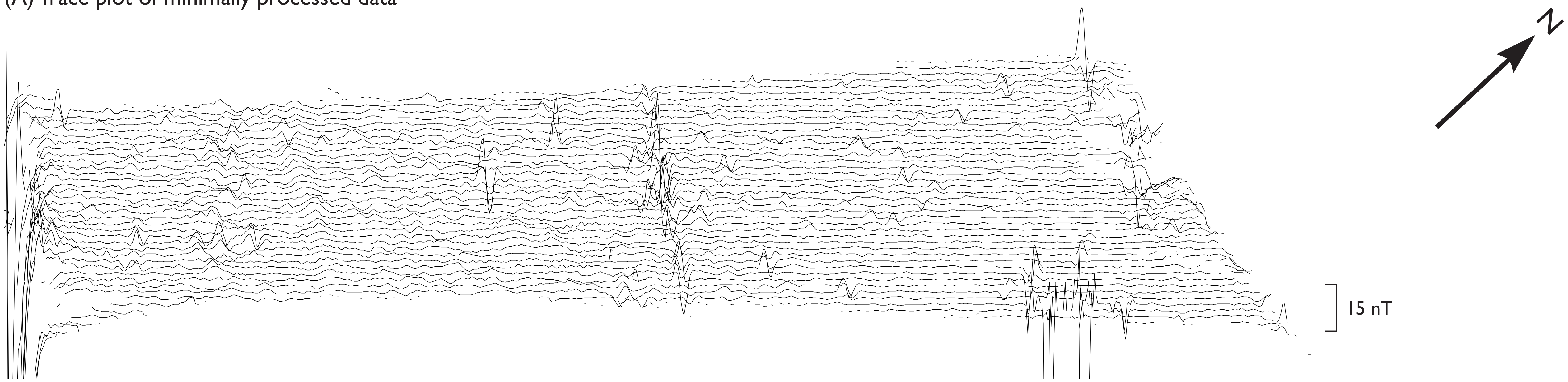


0 60m
1:750

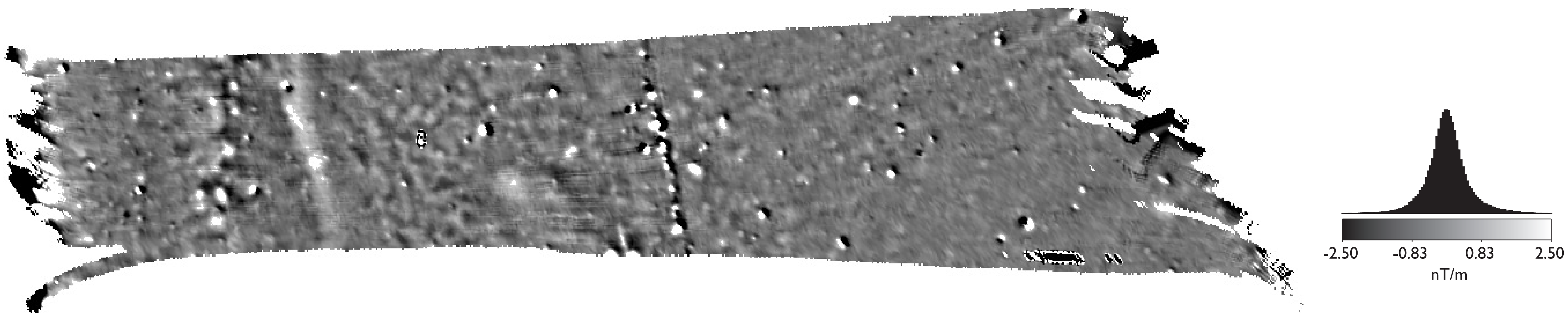
SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE
Caesium magnetometer survey, July 2015

Figure 12

(A) Trace plot of minimally processed data



(B) Histogram normalised greyscale image of minimally processed data



0 60m
1:750

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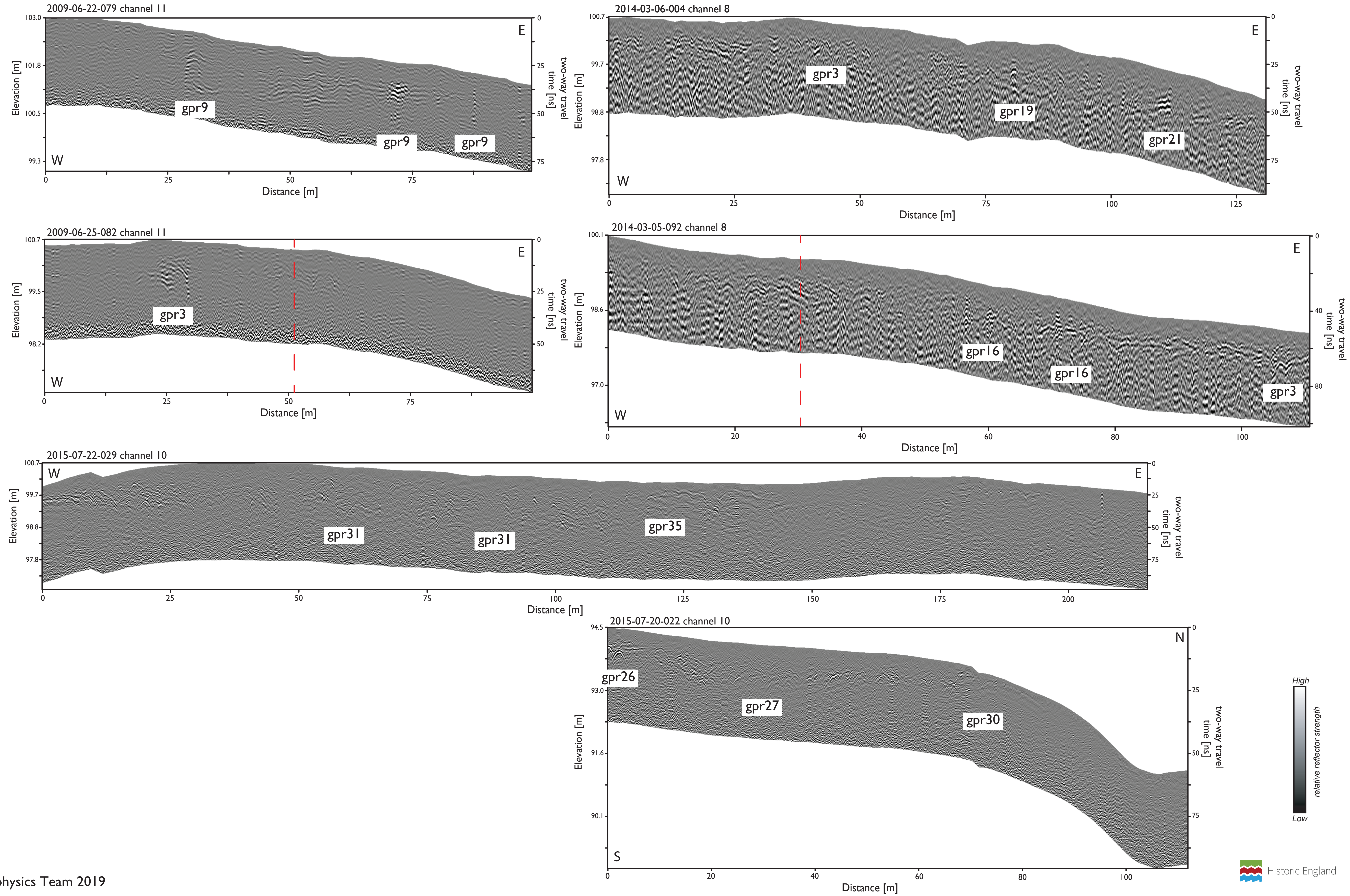
Historic England

