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FISHBOURNE ROMAN PALACE, WEST SUSSEX REPORT ON GEOPHYSICAL SURVEY, JULY 2011

Neil Linford

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Research Report Series 2-2012

FISHBOURNE ROMAN PALACE, WEST SUSSEX

REPORT ON GEOPHYSICAL SURVEY, JULY 2011

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SUMMARY

A Ground Penetrating Radar (GPR) survey was conducted over an area of approximately 0.16 ha covering the West Wing of the Fishbourne Roman Palace, West Sussex. The field work was undertaken to complement a volunteer led earth resistance survey, conducted simultaneously over the same area during the 2011 Festival of British Archaeology. The aim for both surveys was to investigate the buried remains of the former West Wing and, potentially, reveal evidence for buildings predating the Flavian Palace. Despite the deliberate reburial of the West Wing following partial excavation in the 1960s the site proved suitable for GPR survey and successfully imaged building remains to beyond 1.3m from the ground surface. The orientation and depth of the causative features suggests multiple phases of the site have been distinguished by the GPR survey.

CONTRIBUTORS

The field work was conducted by Neil Linford, Paul Linford and Andy Payne from the English Heritage Geophysics Team with the assistance of volunteers working in collaboration with Fishbourne Roman Palace and Chichester District Council.

ACKNOWLEDGEMENTS

The author wishes to express his thanks to Mary and Neville Haskins who led the volunteer earth resistance surveys at the site and to David Rudkin, former director of the Fishbourne Roman Palace Museum, together with many other colleagues at the site provided useful interpretative information as the survey results unfolded.

ARCHIVE LOCATION

Fort Cumberland and through the West Sussex museum collections accession number 2011.3.

DATE OF FIELDWORK AND REPORT

The fieldwork was conducted on the 27th of July 2011. The report was completed on 5th January 2012. The cover photograph shows the survey in progress with the multi-element air-launched antenna array towed behind a light weight All Terrain Vehicle whilst a member of the volunteer team assists with GPR data acquisition.

CONTACT DETAILS

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CONTENTS

INTRODUCTION

The Roman Palace at Fishbourne, near Chichester, West Sussex was first discovered during the laying of a new water main in 1960. A subsequent programme of excavation, led by Barry Cunliffe, revealed a large palatial site built in the 1st century AD soon after the Roman conquest of Britain constructed over a series of precursor buildings associated with a supply base for the invading Roman army. The final phase of the palace consisted of four substantial wings with colonnaded fronts surrounding a central formal garden and contained a wealth of mosaic floors, before the site was abandoned following a catastrophic fire in around 270AD. Today, the remains of the North Wing of the Palace are on display to the public under a modern cover building and include the perfectly preserved dolphin mosaic.

Archaeological research continues at the site including a programme of volunteer led geophysical survey that has included an earth resistance survey of the partially excavated West Wing in 2009 (Haskins 2009). Despite the protective reburial of the remains in this area the initial earth resistance survey produced encouraging results prompting both a second investigation using this technique, with an improved sampling regime, and complementary coverage with Ground Penetrating Radar (GPR). It was hoped that this combination of geophysical techniques might produce a detailed image of the West Wing and any precursor buildings whilst also providing a demonstration of non-destructive geophysical techniques at the site as a contribution to the 2011 Festival of British Archaeology events.

The site covered by the GPR survey is centred on SU 839 048 and covers an area of approximately 0.16ha immediately south of the museum building extending into a portion of the site that originally formed part of an adjacent garden, purchased by Sussex Past in 1986. Following the original excavations at the site the remains in this area were deliberately reburied for their protection and this has, no doubt, introduced a mixed overburden of soil. The underlying geology consists of undifferentiated sand, silt and clay river terrace deposits. Weather conditions were dry and sunny throughout the field work.

METHOD

A survey grid (Figure 1) was first established over the site using a Trimble kinematic differential global positioning system (GPS). A roving GPS receiver was also mounted on the GPR antenna array to provide continuous positional control for the survey, although this was compromised by deciduous tree cover in some areas.

