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St Mary and All Saints Church, Droxford, Winchester

Ground Penetrating Radar, Earth Resistance and Detailed Gradiometer Survey Report

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geoservices

St Mary and All Saints Church
Droxford, Winchester

Ground Penetrating Radar, Earth Resistance and Detailed Gradiometer Preliminary Survey Report

Prepared for:
Friends of Droxford Church
C/o Oakleaf
Ludwells Lane
Waltham Chase
Southampton
SO32 2NP

Prepared by:
Wessex Archaeology
Portway House
Old Sarum Park
SALISBURY
Wiltshire
SP4 6EB

www.wessexarch.co.uk

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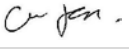
v01	I	*ECR*	*CJRH*		06/10/2015
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DISCLAIMER

St Mary and All Saints Church
Droxford, Winchester

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Contents

Figures

Tables

St Mary and All Saints Church
Droxford, Winchester

Ground Penetrating Radar, Earth Resistance and Detailed Gradiometer Preliminary Survey Report

Summary

Ground penetrating radar survey was conducted in St Mary and All Saints Church with earth resistance and ground penetrating radar survey over land to the north of the church and a detailed gradiometer survey to the south of the church at Palace Field, Droxford, Winchester (centred on NGR 460780, 118220). The project was commissioned by the Friends of Droxford Church with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features, with the specific goals of locating any crypts beneath the church, previous phases and to identify any structural remains within Palace Field.

The site comprises an arable field located to the south of Saint Mary and All Saints Church, known as Palace Field, covering an area of 0.6ha, alongside three areas within the churchyard; to the north, south and west of the church and within the church. The geophysical survey was undertaken during 10th-12th August 2015 and additional earth resistance data were collected 9th September 2015.

The detailed gradiometer survey in Palace Field has demonstrated the presence of a number of anomalies of potential archaeological interest, whilst the GPR survey in and around the church as detected a number of high amplitude responses of possible archaeological origin.

The anomalies identified as being of archaeological interest are primarily potential pit and posthole features in Palace Field alongside a linear trend that almost bisects the site in the northern part of the gradiometer survey area. Several high amplitude responses detected by the GPR survey suggest burials and walls associated with previous phases of the church.

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The fieldwork was undertaken by Lizzie Richley, Diana Chard, Alistair Black and Alistair Salisbury. Lizzie Richley processed and interpreted the geophysical data and wrote the report. The geophysical work was quality controlled by Genevieve Shaw and Lucy Learmonth. Chloe Hunnisett undertook quality assurance. Illustrations were prepared by Kitty Foster. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.

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1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by the Friends of Droxford Church to carry out geophysical survey at two locations within the village of Droxford, Winchester. Ground-penetrating radar (GPR) and earth resistance survey were undertaken at St Mary and All Saints Church whilst detailed gradiometer survey was undertaken over nearby land at Palace Field. The overall location of both the survey areas the church and Palace field is hereafter referred to as "the Site, centred on NGR 460780, 118220 (**Figure 1**).

1.1.2 The surveys form part of an ongoing programme of archaeological works being undertaken in support of a grant application for the repair, improvement and development of the church facilities, in addition to providing more information on the history of the church and surrounding area.

1.1.3 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey areas. In particular the GPR survey sought to ascertain the location, and depth of any crypts or vaults beneath the present church, alongside establishing the presence/absence of earlier structures at the Site with the remaining surveys.

1.1.4 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 Site location and topography

1.2.1 The Site is located in the village of Droxford approximately 5.3 km east of Bishop's Waltham and 8 km north-east of Wickham in the Winchester District. Droxford village is in the Meon Valley within the South Downs National Park.

1.2.2 St Mary and All Saints Church is located on the eastern edge of Droxford village. The Site is bounded by hedgerows to the north, east and west and by metal fencing to the south. The church is surrounded on the south, east and west by arable fields and to the north by housing. Palace Field is an irregular shaped arable field located *c.* 95 m to the south of the church. Palace Field is bounded on all sides by hedgerow field boundaries, with additional arable land beyond.

1.2.3 The overall Site is on a lower-lying flat area of land approximately 55 m above Ordnance Datum (aOD).

1.3 Soils and geology

1.3.1 The solid geology at the Site is chalk of the Seaford Chalk Formation; sedimentary bedrock formed approximately 84-89 million years ago (BGS Online Viewer 2015).

1.3.2 At the Site of St Mary and All Saints Church, superficial Head deposits of clay, silt, sand and gravel are also mapped overlying the chalk. These deposits formed up to 3 million years ago in the Quaternary Period in a local environment previously dominated by subaerial slopes.

1.3.3 Within Palace Field, the geological makeup is slightly different, with the north-west part of this area having no recorded superficial deposits over the bedrock chalk, whilst the south-east of the survey area, nearest the River Meon, is mapped as alluvium deposits of clay, silt, sand and gravel. As such, some waterlogging of the soils is to be expected in this area.

1.3.4 The soils underlying the Site are likely to consist of stone-less mainly calcareous clayey soils of the 814a (Thames) association (SSEW SE Sheet 6 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetic survey.

1.4 Archaeological background

1.4.1 The following information is summarised from the Heritage Gateway website (Heritage Gateway, 2015). A search was performed for all heritage assets with 1 km of the Site in order to ascertain the archaeological potential of the Site.

Previous investigations

1.4.2 Very little previous archaeological investigation is recorded in the vicinity of the Site. A desk-based assessment (DBA) was undertaken by Wessex Archaeology for land off Warnford Road, *c.* 2.25 km north of the Site.

Designated heritage assets

1.4.3 A Scheduled Monument is located *c.* 190 m south-west of Palace Field. The monument comprises a Neolithic long barrow (Historic England list entry 1012694). The long barrow would originally have comprised an earthen mound with an internal burial chamber/s, likely used for communal burial. It was likely constructed during the Early or Middle Neolithic periods (3400-2400 BC). The monument survives as a *c.* 3m high earthen mound in a private garden of Long Barrow House, on the opposite side of South Hill Road, and is recorded on ordnance survey (OS) mapping.

1.4.4 The Church of St Mary and All Saints is a Grade I Listed building (Historic England list entry 1095540) dating from the 13th century.

1.4.5 The Old Rectory, which lies *c.* 50 m south-west of the church is Grade II* Listed (Historic England list entry 1350629).

1.4.6 A large number of the buildings in the village of Droxford are Grade II Listed, however these are not directly relevant to this investigation.

Archaeological and historical context

1.4.7 Neolithic, medieval and post-medieval monuments and find spots are recorded by the Winchester Historic Environment Record (WHER) within a mile radius of the Site.

1.4.8 A Neolithic community in the vicinity of Droxford in indicated by the presence of the long barrow. Little substantial evidence of the settlement and community responsible for this monument has been identified to date, however a Mesolithic flint implement was recovered *c* 800 m north-west of the Site (MWC1706) and a Neolithic flint implement was recovered *c.*800 m north-east of Site (MWC4209).

1.4.9 The land on either side of the river valley flanking Droxford has yielded evidence for prehistoric activity. Prehistoric field systems are recorded to the west of Droxford. A Celtic field system, possibly dating from between the Middle Bronze Age and Romano-British periods, has been recorded south and south-east of Clayhill Farm, Droxford; *c.*1 km south-west of the Site (WHER no. MWC7906). A later prehistoric field system is recorded south of Hackett's Lane, *c.*800 m west of Site (WHER no. MWC8008).

1.4.10 A probable Bronze Age bowl barrow is recorded south of Fiddle Hanger (MWC1461) just over 1 km north-west of the Site.

1.4.11 A Roman coffin was recovered from a field just over 1 km south-west of the Site (MWC4178)

1.4.12 The eastern banks of the River Meon seem to have been a focus for Anglo-Saxon activity. A substantial Anglo-Saxon cemetery is recorded on the opposite bank of the River Meon, *c.*450 m north-west of the Site (MWC4182). A large number of graves were discovered during railway construction works at Droxford in 1900. Subsequent excavations were undertaken where skeletal material and grave goods were recovered. Further excavations were undertaken in 1974 when 41 burials were excavated, many accompanied by grave goods. Most graves were aligned east-west, indicating Christian affiliations, however some were aligned north-south and were thus most likely pagan burials.

1.4.13 The WHER also records late Saxon land boundary earthworks, which are mentioned in charter of A.D. 826, *c.*400 m east of the Site, in close proximity to the cemetery (MWC4180).

1.4.14 An early medieval shield handle has also been found *c.*1 km north of the site (MWC1472).

1.4.15 The earliest details of St Mary and All Saints Church date to 1150, at which time the church was an aisle-less nave and chancel. The chancel area of this church remains intact along with the north and south doorways of the nave (not in their original positions). The aisles of the nave were widened in the late 15th to early 16th century and in 1599 the present tower was built. In the early 18th century the church was fitted with a new roof and ceiling. The north and south chapels are thought to have been built at a similar time in the 1300s. The font is modern and of 12th century design (Friends of Droxford Church, 2015a).