SILCHESTER ROMAN TOWN, SILCHESTER, HAMPSHIRE

Figure 13

Topographically corrected GPR profiles, June 2009, March 2014 and July 2015



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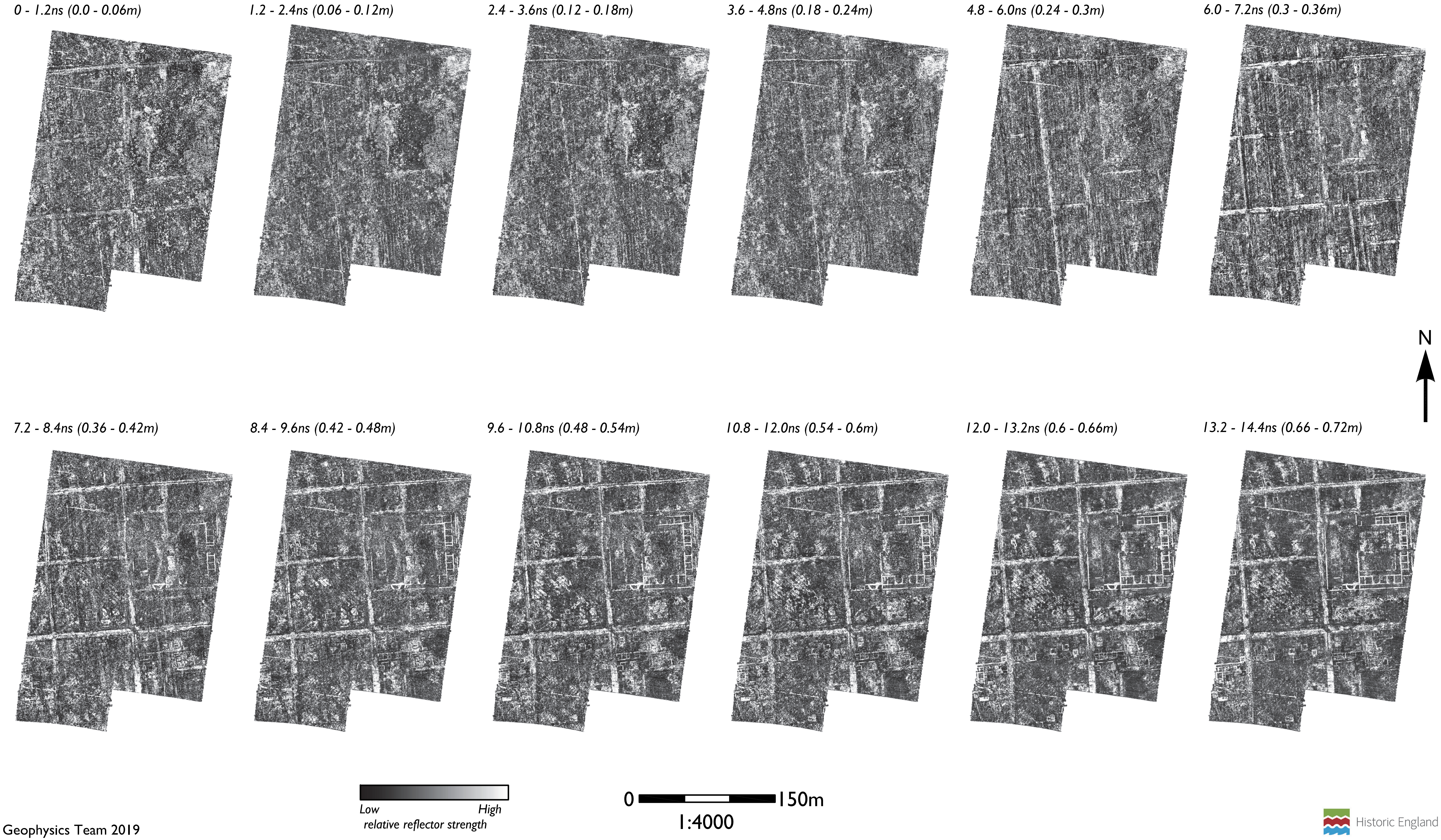
SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slices between 0.0 and 14.4ns (0.0 to 0.72m), June 2009

Figure 14



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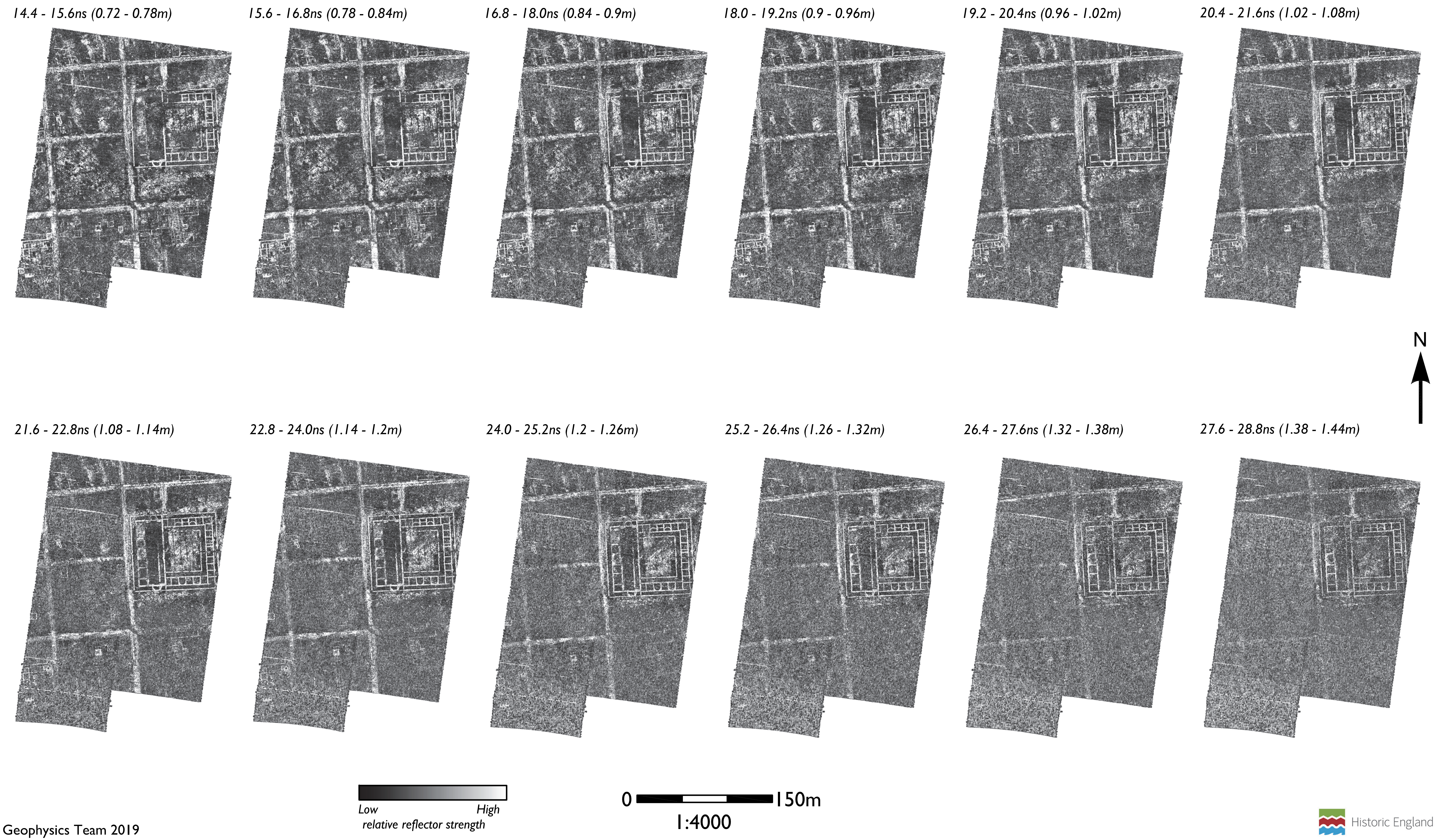
Historic England

