Centre for Archaeology Report 9/2001

Silchester Roman Town, Hampshire: Report on Ground Penetrating Radar Survey, March 2000

N Linford

The Centre for Archaeology Reports Series incorporates the former Ancient Monuments Laboratory Report Series. Copies of Ancient Monuments Laboratory Reports will continue to be available from the Centre for Archaeology (see back of cover for details).

Centre for Archaeology Report 9/2001

Silchester Roman Town, Hampshire: Report on Ground Penetrating Radar Survey, March 2000

N Linford

Summary
A trial Ground Penetrating Radar (GPR) survey was conducted over a previously excavated Romano-Celtic temple and its surroundings in the central area of Silchester Roman Town (Calleva Atrebatum), Hampshire. Amplitude time slices created from the GPR data revealed a plethora of anomalies related to the original street pattern, several buildings, and the remains of the temple. In addition, the GPR data allows the apparent vertical stratigraphy of the anomalies to be estimated and indicates the varying, near-surface preservation of the temple. The GPR data further complements information on the site recovered through excavation, aerial photography, and a more extensive magnetometer survey.

Keywords
Geophysics

Author's address
English Heritage Centre for Archaeology, Fort Cumberland, Fort Cumberland Road, Eastney, Portsmouth, PO4 9LD. Tel: 02392 856761. Email: neil.linford@english-heritage.org.uk

SILCHESTER ROMAN TOWN, Hampshire.

Report on Ground Penetrating Radar Survey, March 2000.

Introduction

A trial Ground Penetrating Radar (GPR) survey was conducted in the immediate vicinity of the urban Romano-Celtic temple found in Insula IV of the Roman town at Silchester, Hampshire (Calleva Atrebatum; NMR: 24336). This substantial circular structure (diameter ~30m) was revealed during the investigations of the Society of Antiquaries between 1890-1909 but has not been re-excavated since this initial examination. More recent archaeological work at the site has been conducted through an ongoing programme of excavation by Reading University (Fulford 1995), aerial photographic mapping by the RCHME (1995) and a more extensive magnetometer coverage undertaken during the same campaign of fieldwork as the GPR survey (Martin 2000).

The aim of the survey reported upon here was to test the response of the site to GPR and to establish what additional information, if any, this data could add to that available from more traditional geophysical techniques.

The site (SU 640 624) lies on fine loamy soils of the Wickham 4 association (Soil Survey of England and Wales 1983) developed over Plateau Gravel (Institute of Geological Sciences 1946). At the time of the survey the field was under grass and used for pasture.

Method

A Pulse Ekko PE1000 console was used to collected trial profiles with both 450MHz and 900MHz antennas. From this data the 450MHz antenna was selected as the most suitable centre frequency for obtaining the depth of penetration and lateral resolution required for the survey. A common mid-point (CMP) velocity analysis was subsequently conducted with this antenna and confirmed that the velocity of the radar wavefront in immediate topsoil was ~0.08m/nS. This latter velocity was then used to estimate the depth to reflection events in the recorded profiles. Individual profiles were subject to post-acquisition processing involving the adjustment of time-zero to coincide with the true ground surface, removal of any low frequency transient response (dewow) and the application of a spreading and exponential compensation (SEC) gain function to enhance late arrivals.

A total of 120 parallel 60m EW profiles separated by 0.5m were collected over the site at a sample interval 0.05m (Figure 1). Amplitude time slices were subsequently created from the entire data set by averaging data within successive 4nS (two-travel time) windows (David and Linford 2000, Pulse Ekko 1996). This data is illustrated as a series of false colour images in Plan A and as histogram equalised greyscale images in Plan B.

Results

General response and modern interference

Conditions at the site were generally good for GPR survey and the short cropped grass provided a suitable surface for the transport of the antenna. Depth penetration was apparently good with significant reflections recorded to a maximum two-way travel time of ~40nS (~1.6m). From the CMP velocity estimate made at the site each successive amplitude time slice represents a vertical window of ~0.16m extending from the modern surface to a maximum depth of ~1.6m. However, the true depth to anomaly source targets may vary due to the inhomogeneous nature of the subsoil.