1.4.16 The Friends of Droxford Church opened up a crypt in the north chapel area in February 2015. It was found to be a brick lined vaulted crypt on an east-west orientation that contained three lead coffins. Dating has not been performed on the bones and no inscriptions were found to identify the burials or the date of interment (Friends of Droxford Church, 2015b).

1.4.17 The WHER records that the western banks of the River Meon, in particular Palace Field, were the site of water meadows, possibly dating from between the early medieval to the Victorian period (MWC7311). Water meadows were typically a water management system comprising a series of man-made leats and drains, which ranged in complexity.

1.4.18 Online historic OS mapping sources were consulted, which indicate that the Site of Palace Field has been in use as arable fields from at least the late 19th century to present (Old-Maps.co.uk, 2015). The first edition OS map of 1869 shows what appear to be traces of water meadow features in the field immediately east of the Palace Field. The historic OS mapping indicates that the Church of St Mary and All Saints and its immediate environs has remained essentially unchanged since the 1st edition map.

2 METHODOLOGY

Introduction

2.1.1 The multi-method survey undertaken at St Mary and All Saints Church, Droxford was undertaken in accordance with the Historic England guidelines (English Heritage, 2008) for each technique employed. The data were collected in zigzag method for all techniques excluding the GPR surveys in the vestry and altar areas of the church which necessitated parallel survey due to space restrictions.

2.1.2 The geophysical surveys were undertaken by Wessex Archaeology's in-house geophysics team between the 10th and 12th August 2015 with a further day undertaken on 9th September. Field conditions at the time of the survey were good, with dry conditions throughout the period of survey. Different levels of coverage were attained by each technique with 0.05 ha covered by the GPR, 0.6 ha by gradiometer survey and 0.03 ha by earth resistance.

2.1.3 Survey grid nodes were established around the church and in Palace Field using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds Historic England recommendations (2008). Grid nodes were established at 30m x 30m intervals in Palace Field for the detailed gradiometer survey, within the churchyard for the earth resistance and GPR survey. To enable grid nodes to be established within the church for the GPR survey a Leica TCR307 Total Station was used. This allowed precise grid points to be set up inside from a GPS point outside the church.

2.1 Detailed gradiometer survey method overview

2.1.1 The detailed gradiometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1 m between sensors. Data were collected at 0.25 m intervals along transects spaced 1 m apart with an effective sensitivity of 0.03nT, in accordance with Historic England guidelines (English Heritage, 2008). Data were collected in the zigzag method.

2.1.2 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied throughout the survey area, with no interpolation applied.

2.1.3 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

2.2 Ground penetrating radar survey method overview

2.2.1 Ground penetrating radar survey was conducted within the interior of St Mary and All Saints Church, and in two areas outside. The exterior survey areas comprised an area that covered land immediately to the north and west, in addition to a small area on the southern side of the church.

2.2.2 The GPR survey was conducted using a GSSI SIR 3000 with 400 MHz antenna and a 900 MHz antenna mounted on a tricycle cart with odometer to record horizontal distances. The 400 MHz antenna was deployed outside of the church and both antennae were used within the church. Data were collected at 60scans per unit (1 unit = 1 m) along traverses spaced 0.25m apart within the church and 0.5m apart outside the church with an effective time window of 110 ns for the 400 MHz and an effective time window of 80 ns for the 900

MHz antenna. The GPR survey was undertaken in accordance with Historic England guidelines (English Heritage, 2008) and data were collected in the zigzag method, with the exception of the vestry and altar areas of the church where parallel survey was undertaken due to the restricted space.

2.2.3 The approximate depth conversion for the 900 MHz antenna is shown in **Table 1** below and 400 MHz antenna is shown in **Table 2**, assuming the GPR pulse through the ground is 0.109 m/ns. It is possible to determine more precisely the average velocity of the GPR pulse through the ground if excavated features at a known depth can be identified in the data. Radargrams were analysed for suitable hyperbolic reflections, which can be used to determine the velocity of the GPR pulse through the subsurface deposits.

2.2.4 The Relative Dielectric Permittivity (RDP) of the bulk structure can be calculated using $K = \left(\frac{V_c}{V_r}\right)^2$ where K is the RDP, Vc speed of light in a vacuum and Vr the GPR pulse velocity.

2.2.5 Data from the survey were subject to common radar correction processes. These comprise amplitude and wobble correction of the radar profile to correct for variance in temperature and soil moisture content, background and band pass filtering to remove noise in the data from the surrounding area and XYZ mean line to correct for mosaic effects from variance in the day to day conditions during survey. These steps were applied on the both datasets collected at the Site.

2.2.6 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

Table 1 - Relative velocity to depth conversion based on a dielectric constant of 9.06 for the 900 MHz Antenna

Time Slice	Time (ns)	Depth (cm)
1	0-4.38	0-5
2	3.63-8.01	4-10
3	7.27-11.64	9-15
4	10.9-15.27	14-20
5	14.53-18.91	19-25
6	18.61-22.54	24-30
7	21.8-26.17	29-35
8	25.43-29.8	34-40
9	29.06-33.44	39-45
10	32.7-37.07	44-50
11	36.33-40.7	49-55
12	39.96-44.34	54-60
13	43.59-47.97	59-65
14	47.23-51.6	64-70
15	50.86-55.23	69-75
16	54.49-58.87	74-80
17	58.12-62.5	79-85
18	61.76-66.13	84-90
19	65.39-69.77	89-95
20	69.02-72.66	94-100

Table 2 - Relative velocity to depth conversion based on a dielectric constant of 9.06 for the 400 MHz Antenna

Time Slice	Time (ns)	Depth (cm)
1	0-5.47	0-29
2	4.52-9.99	24-53
3	9.04-14.51	48-77
4	13.56-19.03	72-101
5	18.09-23.55	96-125
6	22.61-28.08	120-149
7	27.13-32.6	144-173
8	31.65-37.12	168-197
9	36.17-41.64	192-221
10	40.69-46.16	216-245
11	45.21-50.68	240-269
12	49.74-55.21	264-293
13	54.26-59.73	288-317
14	58.78-64.25	312-341
15	63.3-68.77	335-364
16	67.82-73.29	359-388
17	72.34-77.81	383-412
18	76.87-82.33	407-436
19	81.39-86.86	431-460
20	85.91-90.43	455-479

2.3 Earth resistance survey method overview

2.3.1 Earth resistance data were collected in an area to the north and west of the church and a small area to the south of the church within the graveyard. The area was restricted by the presence of gravestones and other grave markers plus a hard gravel track that impeded the survey. Increased contact resistance from a prolonged period of dryness meant that no data could be collected over the pathways leading to the church nor could data be collected over the mortuary structures.

2.3.2 The earth resistance survey was conducted using a Geoscan RM85 earth resistance meter with integrated multiplexer enabling two parallel data lines to be collected concurrently increasing the sampling density. Data were collected with an effective traverse interval of 0.5m and a sample interval of 0.5m in accordance with English Heritage guidelines (2008). Data were collected in the zigzag method.

2.3.3 Data from the survey were subject to minimal data correction processes. Those that were applied to the data were Despike, High Pass Filter, Low Pass filter, and interpolation. Data are presented before and after data correction processes

2.3.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The detailed gradiometer survey has identified magnetic anomalies across the Site, along with areas of increased magnetic response and a large amount of ferrous. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:1000 (**Figures 2**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 25nT per cm for the XY trace plots.

3.1.2 The ground penetrating radar survey has identified several point reflectors and linear responses across the Site along with anomalous areas of high and low amplitude reflections. Results are presented as a series of greyscale timeslices and archaeological interpretations at a scale of 1:500 (**Figures 4** to **7**) with black representing high amplitude responses and white relating to low amplitude responses.

3.1.3 The earth resistance survey has identified high and low resistance responses across the site. Results are presented as a series of greyscale plots showing the raw data, high pass filtered data and low pass filtered and interpolated data with a final plot of the archaeological interpretation at a scale of 1:350 (**Figure 8**).

3.1.4 The interpretation of the gradiometer data highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 2**). Numerous point source reflectors and linear reflectors are visible in the GPR data (**Figures 5** and **7**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.5 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.1.6 It should be noted that small, weakly magnetised features and water logged features may produce responses that are below the detection threshold of gradiometers and GPR antenna. Excess disturbance in the form of excavation and demolition can also impede the ability of geophysical techniques to detect archaeological remains. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.

3.1.7 Gradiometer survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

3.1.8 Depths calculated from the GPR data may not be accurate and have been calculated post survey using hyperbole searching. As such, any depths presented in this report are approximations and may not reflect accurately the true depths of features.

3.2 Gradiometer survey results and interpretation

3.2.1 In the south east of Palace Field (**Figure 2**) several positive responses at **4000** measuring +2-3nT have been interpreted as possible archaeology. Similar responses are seen at **4001**, and are considered to also be of possible archaeological potential. It is difficult to determine the function or origin of these features; however they are thought to be possible pits.