Figure 15

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slices between 14.4 and 28.8ns (0.72 to 1.44m), June 2009



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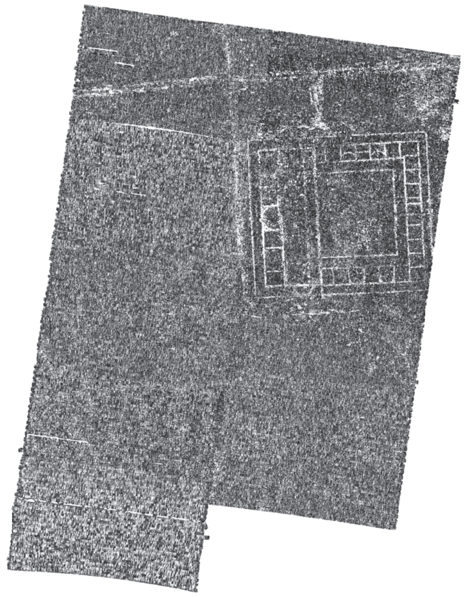
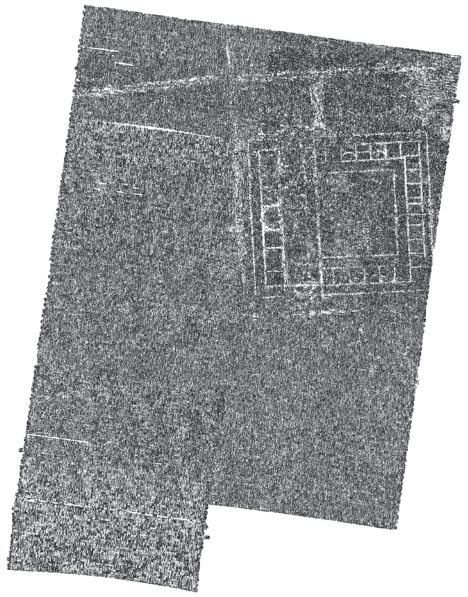
SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slices between 28.8 and 36.0ns (1.44 to 1.86m), June 2009

Figure 16

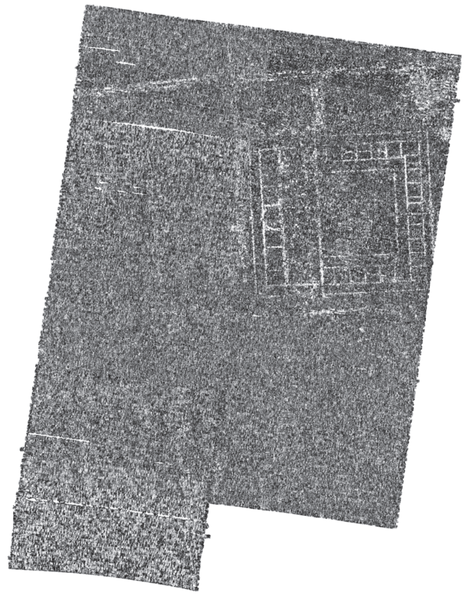
28.8 - 30.0ns (1.44 - 1.5m)



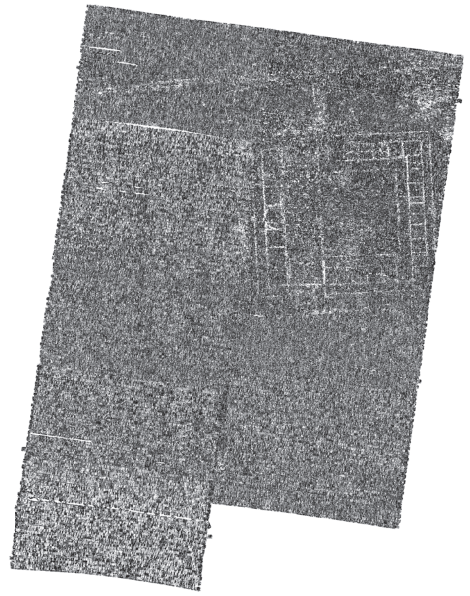
30.0 - 31.2ns (1.5 - 1.62m)



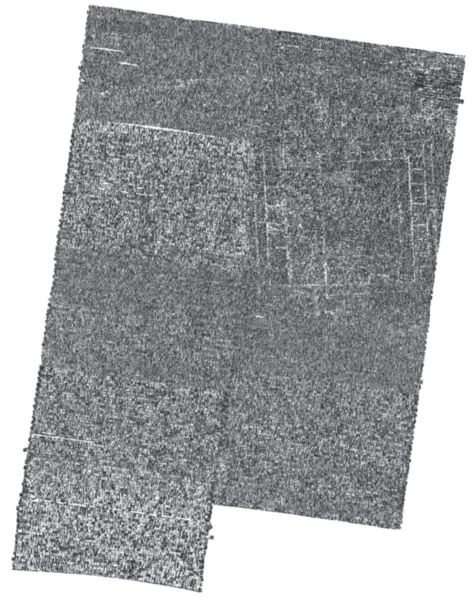
31.2 - 32.4ns (1.62 - 1.68m)



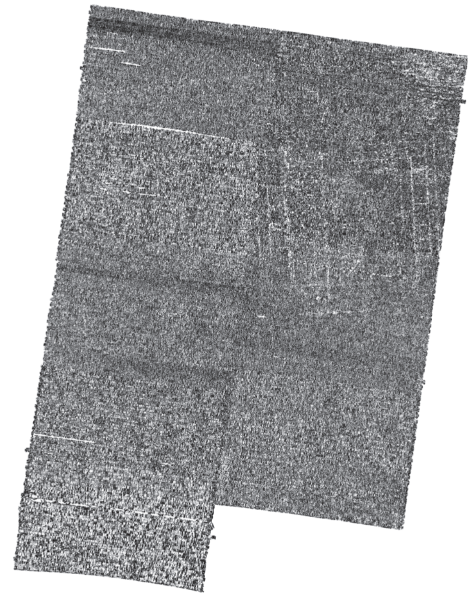
32.4 - 33.6ns (1.68 - 1.74m)



33.6 - 34.8ns (1.74 - 1.8m)



34.8 - 36.0ns (1.8 - 1.86m)