Ground Penetrating Radar (GPR) survey

A 3d-Radar GeoScope Continuous Wave Stepped-Frequency (CWSF) radar system was used to conduct the survey collecting data with a multi-element V1821 vehicle towed, air

launched antenna array (Linford *et al.* 2010). Data were acquired at a 0.075m x 0.075m sample interval across a continuous wave stepped frequency range from 50 to 1250MHz in 2MHz 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.

Post acquisition processing using in-house software 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. A representative profile from the GPR survey is shown on Figure 3. To aid visualisation amplitude time slices were created from the entire data set, after applying a 3D-migration algorithm, by averaging data within successive 1.2ns (two-way travel time) windows (e.g. Linford 2004; Linford 2006). An average sub-surface velocity of 0.067m/ns was assumed following constant velocity tests on the data, and was used for both the migration velocity field and the time to estimated depth conversion. Each of the resulting time slices, shown as individual greyscale images in Figures 2, 4 and 5, therefore represents the variation of reflection strength through successive ~0.04m intervals from the ground surface. Further details of both the frequency and time domain algorithms developed for processing this data, including the variable hyperbola velocity model used for the migration can be found in Sala and Linford (2010).

RESULTS

Graphical summaries of significant anomalies discussed in the following text, superimposed on the base Ordnance Survey map data, are provided in Figure 6.

General response and modern interference

Despite some concern over the introduction of overburden to level the site following excavations in the 1960s, significant reflections have been recorded to approximately 40ns (1.34m). The first reflections due to the buried building remains become apparent from approximately 4.8ns (0.16m) onwards and above this some coherent anomalies, such as [gpr1], may well represent the topographic expression of surviving subsurface features picked up by the air-launched antenna. However, [gpr1] does follow the former line marking the extent of the back garden to 80 Fishbourne Road and might equally represent a response to this boundary or to a more significant archaeological feature.

Significant anomalies

The first structural elements of the West Wing to become apparent in the data are two rectilinear reflectors [gpr2 and 3] that would appear to represent areas of in-situ flooring or, perhaps, destruction layers collapsed into the building. Some variation in the response of [gpr2] throughout the time slices between 4.8 and 15.6ns (0.16 and 0.52m) suggests a buckled floor layer approximately 0.2m thick that has slumped towards the centre of the room (Figure 3). Wall-type reflections become evident from just below the floor layers and are well represented between 9.6 and 32.4ns (0.32 and 1.08m), suggesting better survival of the deeper buried footings. Figure 6 shows a schematic plan of the identified wall-type anomalies with individual rooms within the West Wing annotated according to the numbering scheme suggested by Cunliffe (1971).

Starting from the southern extent of the building range imaged by the GPR survey the main audience chamber W14 is evident from the response to the apsidal recess [gpr4] and a flanking corridor W17 immediately to the S. A wall-type anomaly [gpr5] to the E of W14 is found between 13.2 and 21.6ns (0.44 and 0.72m) with an apparent 1.5m wide opening along the centre line of the apse. The anomaly at [gpr5] cannot represent the rear wall of the audience chamber, located by excavation, as it does not appear far enough to the E and is set at a slightly skewed angle, it therefore seems more likely to represent some part of the pre-Palace building located during the subsequent excavation in the garden of 80 Fishbourne Road (Rudkin 1996).

Some evidence for the small room W15 adjoining the apse to the N is found together with the companion flanking corridor W13, although the GPR data in this area is rather confused. However, rooms W11 and W12 are identifiable, including the dividing wall between the two and the discrimination of discrete responses [gpr6] from the individual pilae stacks of the hypocaust imaged between 16.8 and 21.6ns (0.56 to 0.72m). Whilst the hypocaust in room W11 was recorded during the excavation (cf Cunliffe 1998, colour plate 13), it is remarkable that the GPR survey has managed to image such subtle structural details (approximately 0.4m x 0.4m) and attests to the use of this methodology.