3.2.2 At **4002** a linear trend has been identified extending from the western edge of the survey area and running on a north-east / south-west alignment for some 40 m. It is possible that this relates to an old path. Examination of historic OS mapping shows no field boundaries on this alignment but the sources studied for this report only extend to 1869 so there is the possibility that there were earlier field divisions.

3.2.3 An additional fainter trend can be seen running parallel, *c.*70 m to the south of **4002**. It is possible that these linear trends represent water meadow features, however they do not seem to correspond to the orientation of the remnants of water meadow features shown on the 1st edition OS map of 1869, and they are not aligned perpendicular to the river. It is also possible that these trends are archaeological in origin or represent ploughing marks.

3.2.4 **4003** is a linear feature returning an acute magnetic response usually indicative of a modern service. However the alignment of **4003** corresponds exactly to a mapped water meadow feature observed on the 1896 OS mapping. It is possible that a metal drain was installed along the course of the earlier water feature at some point, thus leading to the anomaly observed in the data.

3.3 Ground Penetrating Radar 900 MHz survey results and interpretation

3.3.1 Within the church, three areas were surveyed using the 900 MHz antenna: the nave area with data collected in both X and Y directions, the altar and vestry in Y direction (**Figures 3** to **5**). The 900 MHz antenna is able to detect features up to a depth of approximately 1 m in good conditions (**Table 1**).

3.3.2 At a depth of approximately 9-15 cm (7-12 ns) a series of linear and point source reflectors can be seen with in the church. At **3000** (**Figure 5**), a small rectangular response thought to be possible archaeology can be seen in close vicinity to the currently open brick lined tomb, in the doorway to the vestry. However, its proximity to the surface and its size suggests that it is related to the flooring rather than a crypt. **3001** lies on the eastern edge of the nave and denotes a high amplitude response; to the south-west of this is a larger high amplitude response identified at **3002**. In this area, there are a series of grave slabs set in to the floor and it is likely that this response relates to them. Within the vestry of the church, two high amplitude responses are identified at **3003**. These are likely to be related to the floor reinforcement.

3.3.3 The next two time slices, 18-23 ns and 22-26 ns (**Figure 5**) show a number of responses of potential archaeological interest. **3004** shows a continuation of the responses **3001** and **3002** discussed in the preceding paragraph. To the north-west of these, two strong high amplitude responses have been identified, both lying on an east / west alignment. These, alongside responses at **3006**, are considered to be related to the old north and south walls of the church that were demolished during the creation of the north and south chapels (*Pers.comm.* 2015*)*. The trend seen at **3005** is likely to be the inner face of the previous north wall of the church.

3.3.4 At **3007** a small response can be seen on the western side of the pillar, it is difficult to ascertain the origin of this anomaly but it is likely to relate to the old north and south walls.

3.3.5 The responses previously discussed (**3004**) are continued within time slice 22-26 ns, with **3008** to **3010** showing a continuation of them. The continuation of these features further suggests their association with the old north and south walls of the church.

3.3.6 **3011** shows a trend in the centre of the nave on an east / west alignment and lines up with the central aisle of the church. Within time slice 29-33 ns the trend **3011** seen in the

earlier time slice is more defined with a high amplitude response **3013** measuring *c.*0.5m x 3.5 m. This has been interpreted as possible archaeology and may relate to a burial. Features **3012** and **3014-15** and considered to be the responses associated with the previous walls of the church.

3.3.7 Aspects of the north and south walls can be seen throughout the remaining time slices, such as at **3016** in time slice 36-40 ns, **3017** and **3018** in time slice 39-44 ns, **3019** in time slice 50-55 ns and **3022** in time slice 69-73 ns. These features are present throughout the 900 MHz dataset (approximately 1 m depth; **Table 1**) and confirm that they are substantial features.

3.3.8 Within time slice 50-55 ns a weak, high amplitude anomaly **3020** has been identified in the central area of the nave and measures approximately 1.5m by 1.5m

3.4 Ground Penetrating Radar 400 MHz results and interpretation

3.4.1 The 400 MHz antenna was used both inside and outside of the church (**Figures 6** and **7**) and shows a number of responses of potential archaeological interest. This antenna has the potential of detecting features to a depth of 4 m in good conditions.

3.4.2 At a depth of approximately 50-80 cm (9-14.5 ns) a number of high amplitude responses can be seen across the survey area (**Figure 7**). Within the church, a high amplitude response extends from the altar steps to the west in line with the central aisle (**5000**). This has been interpreted as possible archaeology due to its shape and position. During discussions with members of the Friends of Droxford church it was mentioned that one of the previous priests was buried either under or in front of the altar (*pers. Comms. 2015*). To the north of the church several high amplitude responses have been identified across the area; these are thought to relate to graves. Two linear responses **5001** and **5002** lie on north-south alignments and are of unknown origin.

3.4.3 Within time slice 22-28 ns **5003** and **5004** represent two high amplitude responses to the north-west of the church. These exist in a grassed area surrounded by several gravestones and as such are thought to be related. Inside the church several high amplitude responses indicate the old north and south walls of the church (**5005** to **5007**). The high amplitude response identified at **5000** continues to this depth (**5008**) and is slightly wider in form (*c.*1.5m). The continued presence of this anomaly in this time slice, and again in time slice 31-37 ns, **5012** suggests that it is substantial in form and is likely to be a tomb.

3.4.4 Within the small area to the south of the church a high amplitude response has been identified **5009** at a time depth between 22 and 28 ns (*c.* 120-150cm), this lies on an east west orientation which is consistent with Christian burial traditions and as such is thought to be a further tomb or crypt. This feature remains present in time slice 31-37ns (**5010**), and can be seen to some degree down to a time depth of 59ns (**5024**) giving it an approximate height of 150cm.

3.4.5 To the west of the church, an area of high amplitude responses at **5011** in time slice 31-37 ns suggests an area of heavy compaction or disturbance. Strong high amplitude features in this area can also be seen in time slice 45-51 **5018**, but they are decreased in size and strength. It is thought that there was a structure at this location due to a roofline visible in the current structure, these responses may signify part of this structure but could also be related to the gravel path. The lack of defined orientations and shape make it impossible to provide an accurate interpretation for these responses.

3.4.6 The northern area of the church remains full of high amplitude responses in time slice 31-37 ns; a continuation of the linear responses at **5002** can be seen at **5013**. The responses **5014** to **17** in time slice 45-52 ns are considered to be related to burials, similarly the responses at **5018** to **19** in time slice 54-59 ns and **5027** in time slice 81-86 ns are also considered graves.

3.4.7 To the west of the church **5020** in time slice 54-59 ns shows an area with two distinct high amplitude anomalies. These take on a more rectangular form in time slice 81-86 ns, **5028** and are as such considered to be probable archaeology and again, most likely related to graves.

3.4.8 Within the church in the two deepest time slices presented in **Figure 7,** several high amplitude anomalies are present. The presence of high amplitude responses throughout all of the presented time slices in the nave show the location of the previous north and south walls. However further, small-scale responses suggest further features of potential interest. **5021** at an approximate depth of 2.9-3.2 m denotes a small high amplitude anomaly in close proximity to the modern font. The north walls of the church were altered with the north aisle and north chapel being built at the end of the 12th century (Friends of Droxford Church, 2015a) and as such this response may relate to the Norman walls. Potentially the most interesting feature that has arisen at this depth is **5022**, which identifies a linear response extending south from the where the old south wall was. It remains present in the last time slice (81-86ns; 431-445cm - **5025**); it is possible that this represents a wall or drain.

3.4.9 Parallel with the current north wall is a high amplitude anomaly **5023**, which is present in time slice 54-59 and time slice 81-86. This response is thought to relate to the brick lined crypt that was discovered here. Centrally to the nave and in line with the central aisle a high amplitude anomaly **5026** has been identified in the final time slice. This feature has been present throughout the GPR data, though varying in relative strength in sequential time slices. This is considered to be a burial with the variation in relative amplitude as a result of the cavity surrounding the burial.

3.5 Earth resistance survey results and Interpretation

3.5.1 The earth resistance survey was conducted in the churchyard immediately north of the church and on an area of grass to the west. The survey area was restricted due to the compacted gravel pathway that leads up to the church door. Dry conditions meant contact resistance was too high to attain readings across this area restricting the survey to the areas of grass.

3.5.2 To the north of the church several high resistance responses can be identified, in particular at **6000**, **6001** and **6002** with readings of 5-6 ohms (Ω), 7-8 Ω and 2-3 Ω. It is probable that the responses detected at **6000** and **6002** are related to one another. The origin of these responses is difficult to ascertain however it is likely that they are related to burials and as such have been interpreted as possible archaeology.

3.5.3 Low resistance responses at **6003** (-6Ω) and **6004** (-4 Ω) would seem to indicate areas of increased moisture content or the presence material with increased conductive attributes. **6003** exists between two graves and it may be that it is as a result of disturbance of material during the digging of these graves. **6004** lies on the northern extent of the earth resistance survey area and is possibly a pit or a response associated with grave cuts.