N

Low *High*
relative reflector strength

0 150m
1:4000

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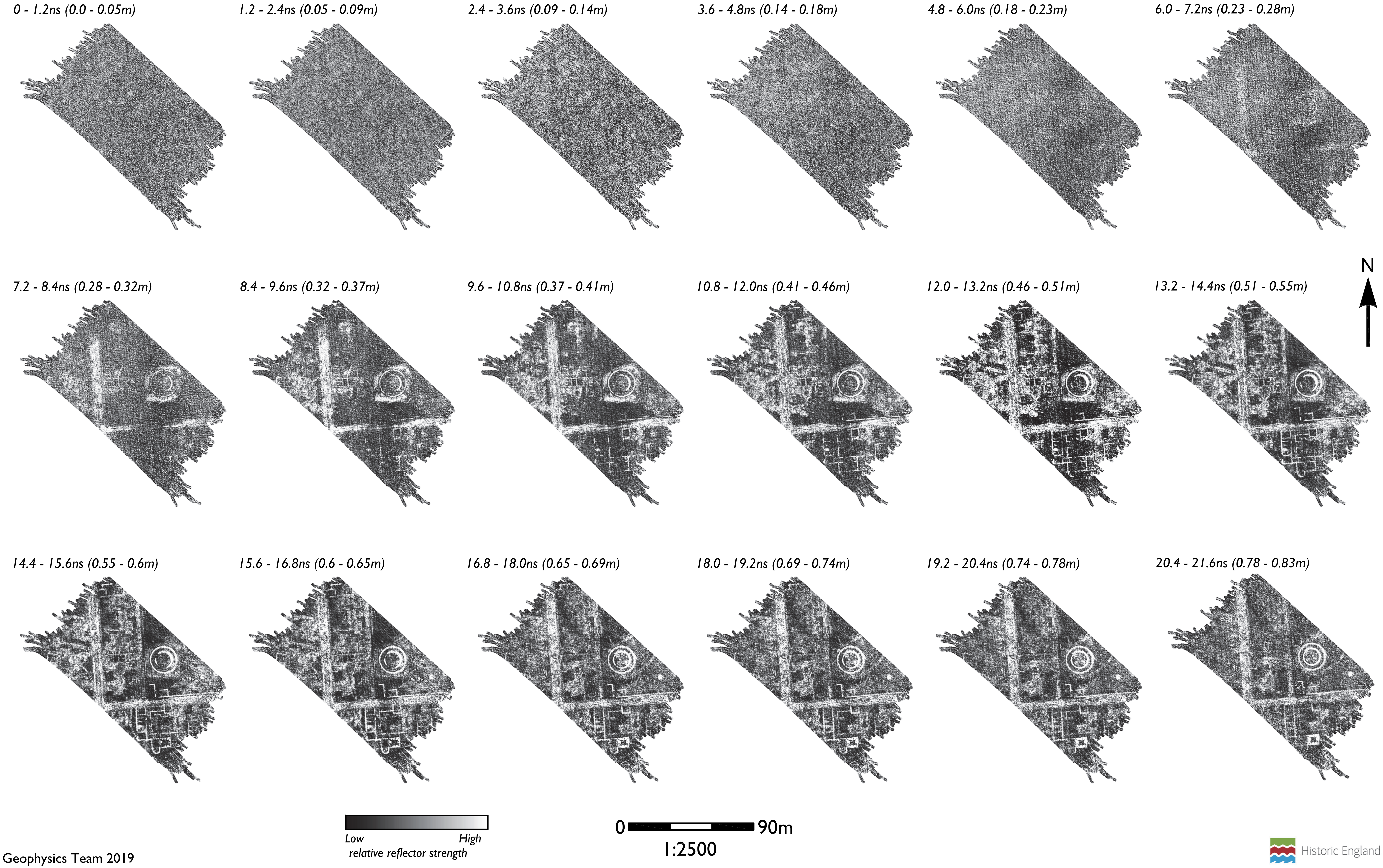
Historic England

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slices between 0.0 and 21.6ns (0.0 to 0.83m), March 2014

Figure 17



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Historic England

Figure 18

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
GPR amplitude time slices between 21.6 and 43.2ns (0.83 to 1.66m), March 2014