Significant anomalies

A graphical summary of significant anomalies discussed in the following text is included on Plan B together with an extract of the gradiometer data from the same area of the site.

The initial two amplitude time slices (0-4 and 4-8 nS) are dominated by near surface reflections due, no doubt, to the air/ground interface and the response from the surface topsoil layer. However, the 4-8 nS time slice contains a number of more significant anomalies that are replicated with greater clarity in the subsequent 8-12 nS window. The location of the temple [1] is evident as two concentric circular responses enclosed within a more diffuse, rectilinear anomaly [2] that may well represent the original Society of Antiquaries excavation trench. Note how the inner circular anomaly of the temple is incomplete within the earlier (near surface) time slices and does not form a closed, circular response until the deeper 24-28 nS (~0.96–1.12m) window.

A NS road way [3] bisects the survey area and would appear to be generated from a 4m wide metalled surface with a ditch or drain type anomaly [4] running parallel to its course. Further evidence for the Roman street plan is found at [5] where part of an EW roadway meets with [3]. An additional road type anomaly is found at [6] but it is unclear how this relates to the grid pattern of major roadways through the Roman town revealed by both AP evidence and the results of the magnetometer survey.

High amplitude rectilinear anomalies related to former building remains are found in the vicinity of the temple at [7] and [8]. Of these, [8] would appear to be closest to the surface producing a strong response in the 12-16 nS time slice (~0.48-0.64m) compared to the later reflections from [7] that do not occur until the 20-24 nS (~0.8-0.96m). Further, less intense building-type anomalies are found at [9] but these appear as shallower responses that do not extend beyond a two-way travel time greater than 20 nS (~0.8m).

Comparison with the magnetometer data

Plan B shows an extract of the magnetometer data (Martin 2000) for comparison with the GPR survey. In this case, the presumed stone wall footings that produced high amplitude reflections in the radar data are replicated as negative anomalies in the magnetometer survey due to the 'depletion' of local magnetic field strength over the non-magnetic flint foundations. It is of interest to note that the magnetometer has responded to the apparently near surface

remains, such as the incomplete inner radius of the temple structure but has failed to detect anomaly [8]. This is curious as the apparently deeper lying anomaly [7] detected by the GPR survey has been recorded in the magnetic data. In addition, the more ephemeral near surface anomalies found at [9] are reproduced with more clarity in the magnetometer data together with a series of discrete, possibly thermoremanent magnetic responses. It seems likely that the concentration of occupation activity, including the deliberate use of fire, may well have increased the local magnetic susceptibility in the vicinity of [9] resulting in a greater contrast between the magnetic properties of the soil and the stone wall footings.

Conclusion

The GPR survey has successfully identified a range of anomalies related to the street plan, former buildings and the Romano-Celtic temple at the site. Whilst this survey provides little additional information to that provided by the AP, excavation and magnetometer data the GPR technique is obviously well suited to conditions at the site. It is of interest to note how the GPR data complements the magnetic survey by revealing responses from more deeply buried features allowing a more detailed interpretation in terms of the apparent vertical stratigraphy. This may prove to be particularly useful in areas of the site where multiple-phase occupation is suspected or the near-surface survival of features is at issue.

Surveyed by: N Linford
P Linford

Date of survey: 13-17/3/2000

Reported by: N Linford

Date of report: 18/1/2001

Archaeometry Branch,
Ancient Monuments Laboratory,
English Heritage.

References

British Geological Survey, 1946, Reading, England and Wales, Sheet 268, Drift Geology, 1:50,000.

David, A. and Linford, N., 2000, Physics and Archaeology, *Physics World*, **13**, No. 5, pp27-31.

Fulford, M. 1995, *Calleva Atrebatum, A guide to the Roman Town at Silchester.*

Martin, L., 2000, Silchester Roman Town, Hampshire. Report on Geophysical Survey, March 2000, *Ancient Monuments Laboratory Report Series*, **65/2000**, English Heritage, *unpublished report.*

RCHME, 1995, Calleva Atrebatum, Silchester. Air Photographic Interpretation and Transcription of the Town and Environs. *Silchester Roman Town Project.* RCHME.

Sensors and Software, 1996, *pulseEKKO IV RUN User's Guide*, Technical Manual 20.