Moving further N rooms W10, the adjoining corridor W9 and W6 are all identified in GPR survey data, although many of the dividing walls appear to survive only as deeper-lying footings in the later reflections from 20.4ns (0.64m) onwards. The floor-type response [gpr2] noted in the near-surface data above is entirely enclosed within room W10 and produces the strongest reflections from between 8.4 and 13.2ns (0.28 to 0.44m). This apparent floor layer within the West Wing sits directly above the top of the pilae (at an estimated depth of 0.56m) in the neighbouring room W11 and correlates with similar, lower amplitude planar reflections within the audience chamber and rooms W6 and W3 to the N.

Rooms W1 and W3 are more difficult to discern, with only a corner of W3 revealed at [gpr7] in the GPR data. Indeed the outer wall of the West Wing appears to fade as it heads N with some evidence of a more ditch-like (low amplitude) response between 10.8 and 15.6ns (0.36m to 0.52m), suggesting the near surface wall material may have been

partially robbed out in this area. A diffuse wall-type anomaly [gpr8] between 9.6 and 13.2ns (0.32m to 0.44m) may indicate a further sub-division within room W3 immediately N of W6. However, anomaly [gpr8] does not extend to the same depth as the other wall footings and may, therefore, represent the response to a less distinct feature such as floor layer. Rooms W1 and W2, forming the northern extent of the West Wing, are not represented within the GPR data beyond the strong reflector [gpr9] that appears to represent part of the internal dividing wall between these two rooms.

The range of rooms facing the courtyard garden to the E of the West Wing do not appear so clearly, perhaps due to an increased depth of overburden to make up the ground in this area. The eastern wall of the wing is found at [gpr10] as an intermittent linear anomaly with some suggestion of further projections E towards the enclosed garden [gpr11], although these may also coincide with elements of the pre-Palace structure. Attempting to follow the internal division of the range identified from the excavation N from the audience chamber (W14) is more difficult with room W8 distinguished only by the rectilinear floor-type reflector [gpr3]. This may, possibly, represent the undamaged portion of the Flavian mosaic discovered in room W8 along the adjoining wall with W11 and W12 to the W (Cunliffe 1998, , Fig. 25). The wall separating room W7 from W8 is not evident in the GPR data, although a linear anomaly dividing W7 is found at [gpr12], but this may well be a response to the position of a baulk from the excavation. The EW division between rooms W5 and W7 has not been identified, although a high amplitude reflector [gpr13] in the NW corner of W5 may well correspond to the portion of mosaic found by the excavation in this area. Again, room W4 is only partially represented and it is difficult to separate the response from the internal wall at [gpr14] from the excavation trench in this area.

Other more fragmentary anomalies, such as part of the outer wall of the pre-Flavian building at [gpr15] and a possible further extension of the range of rooms forming the West Wing to the S at [gpr16], may also be represented. The data to the S of the survey area, within the former rear garden of 80 Fishbourne Road, contains a number of more conjectural anomalies possibly related to the recent use of the site. These anomalies are mostly found within the very near-surface data and include [gpr1], following the original line of the garden wall at the end of the property. The rectilinear anomaly at [gpr17] could represent either the remains of a more recent structure, for example a garden shed or greenhouse base, or be related to rubble removed during the excavation (J. Kenny *pers. comm.*).

The linear anomaly [gpr18] is found much closer to the surface from 3.6ns (0.12m) and continues with a slight fall from N to S extending to a maximum depth of 15.6ns (0.52m) lying between the two sets of trenches excavated within the rear garden of 80 Fishbourne Road (Rudkin 1996). Whilst [gpr18] may possibly represent the response to a wall-type feature the modest depth extent and evident fall along its length is more suggestive of a recent soak-away drain or other service. However, the direction of fall towards the house

and absence of any continuation of this anomaly as a modern feature identified in the excavation questions this interpretation.