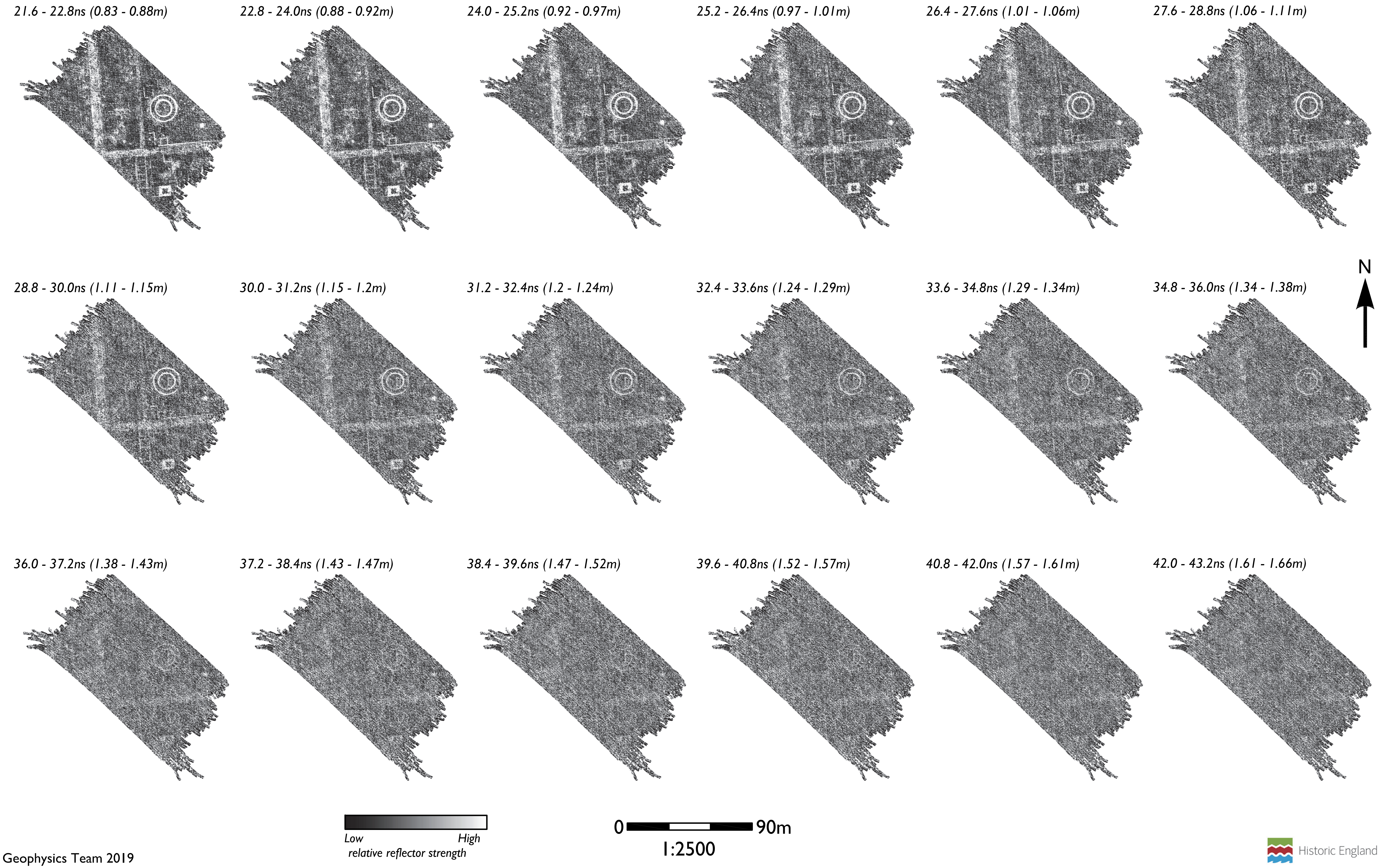

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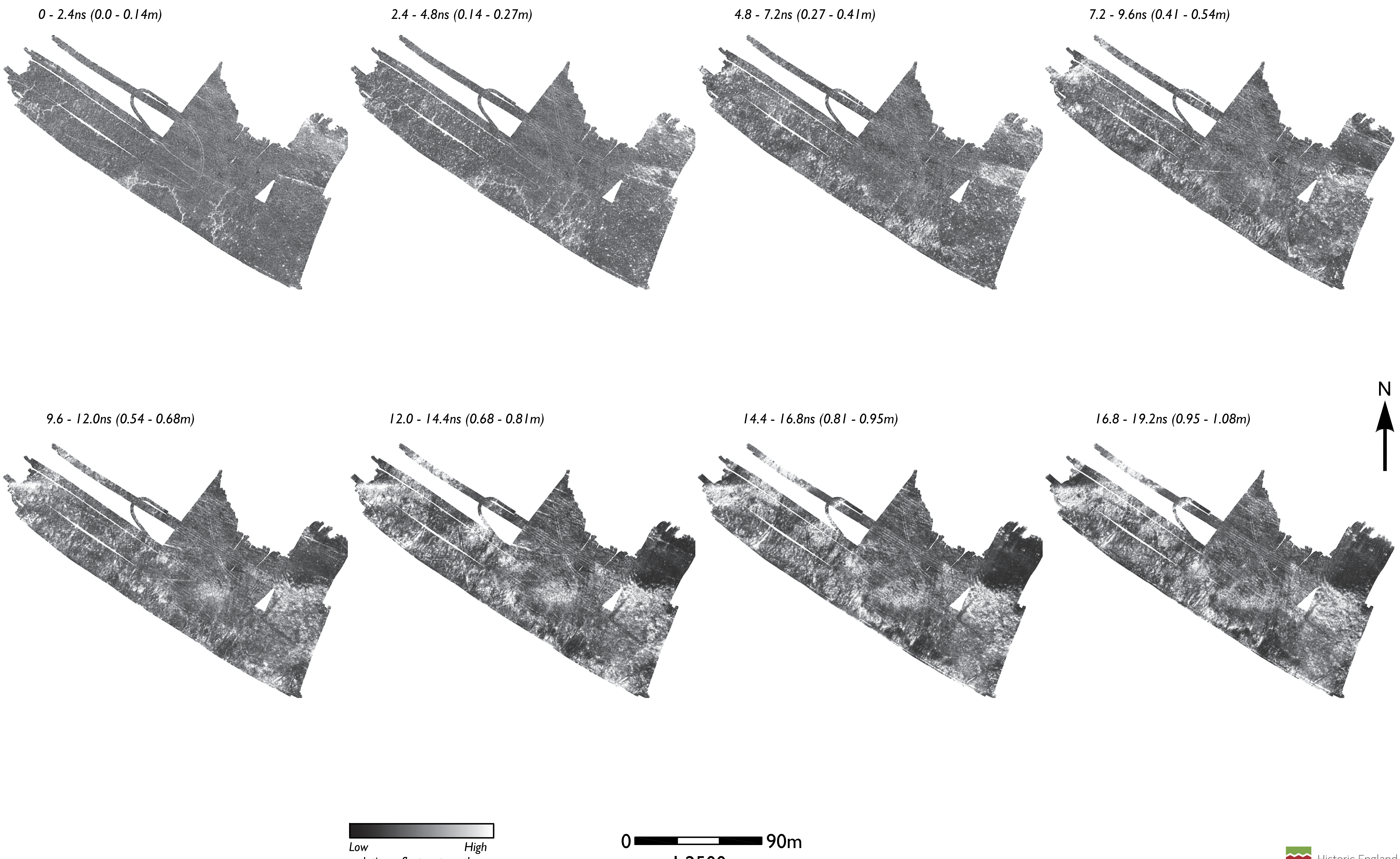
Figure 19

SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE
GPR amplitude time slices between 0.0 and 19.2ns (0.0 to 1.08m), July 2015



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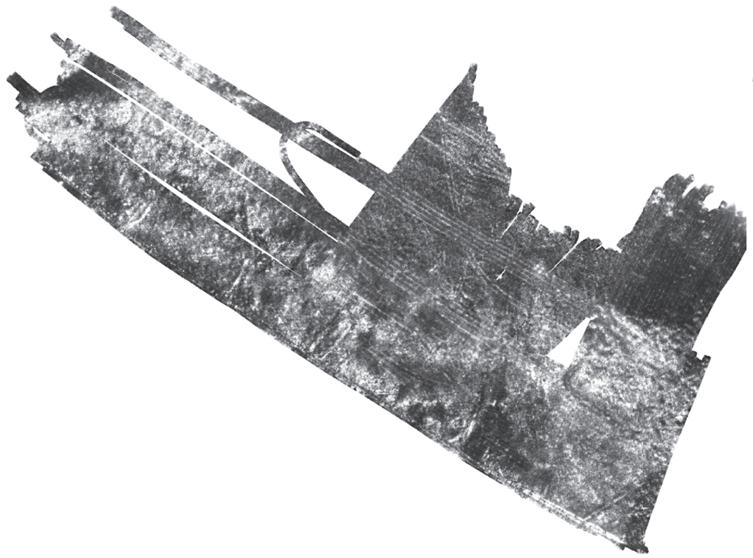
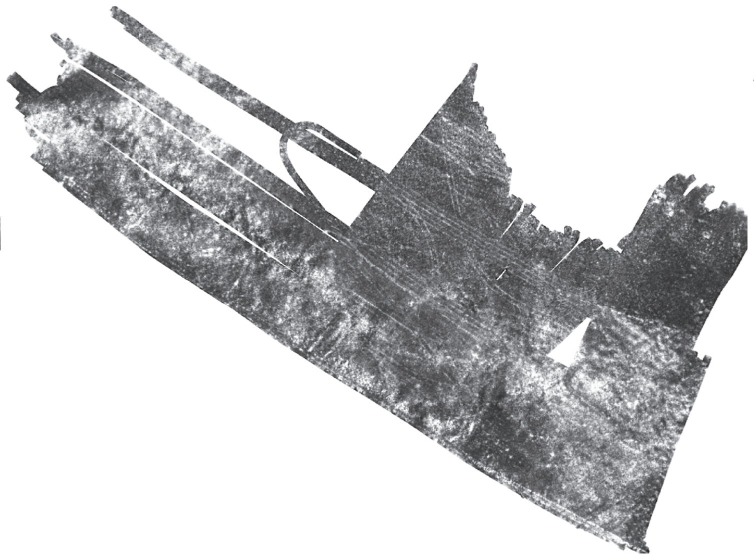
SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE
GPR amplitude time slices between 19.2 and 38.4ns (1.08 to 2.17m), July 2015