Soil Survey of England and Wales, 1983, Soils of England and Wales, Sheet 6, South East England.

List of enclosed figures.

Figure 1 Location plan of the GPR and magnetometer survey grid squares over base OS map (1:2500).

Plan A False colour images of the GPR amplitude time slices (1:1000).

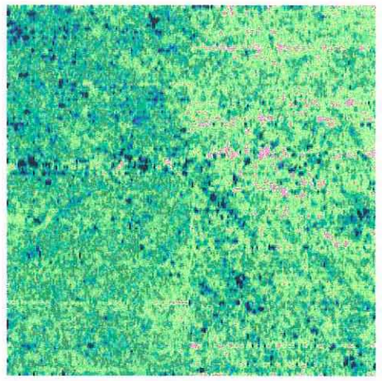
Plan B Histogram equalised greyscale images of the GPR amplitude time slices together with an extract of the magnetometer data and a graphical summary of significant GPR anomalies (1:1000).

SILCHESTER ROMAN TOWN, Hants.
Ground Penetrating Radar Survey, March 2000

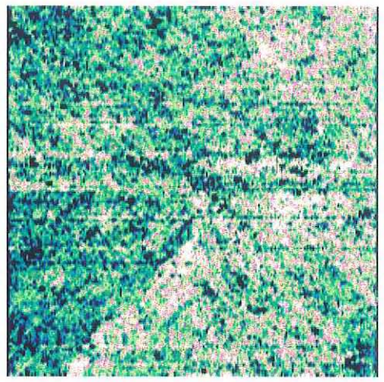
PLAN A