It is also evident that elements of the pre-Palace buildings have been detected by the GPR survey to the S of the survey area [gpr5, 19-21]. Whilst most of these anomalies begin slightly later in data set than the reflections from the Flavian Palace, they are heavily inter-cut with the remains of the West Wing and have been identified mainly through their slightly different orientation compared to the later building range. The main EW range of pre-Palace rooms is found at [gpr19] inter-cut with the wall-footings of the Flavian audience chamber W14 [gpr5]. Some extension of the earlier building to the W seems evident at [gpr20]; perhaps enhancing the plan gleaned from current excavation results, and also to the S at [gpr21], although the anomalies here are more fragmented. Evidence for the E wall of the pre-Palace building located through excavation is more difficult to discern from the GPR data, however, it is possible that [gpr10] may actually represent this earlier phase.

CONCLUSION

The GPR survey has successfully recorded a considerable level of detail over the remains of the West Wing of the Fishbourne Roman Palace and complements the earth resistance data collected over the same area (Haskins and Haskins 2011). Obtaining GPR data at a high sample density (0.075m x 0.075m) has allowed quite subtle structural remains, such as the individual pilae of the hypocaust in room W11, to be imaged. The almost complete geophysical survey coverage of the available area, including the extension into the rear garden of 80 Fishbourne Road, provides some additional context to the previous excavation trenches over the site confirming the structure of the Palace where no invasive investigations were made. In addition, the GPR data has confirmed the preservation state of the surviving remains and allowed some of the deeper lying pre-Palace structures to be imaged. It is, perhaps, unsurprising that the limited evidence for new structural details revealed by the GPR survey has come from the areas of the site between the previous excavation trenches. This includes some possible additional detail related to the pre-Palace structure found to the W of the survey area and a more complex group of anomalies to the S in the unexcavated portion of the former rear garden to 80 Fishbourne Road.

Conducting the GPR coverage simultaneously with the volunteer led earth resistance survey successfully introduced this technique to a wide range of participants as part of the British Festival of Archaeology. The production of amplitude time slices in real time, from the GPR and GPS data, further enhanced the presentation of results to the volunteers who assisted with the field acquisition. This also allowed the GPR coverage to be confirmed in the field and any uneven sampling to be rectified directly through collection additional instrument swaths.

LIST OF ENCLOSED FIGURES

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FISHBOURNE ROMAN PALACE, WEST SUSSEX

Figure 1

Location of GPR survey, July 2011.

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FISHBOURNE ROMAN PALACE, WEST SUSSEX

Figure 2

GPR amplitude time slice from between 16.8 and 18.0ns (0.56 - 0.6m).

Low *High*
relative reflector strength

2011-07-27-035

Location of selected GPR profile shown on Figure 3

0 30m

1:500

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FISHBOURNE ROMAN PALACE, WEST SUSSEX.
Selected GPR profile