3.5.4 Linear trends at **6005** and **6006** may be related to old paths or naturally occurring variations in soil conductivity from vegetation or geology.

3.5.5 The small area to the south of the church shows broad regions of high and low resistance, however a strong high resistance response at **6007** measuring 19Ω, can be identified between two graves.

3.5.6 The small area to the south of the church shows a broad region of high and low resistance, however a strong high resistance response at **6006**, can be identified between two graves.

3.6 Modern Services

3.6.1 A potential modern service has been detected in the south-eastern extent of the gradiometer survey area at **4003** (**Figure 2**). The location of this anomaly corresponds to the course of a drain or water meadow feature identifiable on the 1st edition OS map of 1869. The introduction of the ferrous material causing the acute response is however unknown. No identifiable services were detected within the GPR data.

4 CONCLUSION

4.1.1 The geophysical surveys have been successful in detecting anomalies of archaeological interest. In addition to these, anomalies interpreted as ploughing trends, areas of increased magnetic response and former field boundaries have also been identified.

4.1.2 The anomalies of archaeological interest are primarily those within and around the churchyard. However, within the gradiometer data collected over Palace Field, a linear trend almost bisects the survey area from the western edge to just shy of the eastern edge. It is unclear what this potential feature is but it may represent an old trackway or path. Several positive responses of +2-3nT, such as at **4000** and **4001** are also present in this area and may relate to pit or posthole features.

4.1.3 The eastern boundary of Palace Field was seemingly demarcated by a drain or possible water meadow feature which differs slightly in alignment from the current field boundary. Traces of this boundary/water drainage feature have been identified within the survey results. No evidence of any previous structures has however been identified.

4.1.4 Around the church several high amplitude responses detected within the GPR data are suggestive of graves, many coincide with headstones but there are others which may be indicative of previous burials which have no visible marker.

4.1.5 Inside St Mary and All Saints Church the results from both the 900 MHz and 400 MHz antenna show regions of high amplitude responses. These correspond to the locations of the previous north and south walls when the church was a simple aisle-less nave and chancel before the north and south chapels were added in the 13th century.

4.1.6 Further features within the church identified within the GPR data suggest interments of varying nature. The high amplitude response in the centre of the nave that has been detected by both the 900 MHz (**3011**, **3013** and **3020**) and 400 MHz (**5000**, **5005**, **5012** and **5026**) antennas would suggest an interment of a coffin, the size of the feature is too small to indicate a crypt.

4.1.7 Of particular interest is a linear response **5022** detected by the 400 MHz antenna at an approximate depth of 2.9-3.2 m. This feature extends from the location of the previous southern wall towards what would have been the churchyard to the south. The context or origins of this feature are unclear as to whether it is structural or a drain.

4.1.8 The church yard contains several burials, many of which have markers above ground either tombstones or stone mausoleums. Visible inspection of one of the gravestones to the south of the church appears to have a chamber beneath it. Members of The Friends of Droxford Church have theorised of a possible subterranean passage or crypt (*pers.comms 2015*). The ground penetrating radar survey conducted within the church has identified a linear feature **5022**, it is possible that this is related to the theorised subterranean features however, the data gap between the survey area within the church and the small survey area to the south means that this association is only theoretical and further investigation would be needed clarify the true relationships. The radar results to the south of the church reveal a consistently strong high amplitude response (**5009-10**, **5024**) in close proximity to the gravestone that may cover a crypt. It is therefore considered likely that a crypt or large burial is located here.

4.1.9 The survey has revealed several potential funeral features of varying size and form. No further clear crypt features have been identified besides the known crypt located in the

north chapel however the lack of substantial evidence from the radar survey may not exclude the potential presence of crypts, particularly considering the limitations on survey extent due to church furnishings and the size of the radar equipment. The radar survey has been successful in identifying evidence of previous phases of the church with the earlier Norman north and south walls clearly visible in the data collected in the chancel. The gradiometer survey has revealed no clear evidence of a structure.

5 RECOMMENDATIONS

5.1.1 It is recommended that prior to any construction work under taken at the Saint Mary and All Saints Church, Droxford, the Planning Archaeologist for Winchester Council should be consulted and any decisions made should take in to account the possibility of unknown graves being unearthed in and around the church. An archaeological mitigation strategy should be put in place to deal appropriately and respectfully with any graves or structural remains which may be disturbed.

6 REFERENCES

6.1 Bibliography

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6.2 Cartographic and documentary sources

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6.3 Online resources

UK Soil Observatory, http://www.ukso.org [accessed August 2015]

British Geological Survey, http://www.bgs.ac.uk [accessed August 2015]

Heritage Gateway, http://www.heritagegateway.org.uk [accessed August 2015]

Old-Maps.co.uk, https://www.old-maps.co.uk [accessed September 2015]

Friends of Droxford Church (2015a) History of the Church [accessed October 2015]

Friends of Droxford Church (2015b) Opening of the Crypt [accessed October 2015]

APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey methods and equipment – Gradiometer Survey

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

Survey Methods and Equipment – Ground Penetrating Radar

The ground penetrating radar (GPR) data were collected using a cart-based shielded antennae with central frequencies suitable for the types of target being investigated. Lower frequency antennae are able to acquire data from deeper below the surface, whereas higher frequencies allow high resolution imaging of near-surface targets at the expense of deep penetration. The exact make and model of equipment varies.

The depth of penetration of GPR systems is determined by the central frequency of the antenna and the relative dielectric permittivity (RDP) of the material through which the GPR signal passes. In general, soils in floodplain settings may have a wide range of RDPs, although around 8 may be considered average, resulting in a maximum depth of penetration *c.* 2.5m with the GPR signal having a velocity of approximately 0.1m/ns.

The GPR beam is conical in shape, however, and whilst most of the energy is concentrated in the centre of the cone, the GPR signal illuminates a horizontal footprint which becomes wider with increasing depth. At the maximum depth of the antenna, it becomes impossible to resolve any feature smaller than the horizontal footprint for the corresponding depth. The size of the footprint is dependent upon central frequency, and its size increases as the central frequency decreases.

The vertical resolution is similarly dependent upon the central frequency; for the 300MHz antenna, features of the order of 0.05m may be resolved vertically. Antennae with lower frequencies can therefore penetrate more deeply but are less resolute in both horizontal and vertical directions. Choice of antenna frequency is guided largely by the anticipated depth to the target and the required resolution.

GPR data for detailed surveys are collected along traverses of varying length separated by 0.5m with cross lines collected running perpendicular to these traverses at wider separations. The data sampling resolution is governed by the data logger and a minimum separation of 0.05m between traces is collected for all surveys.

Post-Processing

The radar data collected during the detail survey are downloaded from the GPR system for processing and analysis using commercial software (GPR Slice). This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

- Gain – Amplifies GPR data based upon its position in the profile, which boosts the contrast between anomalies and background. A wobble correction is also applied during this step;
- Background Filter - is used to remove banding noises that are seen across the radargrams
- Bandpass – Removes GPR data lying outside a specified range, which removes high- and low-frequency noise.

Typical displays of the data used during processing and analysis:

- Timeslice – Presents the data as a series of successive plan views of the variation of reflector energy from the surface to the deepest recorded response. The variation in amplitude is represented using a colour scale with red indicating high amplitude and blue indicating low amplitude responses.
- Radargram – Presents each radar profile in a vertical view with distance along the profile expressed along the x axis and depth along the y axis. The amplitude variation is expressed using a greyscale.

Survey methods and equipment – Earth Resistance Survey

The data for this project was acquired using a Geoscan Research RM85 with a multiplexer system using a three probe array. The instrument has three electrodes spaced 0.5m apart fixed horizontally to the portable frame and two electrodes anchored 15-50m away. The probes work in pairs (one mobile, one anchored) to measure the current and potential resistivity. This arrangement of electrodes suppresses any double peaking effects.

The resistivity metres have a range of 20470 ohms to 0.0005 ohms and an effective depth of 0.5m - 0.75m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Resistivity surveys undertaken by Wessex Archaeology depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by Historic England (English Heritage 2008) for geophysical surveys.

Resistivity survey data are collected in a 20m x 20m or 30m x 30m grid at 1m intervals along traverses spaced 1m, giving a reading interval of 1m x 1m. These strategies adhere to the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 16 readings per metre, exceeding that recommended by Historic England (English Heritage 2008) for characterisation surveys.