False colour images of amplitude time slices

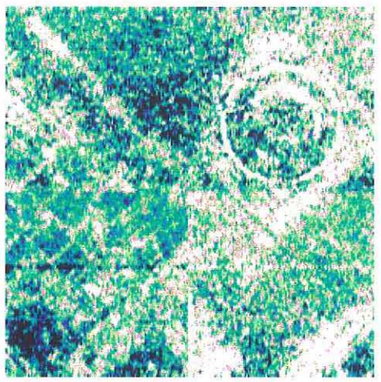
0-4 nS



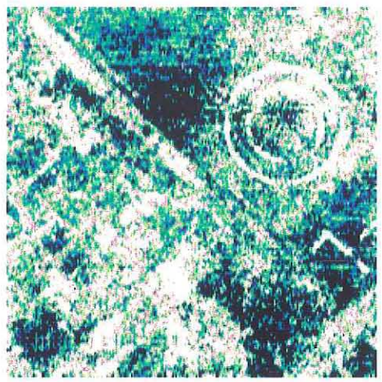
4-8nS



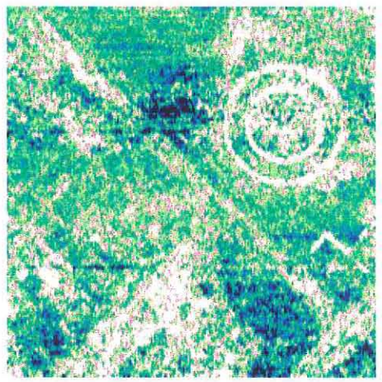
8-12 nS



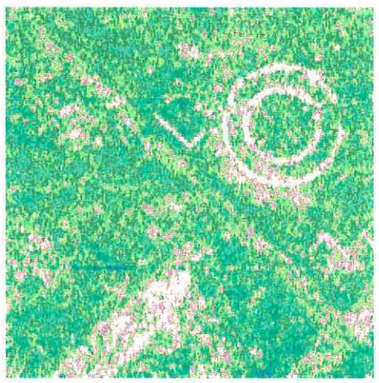
12-16 nS



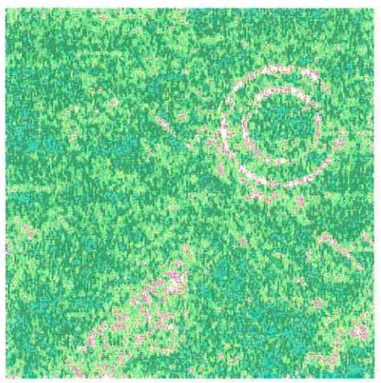
16-20 nS



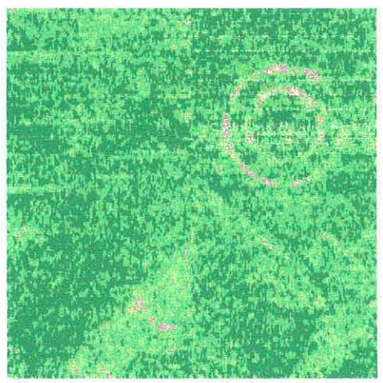
20-24 nS



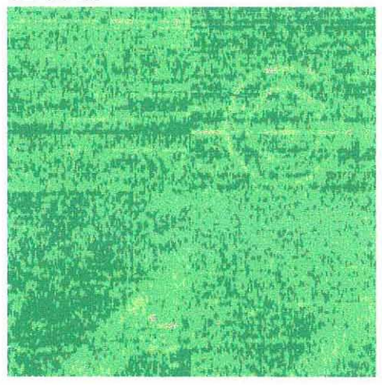
24-28 nS



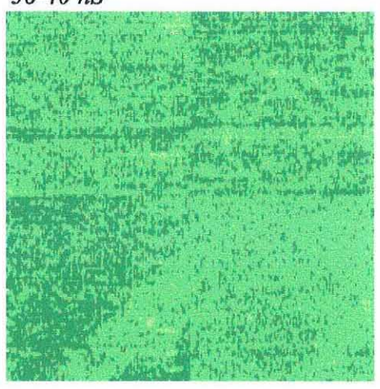
28-32 nS

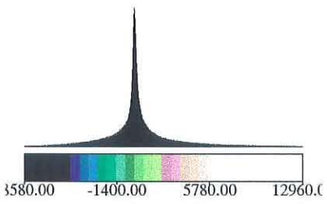


32-36 nS



36-40 nS





0 90m

1:1000

Archaeometry Branch, English Heritage 2000

SILCHESTER ROMAN TOWN, HAMPSHIRE
Geophysical survey, March 2000.