Figure 3

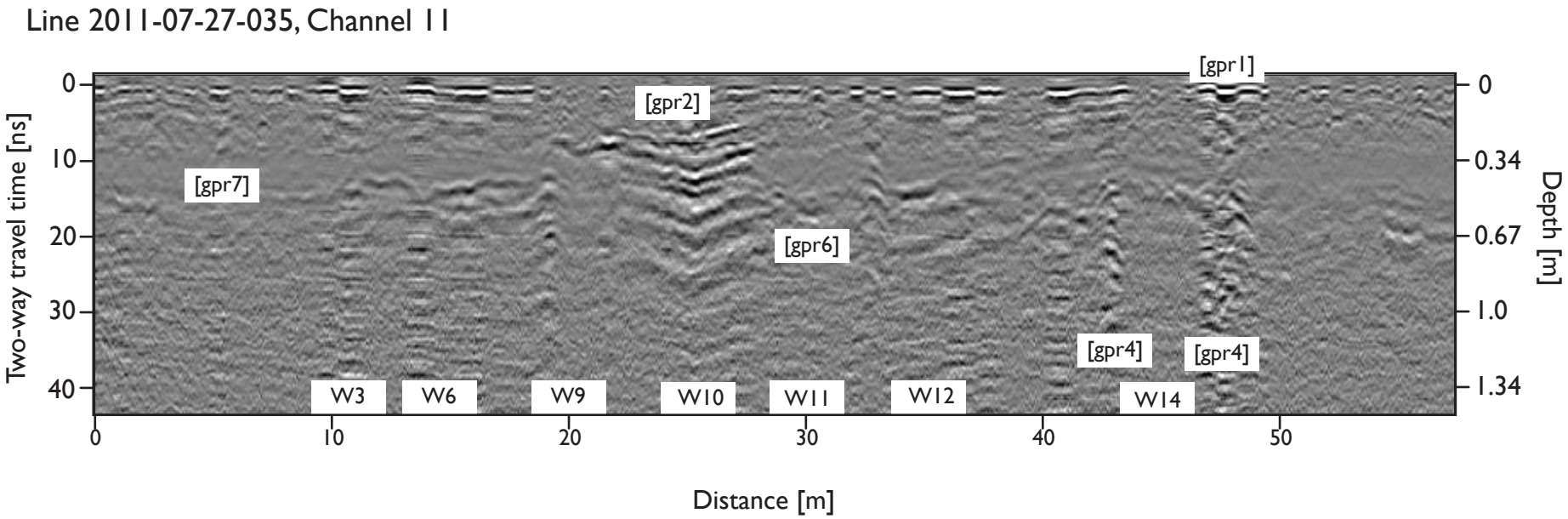

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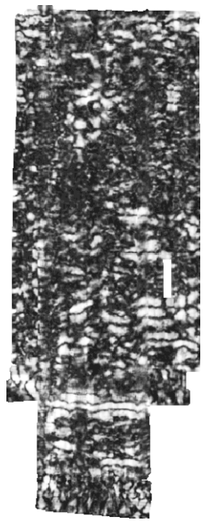
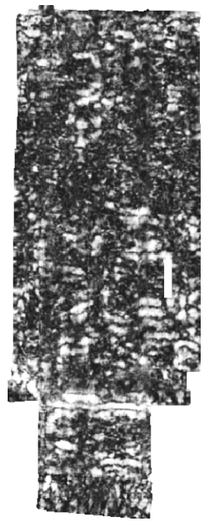
Figure 4

FISHBOURNE ROMAN PALACE, WEST SUSSEX
GPR amplitude time slices from 0.0 to 16.8ns, July 2011.

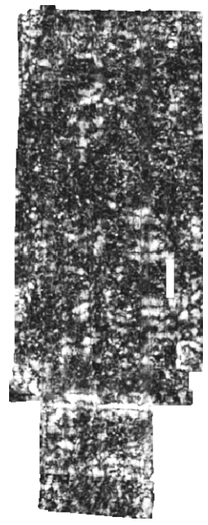
0 - 1.2ns (0.0 - 0.04m)



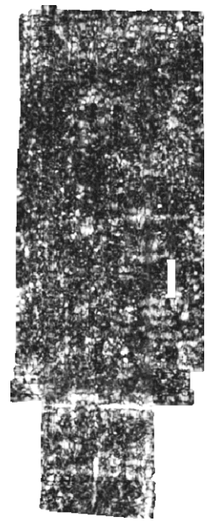
1.2 - 2.4ns (0.04 - 0.08m)



2.4 - 3.6ns (0.08 - 0.12m)



3.6 - 4.8ns (0.12 - 0.16m)



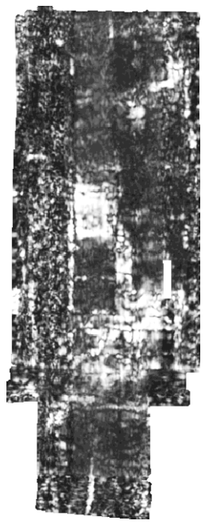
4.8 - 6.0ns (0.16 - 0.20m)

6.0 - 7.2ns (0.20 - 0.24m)

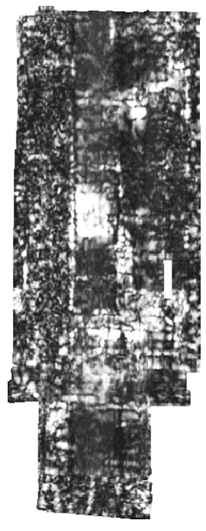
7.2 - 8.4ns (0.24 - 0.28m)