Figure 20

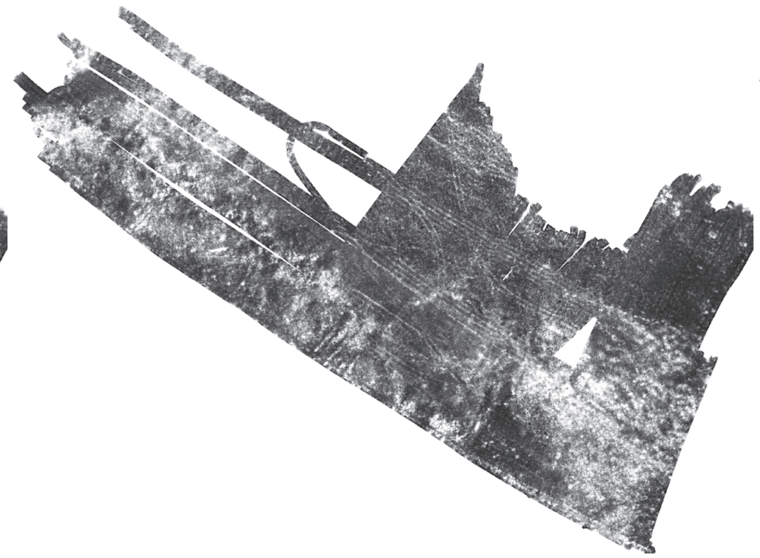
19.2 - 21.6ns (1.08 - 1.22m)



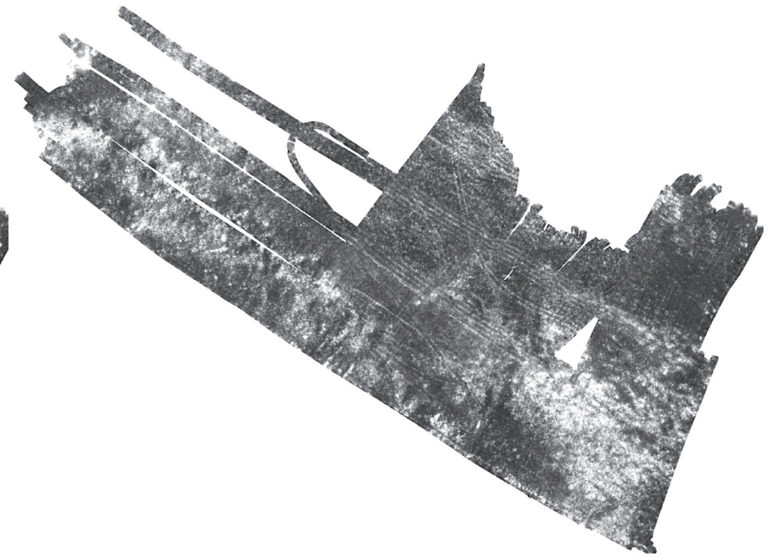
21.6 - 24.0ns (1.22 - 1.36m)



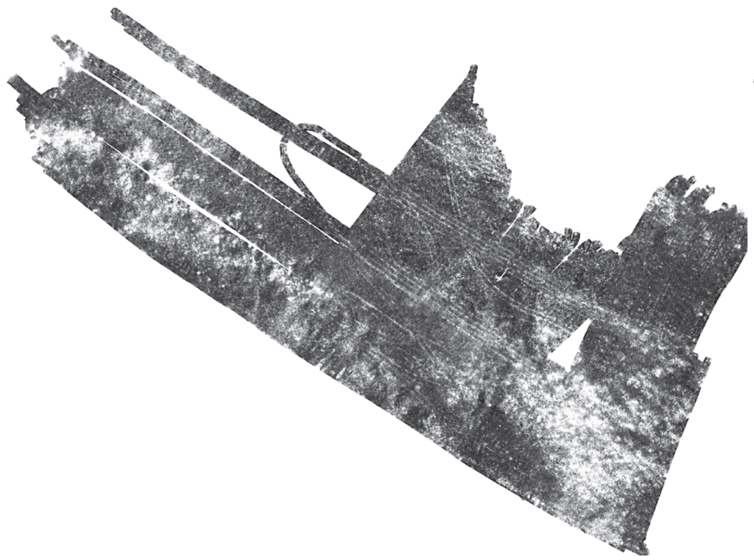
24.0 - 26.4ns (1.36 - 1.49m)



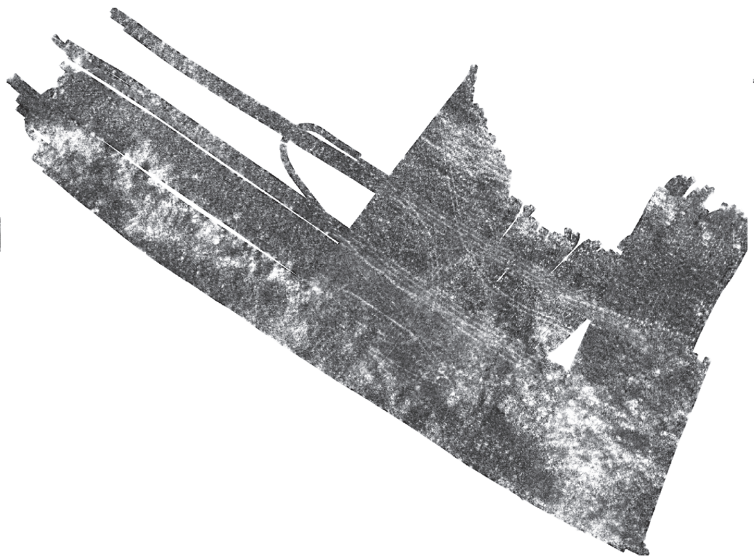
26.4 - 28.8ns (1.49 - 1.63m)



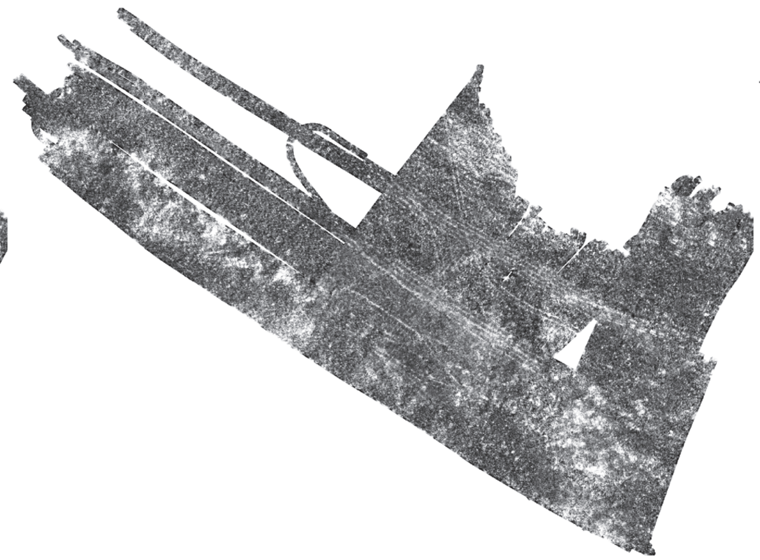
28.8 - 31.2ns (1.63 - 1.76m)