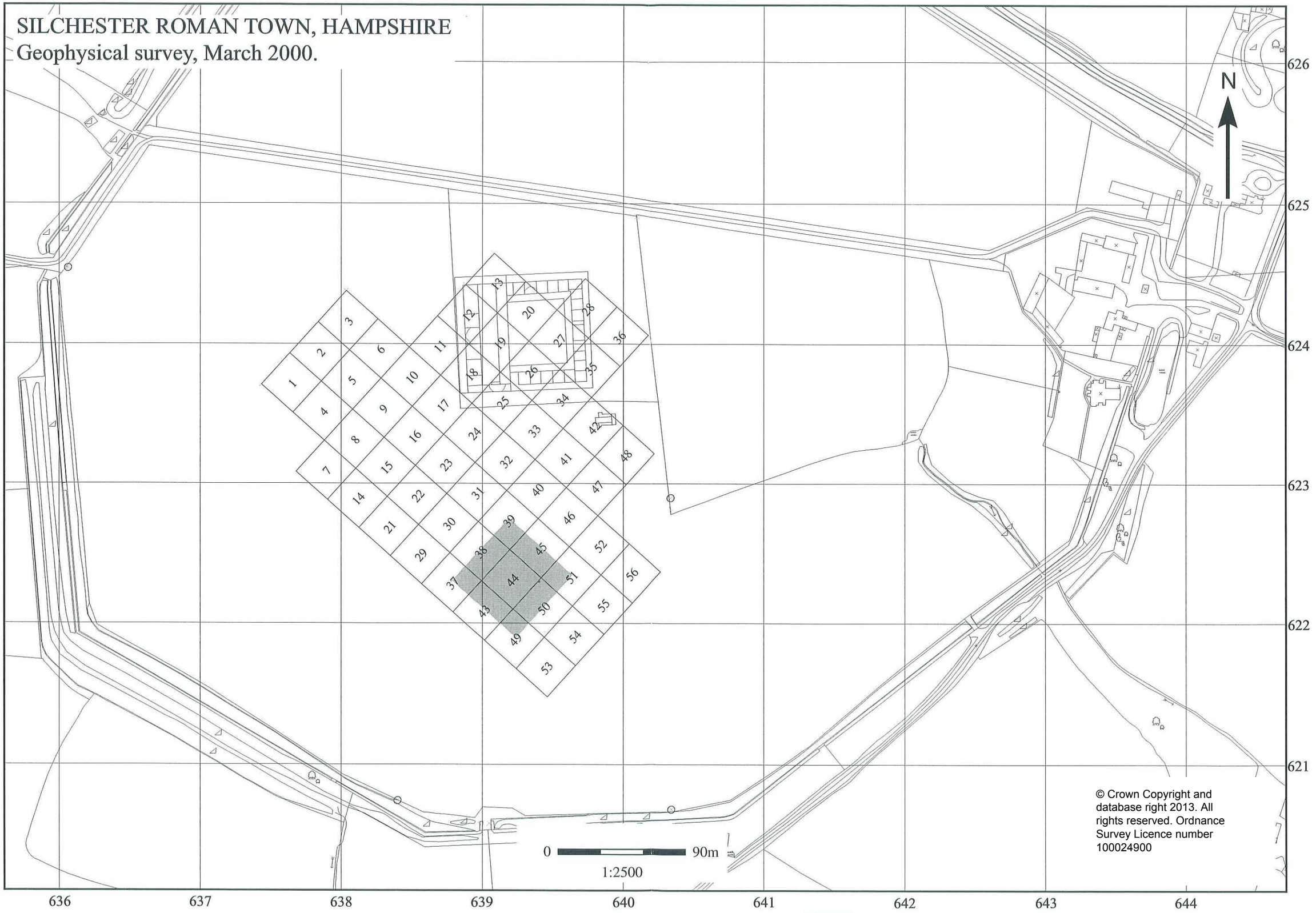


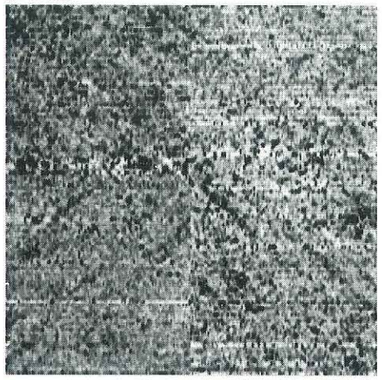
Figure 1; Silchester Roman Town, Hampshire, *Location of geophysical surveys, March 2000.*