N

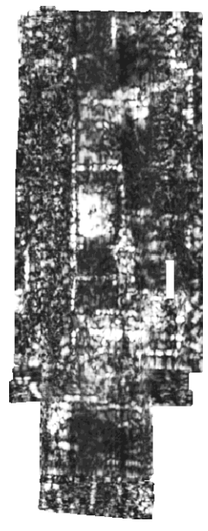
8.4 - 9.6ns (0.28 - 0.32m)



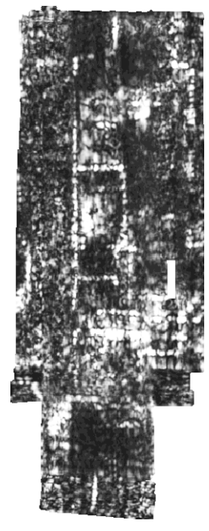
9.6 - 10.8ns (0.32 - 0.36m)



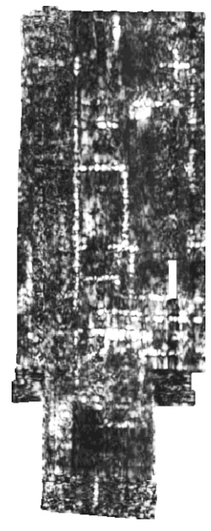
10.8 - 12.0ns (0.36 - 0.40m)



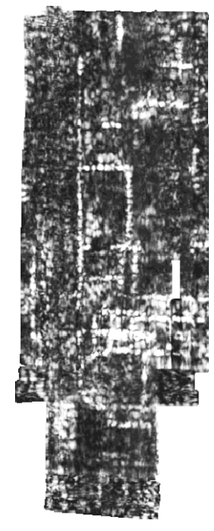
12.0 - 13.2ns (0.40 - 0.44m)



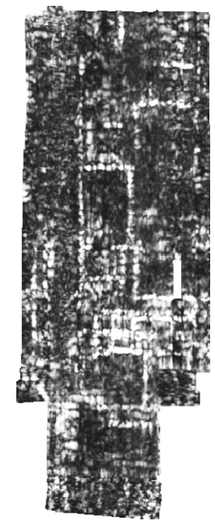
13.2 - 14.4ns (0.44 - 0.48m)



14.4 - 15.6ns (0.48 - 0.52m)



15.6 - 16.8ns (0.52 - 0.56m)