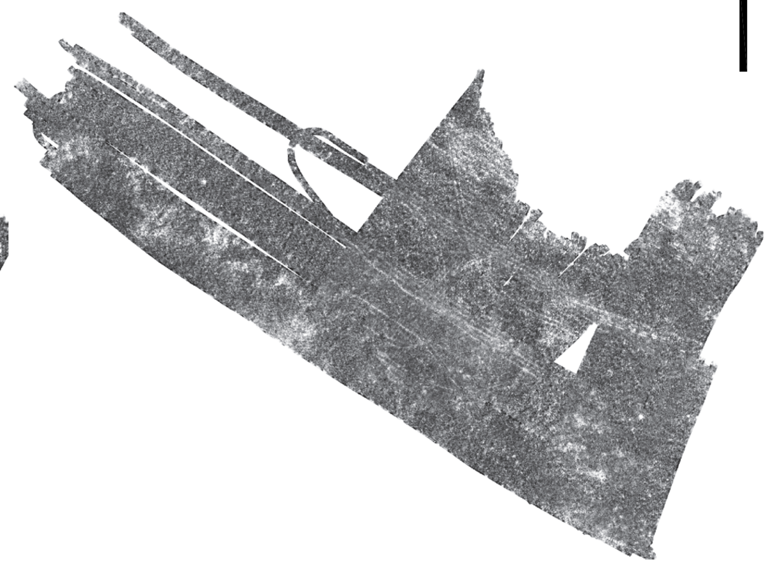
31.2 - 33.6ns (1.76 - 1.9m)



33.6 - 36.0ns (1.9 - 2.03m)



36.0 - 38.4ns (2.03 - 2.17m)



N

Low *High*
relative reflector strength

0 90m
1:2500

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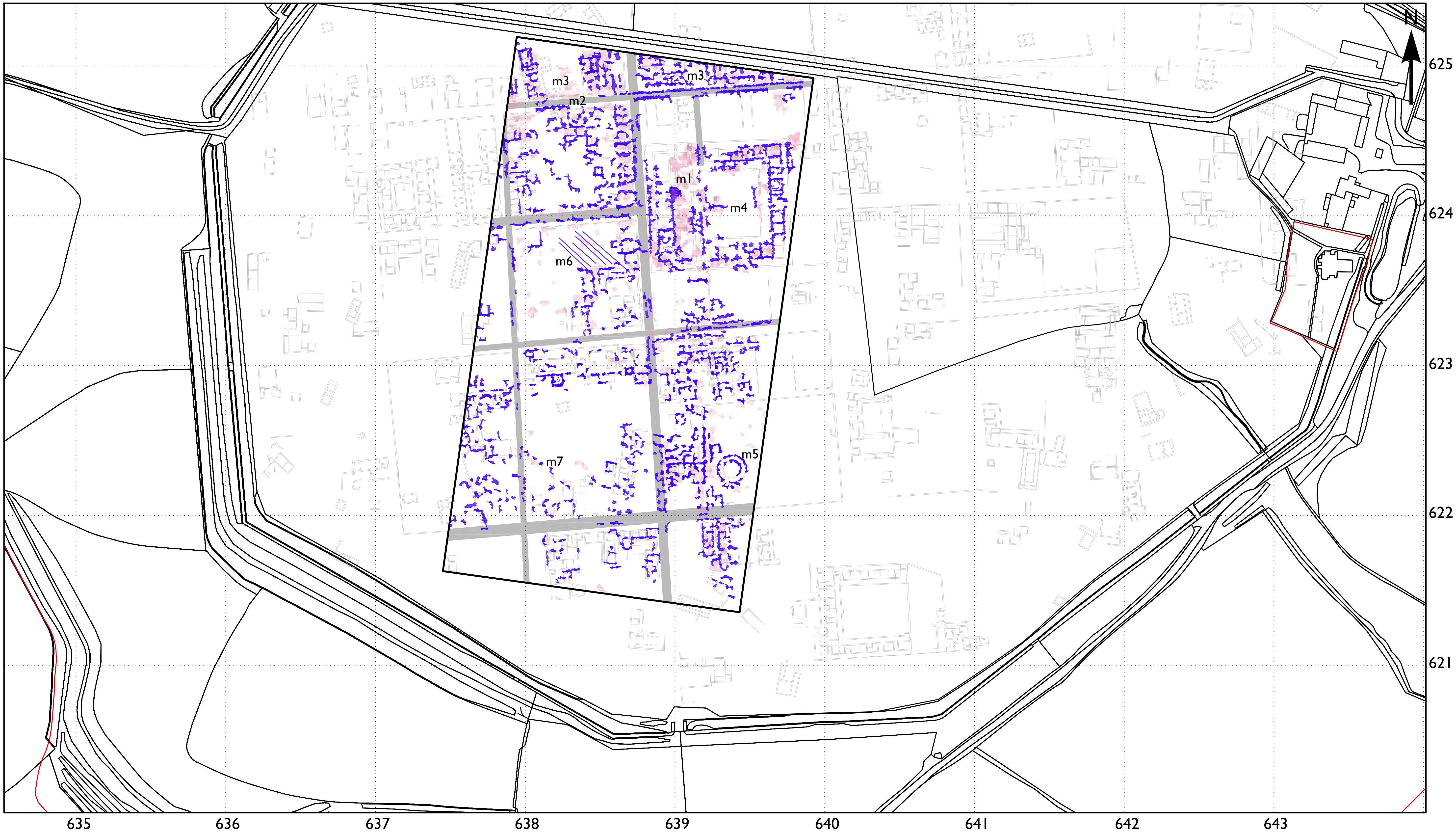
Historic England

Figure 21

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE

Summary of significant magnetic anomalies, June 2009



0 90m
1:2500

positive magnetic
raised magnetic
negative magnetic
magnetic noise
known buildings and walls