Post-processing

The data collected during the detailed resistivity survey are downloaded from the Geoscan Research system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings.
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- High Pass Filter - used to remove low frequency, large scale spatial detail
- Low Pass Filter - used to remove high frequency, small scale spatial detail, smooth data and for enhancing larger weak features.
- Interpolation - used to increase or decrease the number of data points in a survey. Increasing the number of data points can be used to create a smoother appearance to the data

Typical displays of the data used during processing and analysis:

- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

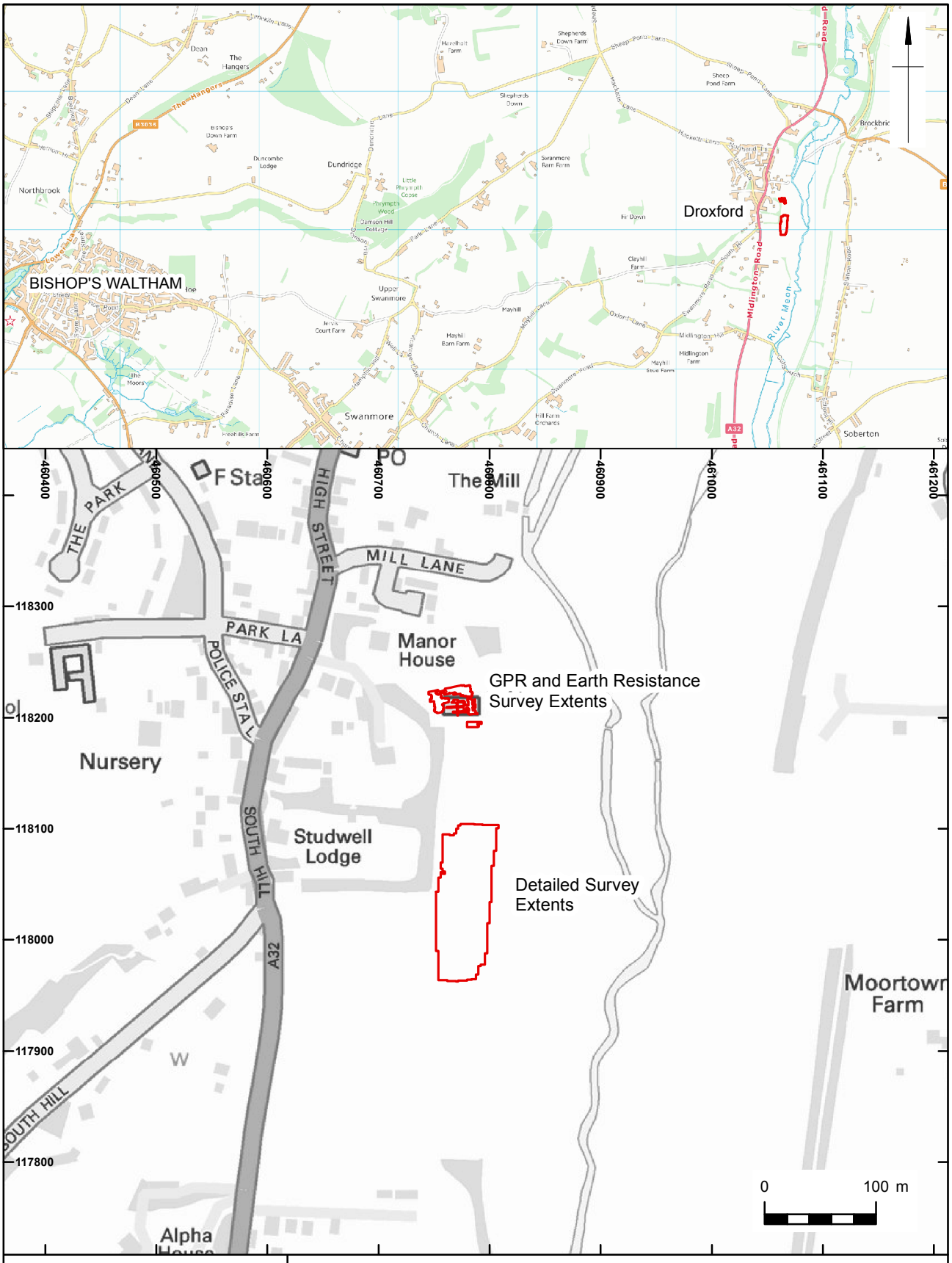
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Agricultural ditches – used for ditch sections that are aligned parallel to existing boundaries and former field boundaries that are not considered to be of archaeological significance.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



Survey Extents

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Site Location and Survey Extents

Figure 1

460800

118100

118000

+3 nT

-2 nT

+25 nT

-25 nT

4002

4001

4000

4003

Detailed Survey Extents

Trend

Ploughing

Possible Archaeology

Ferrous

Modern Service

0 50 m

Date:	27/08/2015	Revision Number:	0
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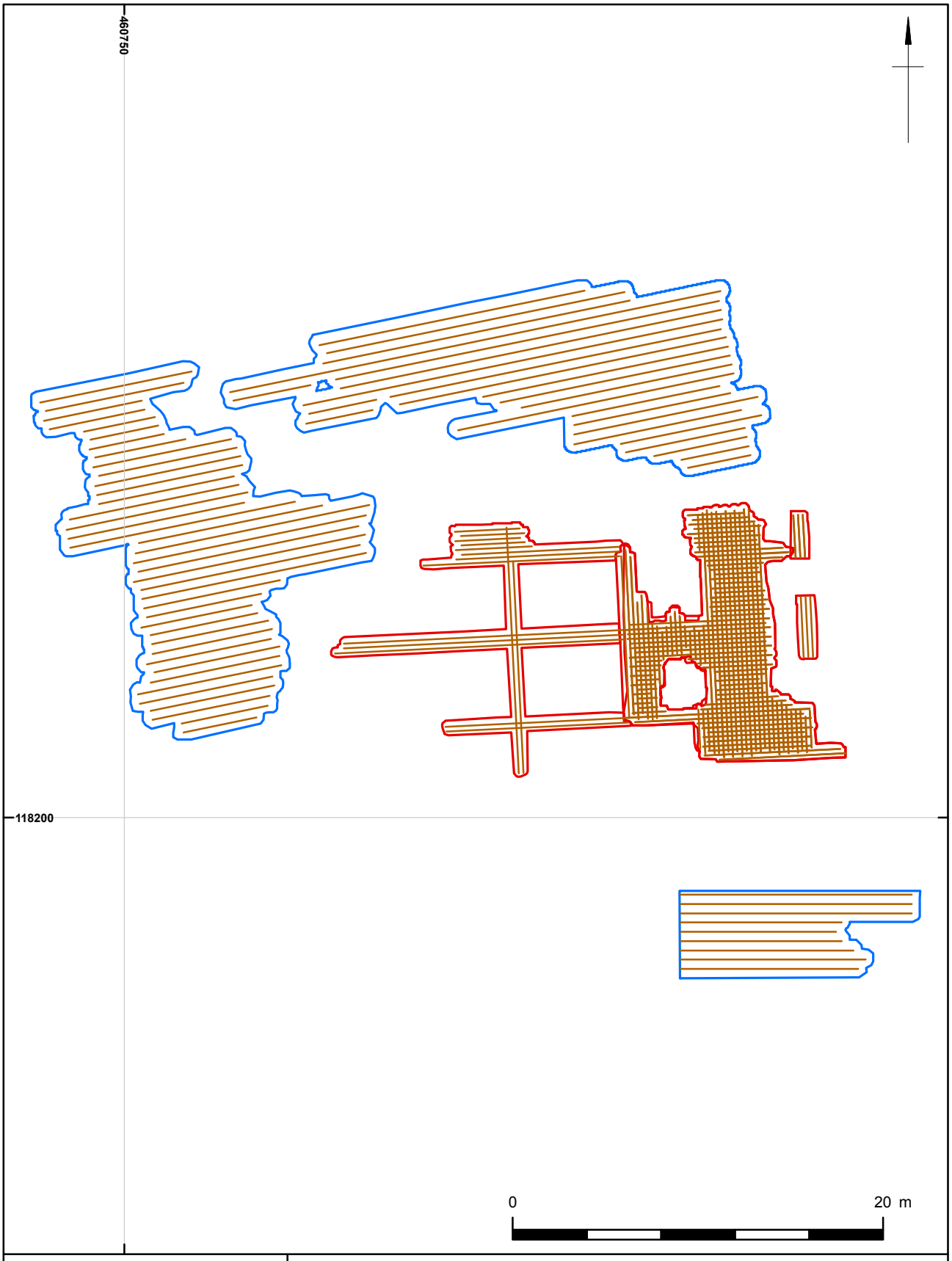
Gradiometer Results

Figure 2



Church Interior Survey Extents

Church Exterior Survey Extents

GPR Transects

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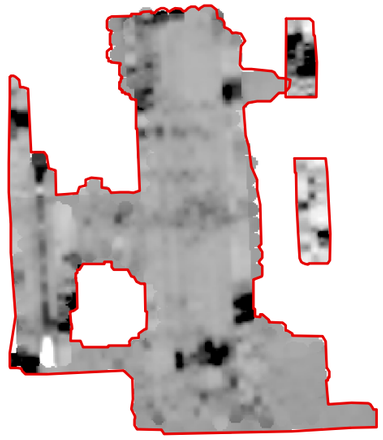
GPR Survey Area and Transect Locations