Low *High*
relative reflector strength

0 30m

1:750

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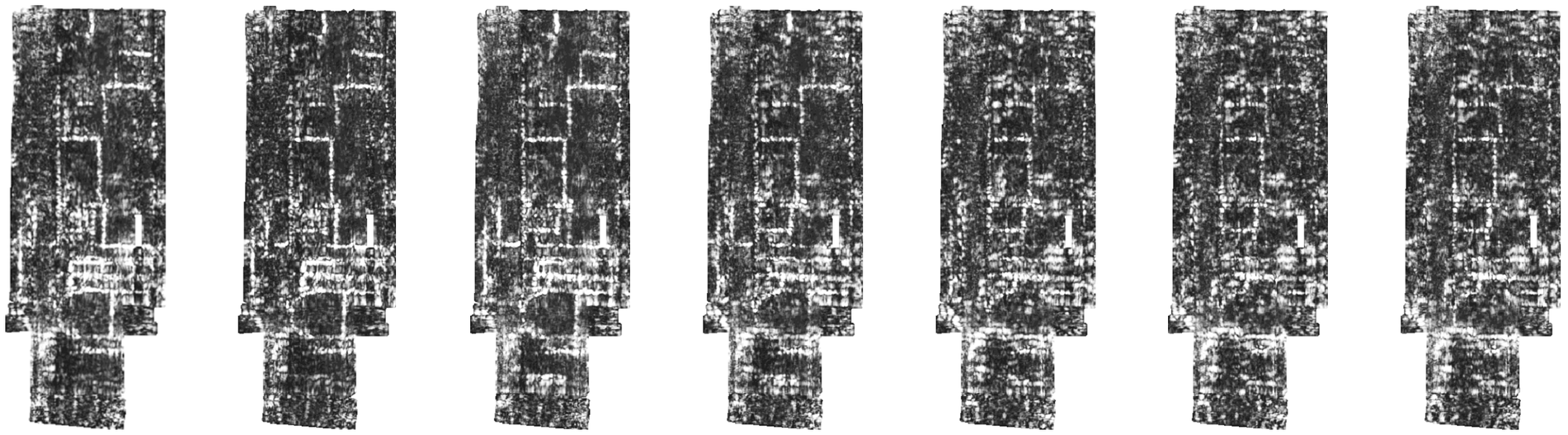
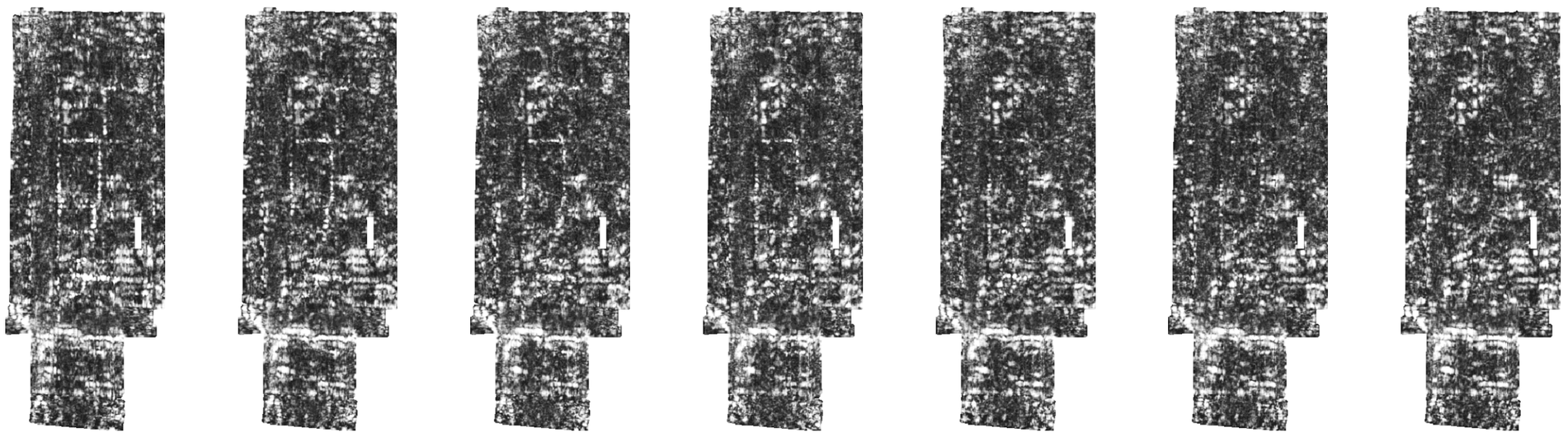
Figure 5

FISHBOURNE ROMAN PALACE, WEST SUSSEX
GPR amplitude time slices from 16.8 to 33.6ns, July 2011.

16.8 - 18.0ns (0.56 - 0.60m) *18.0 - 19.2ns (0.60 - 0.64m)* *19.2 - 20.4ns (0.64 - 0.68m)* *20.4 - 21.6ns (0.68 - 0.72m)* *21.6 - 22.8ns (0.72 - 0.76m)* *22.8 - 24.0ns (0.76 - 0.80m)* *24.0- 25.2ns (0.80 - 0.84m)*



25.2 - 26.4ns (0.84 - 0.88m) *26.4 - 27.6ns (0.88 - 0.92m)* *27.6 - 28.8ns (0.92 - 0.96m)* *28.8 - 30.0ns (0.96 - 1.0m)* *30.0 - 31.2ns (1.0 - 1.04m)* *31.2 - 32.4ns (1.04 - 1.08m)* *32.4 - 33.6ns (1.08 - 1.12m)*



N

Low *High*
relative reflector strength

0 30m
1:750

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Figure 6

FISHBOURNE ROMAN PALACE, WEST SUSSEX

Graphical summary of significant GPR anomalies, July 2011.

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