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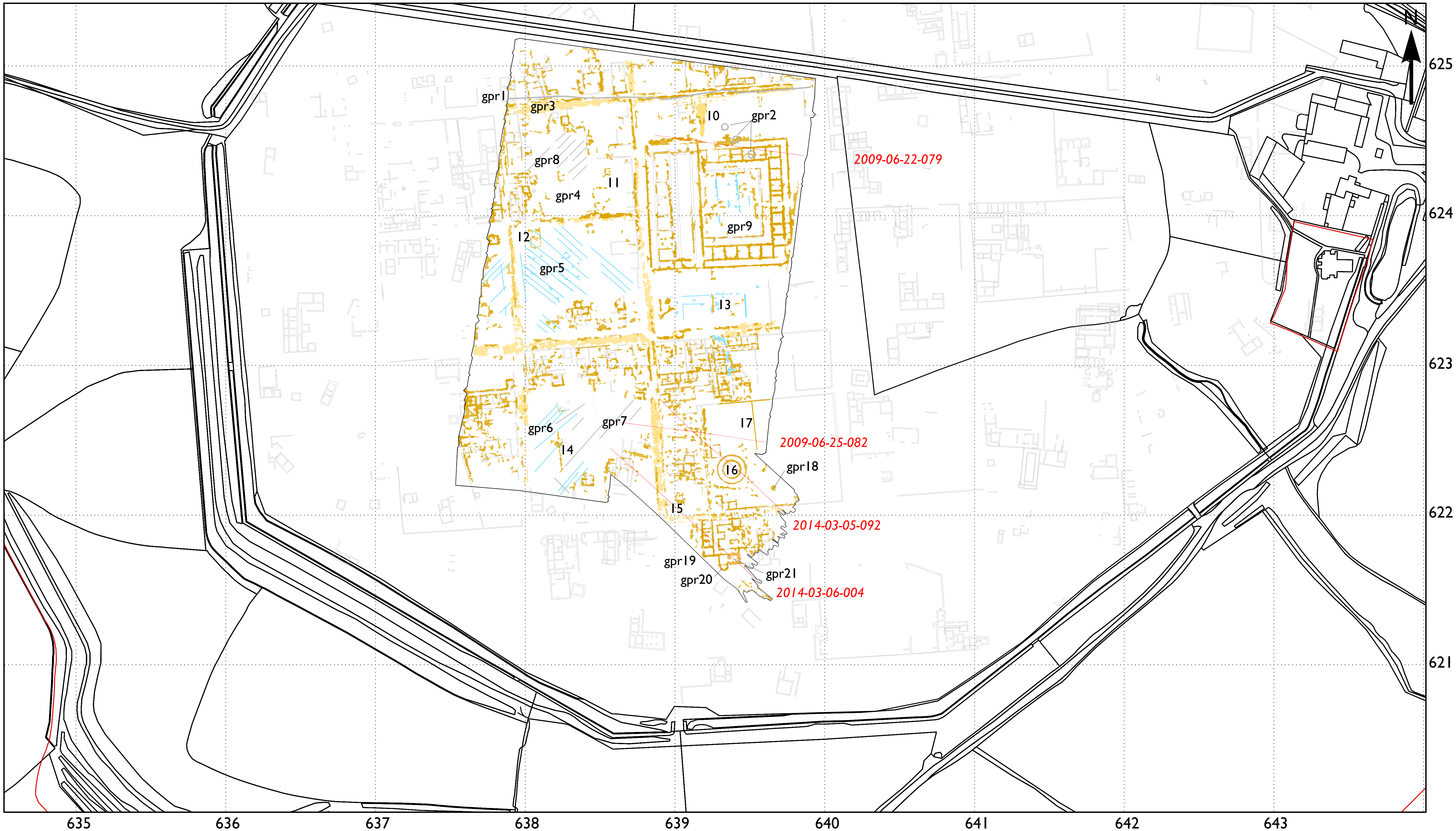
Historic England

Figure 22

SILCHESTER ROMAN TOWN, INSULA III, SILCHESTER, HAMPSHIRE
Summary of significant GPR anomalies, June 2009 and March 2014

SU6259



0 90m

1:2500

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

2009-06-22-079 Location of selected GPR profiles shown on Figure 13

known buildings and walls

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Historic England

Figure 23

SILCHESTER ROMAN TOWN, WEST GATE CEMETERY, SILCHESTER, HAMPSHIRE

Graphical summary of significant magnetic anomalies, June 2009

0 60m

1:1250

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

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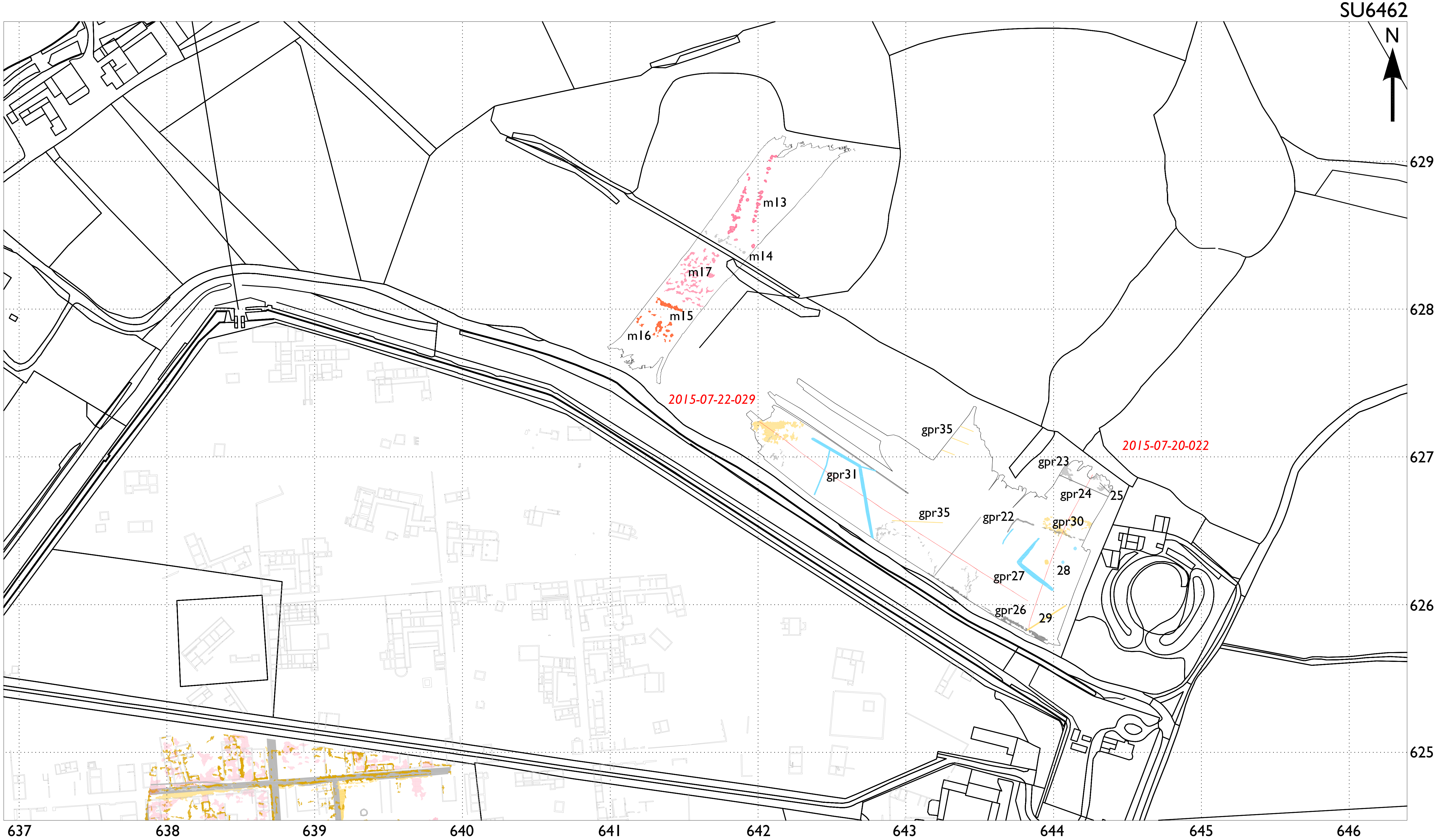
Historic England

Figure 24

SILCHESTER ROMAN TOWN, CHITTY FARM, MORTIMER WEST END, HAMPSHIRE

Summary of significant magnetic and GPR anomalies, July 2015

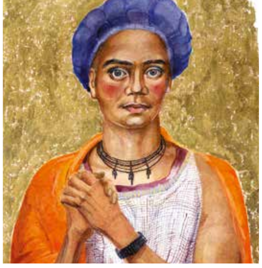


0 90m
1:2500

positive magnetic
raised magnetic
negative magnetic
magnetic noise
low amplitude reflectors
high amplitude reflectors
anomalies of known or recent origin
2015-07-20-022 Location of selected GPR profiles shown on Figure 13

Geophysics Team 2019

Historic England



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