Figure 3

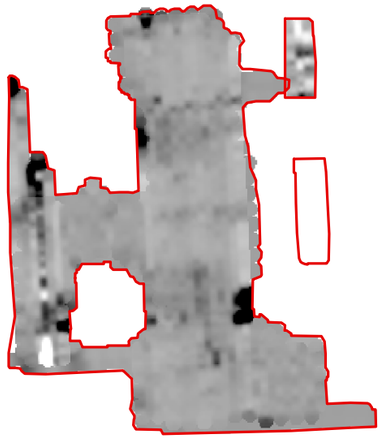
7.27-11.64ns



18.16 - 22.54 ns

21.8 - 26.17ns

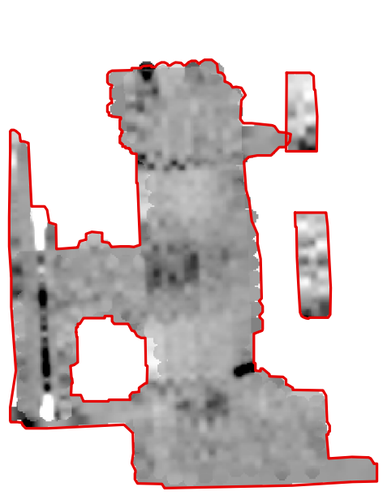
29.06 - 33.44 ns



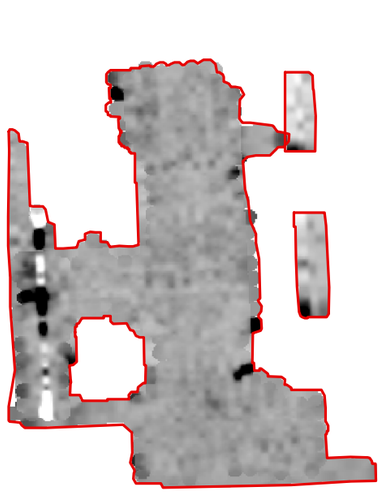
36.33 - 40.7 ns

39.96 - 44.34 ns

50.86 - 55.23 ns



69.02 - 72.66 ns



Survey Extent

0 10 m

High Amplitude

Low Amplitude

Date:	27/08/2015	Revision Number:	0
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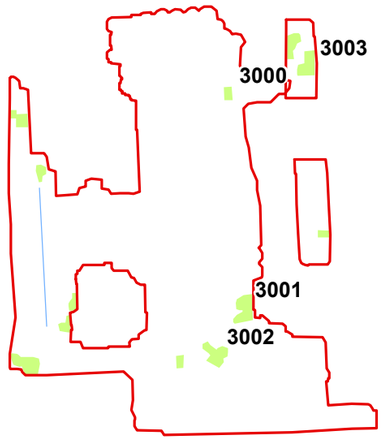
Path:	X\PROJECTS\110360\GIS\FigsMXD		

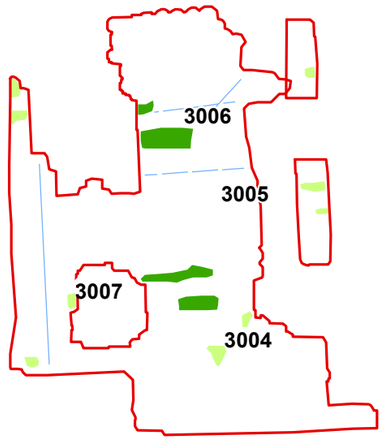
900 MHZ GPR Results

Figure 4

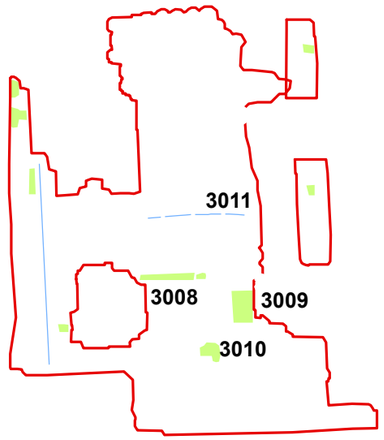
7.27-11.64ns



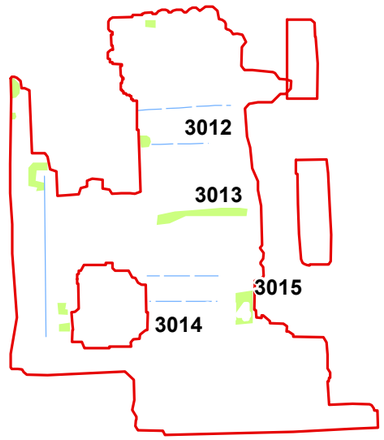
18.16 - 22.54 ns



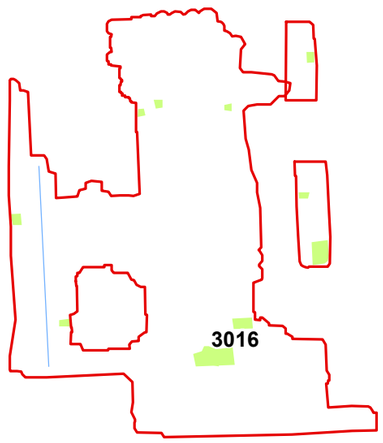
21.8 - 26.17ns



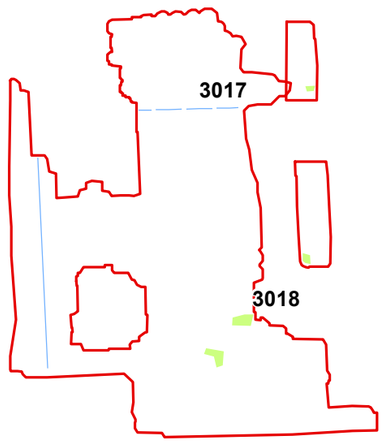
29.06 - 33.44 ns



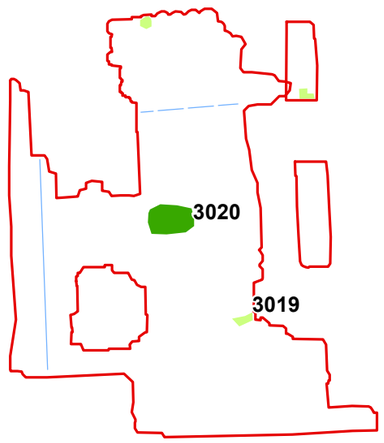
36.33 - 40.7 ns



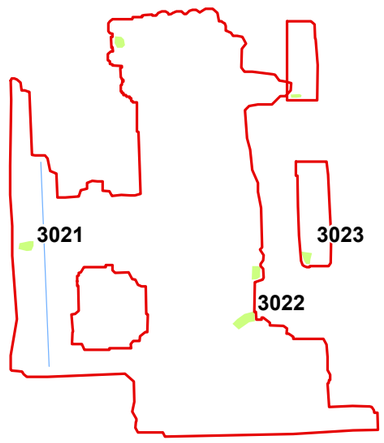
39.96 - 44.34 ns



50.86 - 55.23 ns



69.02 - 72.66 ns



Survey Extent
Metal Grill
Trend
Possible Archaeology
Archaeology

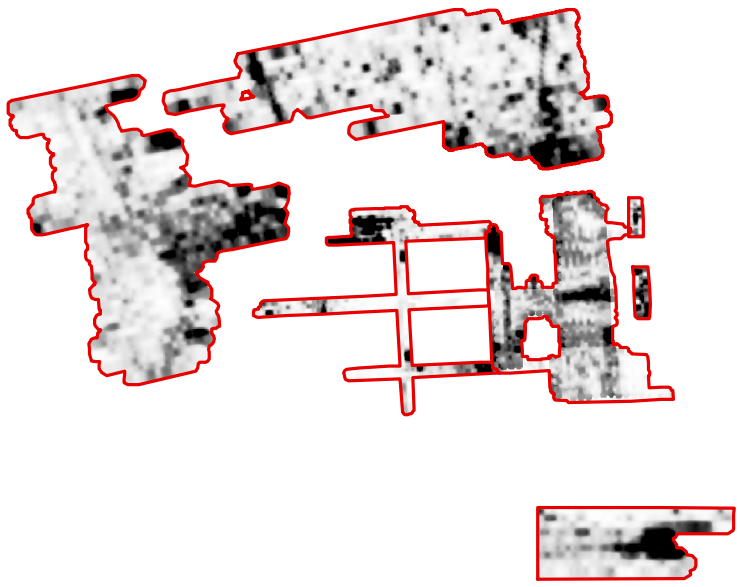
0 10 m

Date:	27/08/2015	Revision Number:	0
Scale:	1:200 at A3	Illustrator:	KJF
Path:	X\PROJECTS\110360\GIS\FigsMXD		