SILCHESTER ROMAN TOWN, Hants.
Ground Penetrating Radar Survey, March 2000

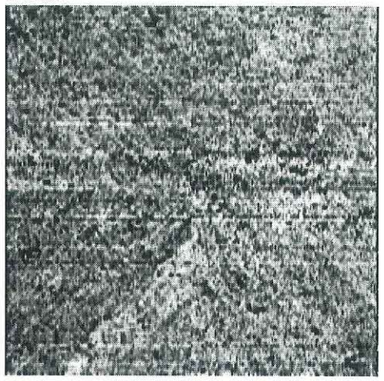
PLAN B

Histogram equalised greyscale images of amplitude Timeslices

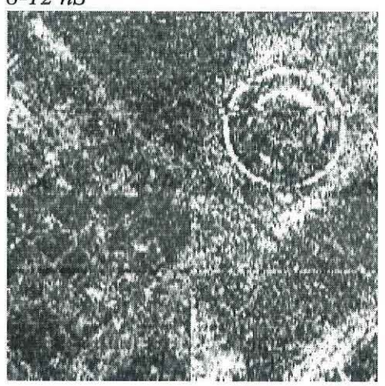
0-4 nS



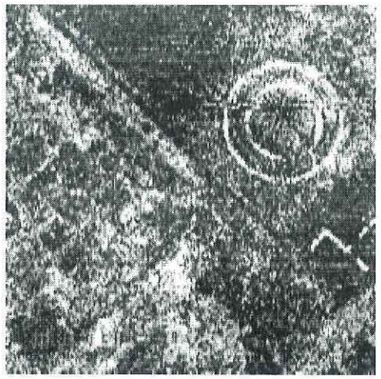
4-8nS



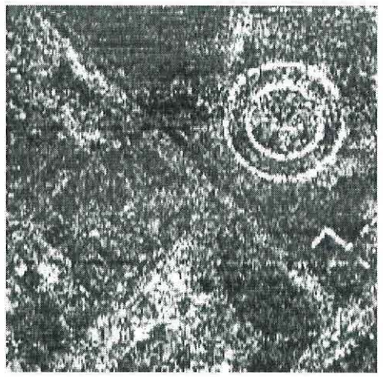
8-12 nS



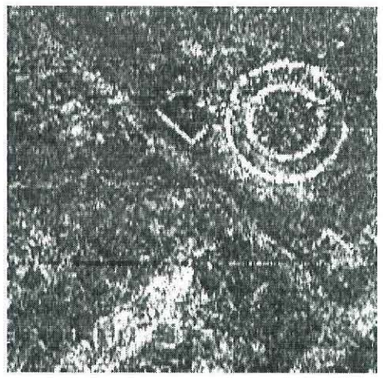
12-16 nS



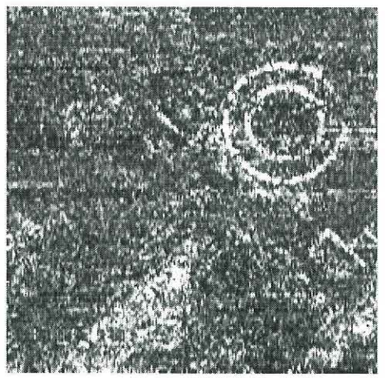
16-20 nS



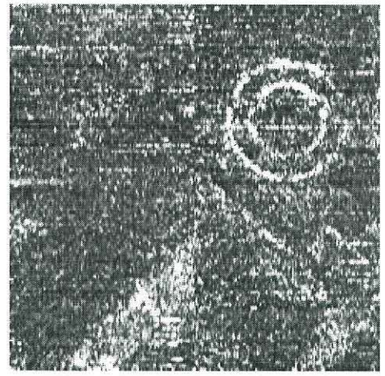
20-24 nS



24-28 nS

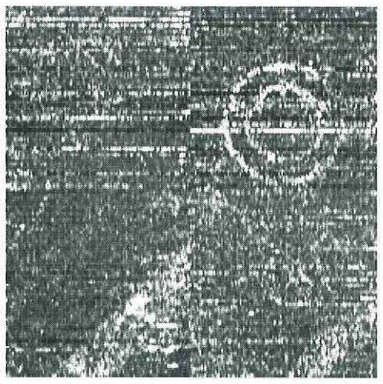


28-32 nS

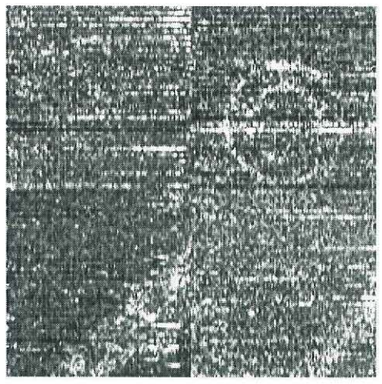


N

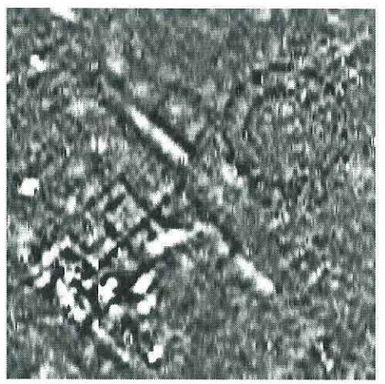
32-36 nS



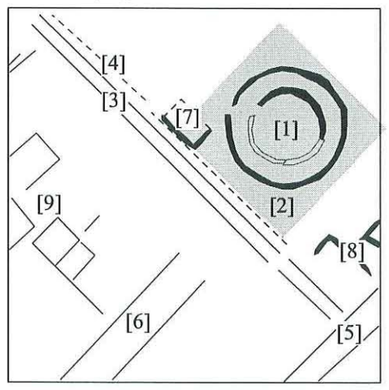
36-40 nS



Magnetometer data



Summary of GPR Anomalies



0 90m

1:1000

Archaeometry Branch, English Heritage 2000