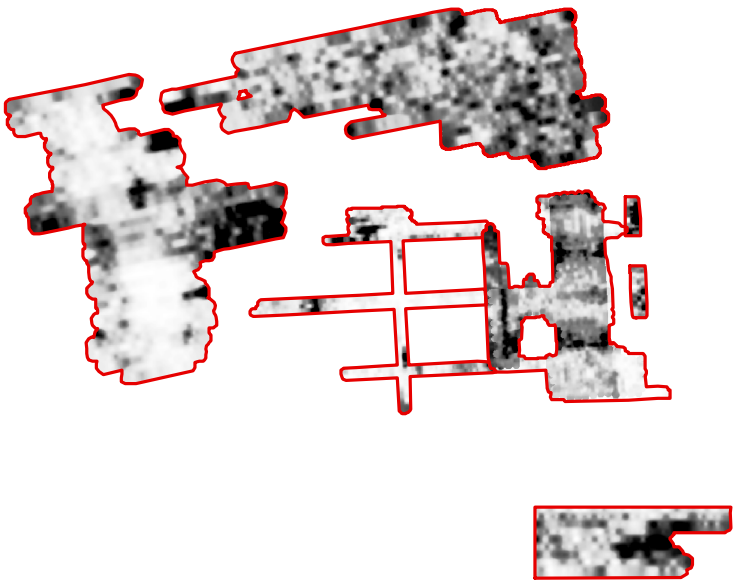
900 MHZ GPR Interpretation

Figure 5

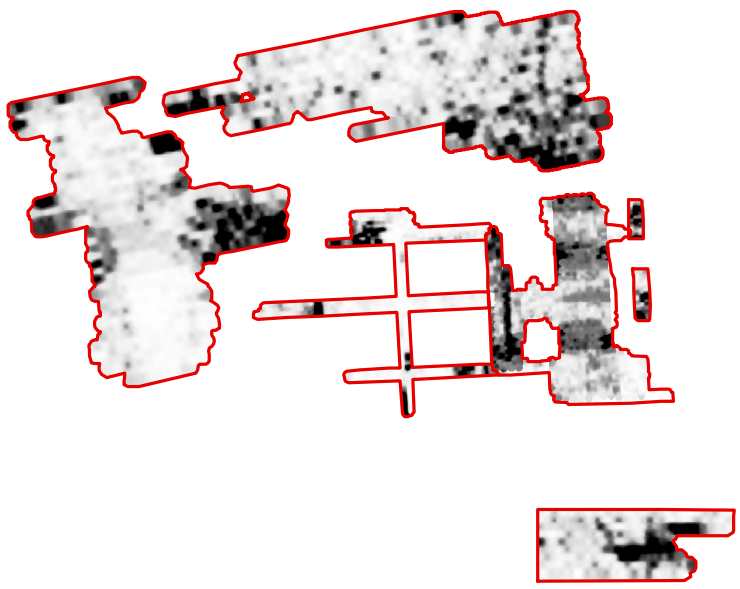
9.04 - 14.51 ns



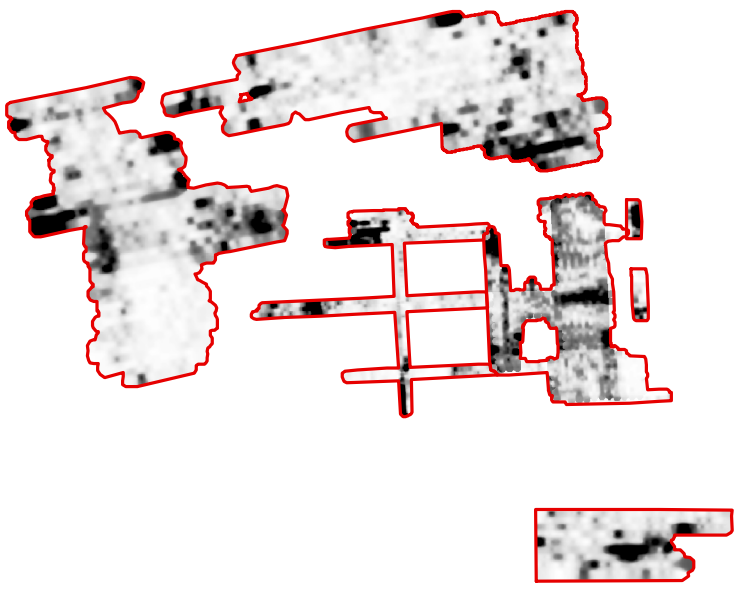
22.61 - 28.08 ns



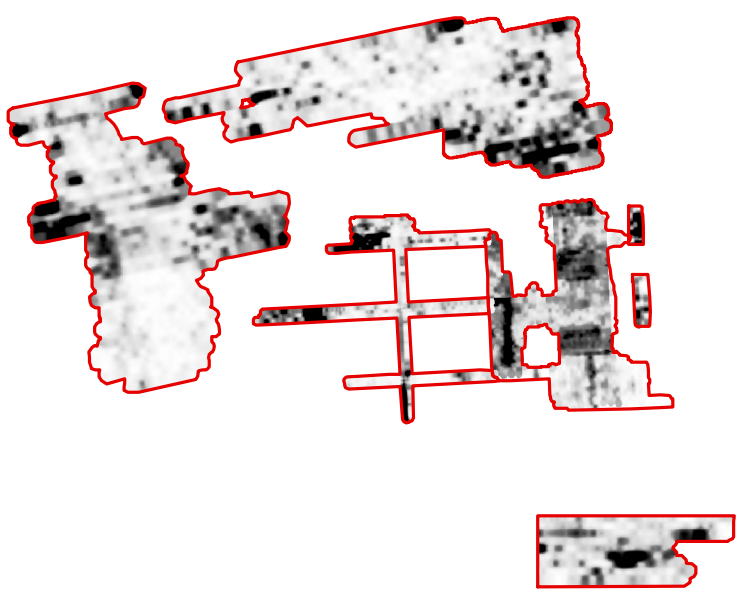
31.65 - 37.12 ns



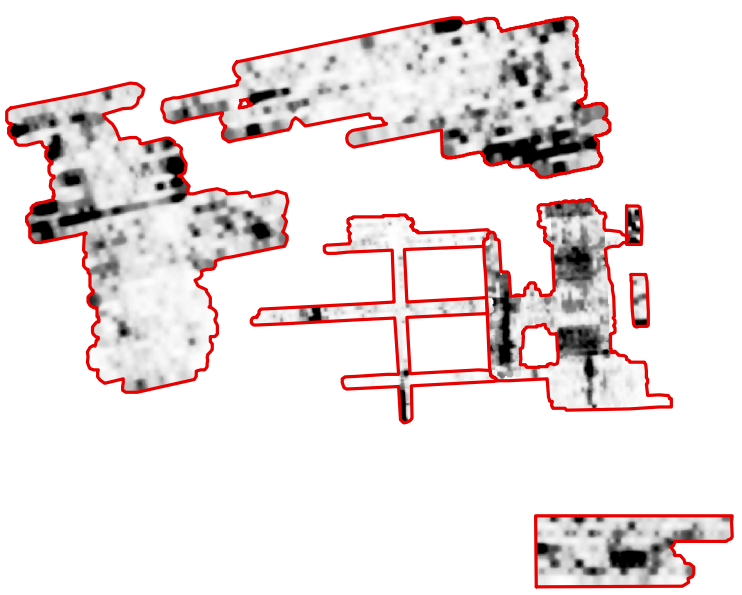
45.21 - 50.68 ns



54.26 - 59.73 ns



81.39 - 86.86 ns



Survey Extents

0 25 m

High Amplitude

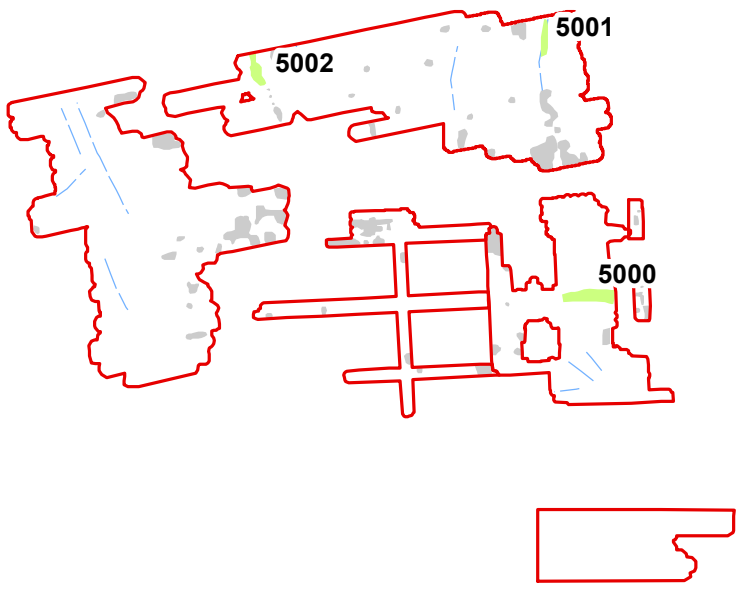
Low Amplitude

Date:	27/08/2015	Revision Number:	0
Scale:	1:500 at A3	Illustrator:	LR/KJF
Path:	X\PROJECTS\110360\GIS\FigsMXD		

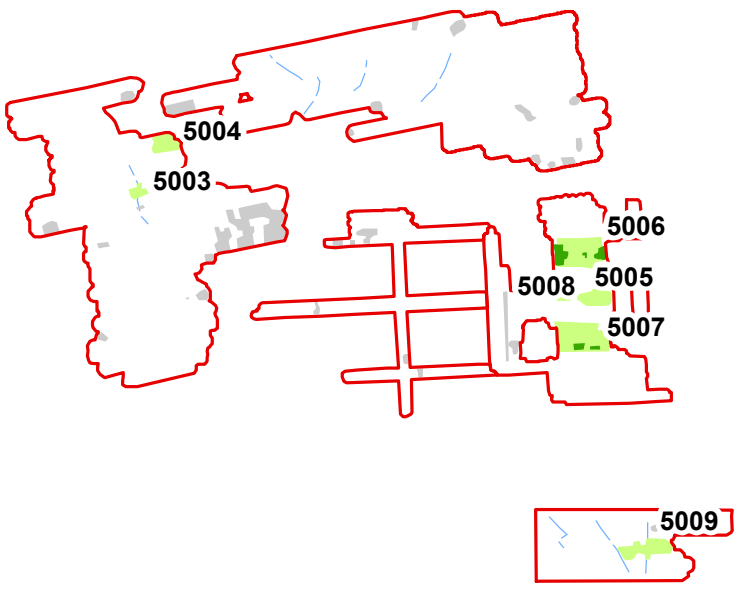
400MHZ GPR Results

Figure 6

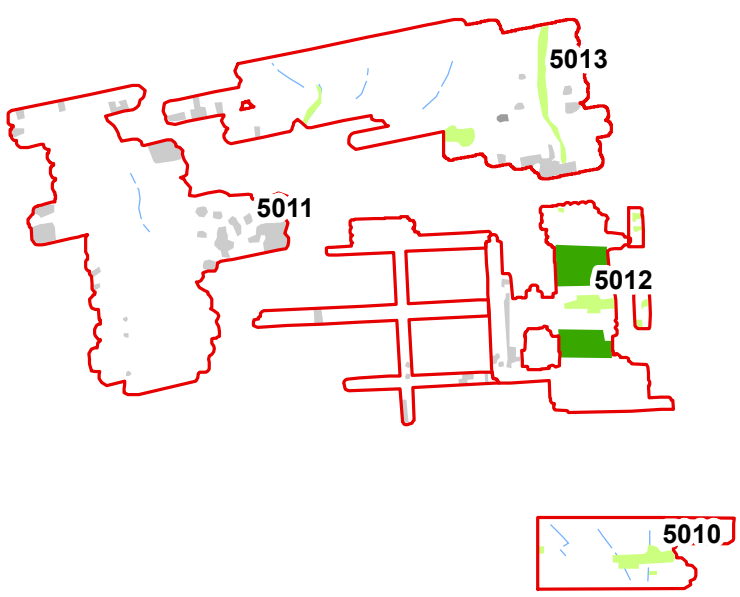
9.04 - 14.51 ns



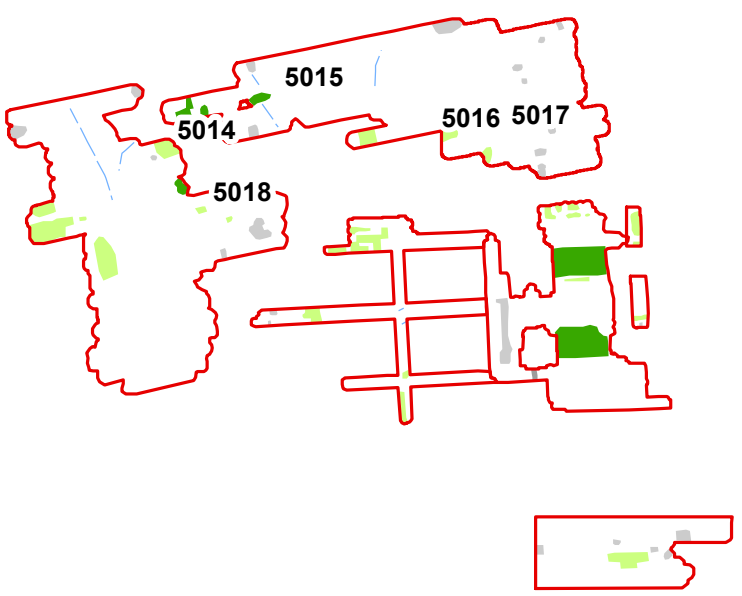
22.61 - 28.08 ns



31.65 - 37.12 ns



45.21 - 50.68 ns



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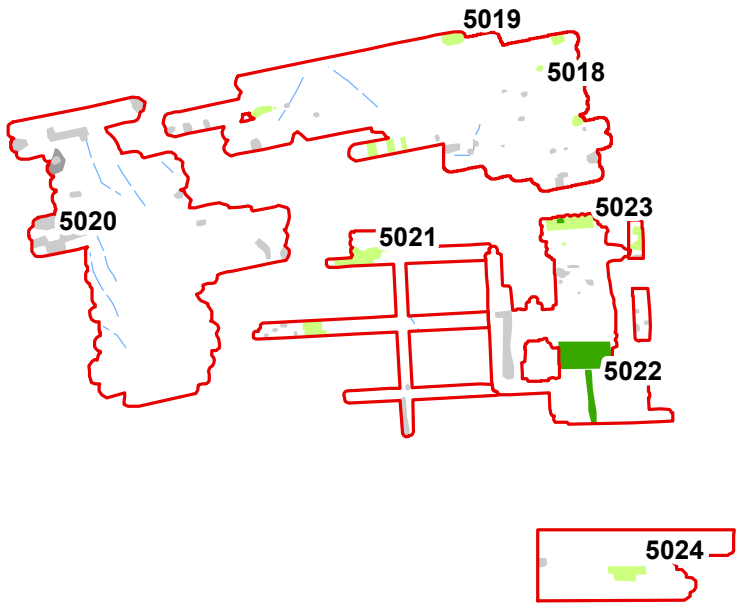
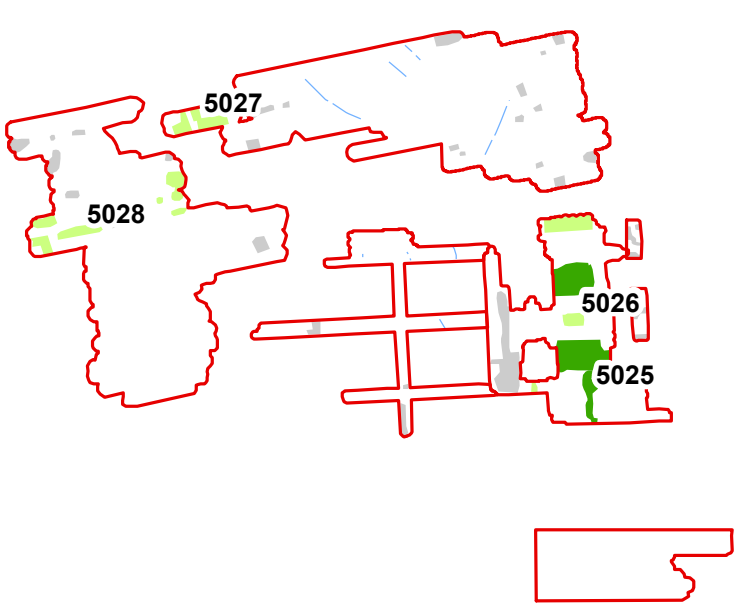


81.39 - 86.86 ns



Survey Extents
Trend
Archaeology
Possible Archaeology
Strong High Amplitude Response
Weak High Amplitude Response

0 25 m

Date:	27/08/2015	Revision Number:	0
Scale:	1:500 at A3	Illustrator:	KJF
Path:	X\PROJECTS\110360\GIS\FigsMXD		

400MHZ GPR Interpretation

Figure 7

460740 460760 460780 460800

118220

118200

+280 ohm

-100 ohm

Raw Earth Resistance Data

460760 460780 460800

118220

118200

+9 ohm

-6 ohm

High Pass Filtered

460760 460780 460800

118220

118200

+6 ohm

-4 ohm

Low Pass Filtered and Interpolated

460740 460760 460780 460800

118220

118200

6000 6001 6002 6003 6004 6005 6006 6007

Detailed Survey Extents

Possible Archaeology

Low Resistance Response

Trend

Interpretations

0 10 m

Date:	14/09/2015	Revision Number:	0
Scale:	1:350 at A3	Illustrator:	ECR
Path:	X:\PROJECTS\110360_Reports\PDFs\2015_09_14		

Earth Resistance Results and Interpretations

Figure 8

Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk