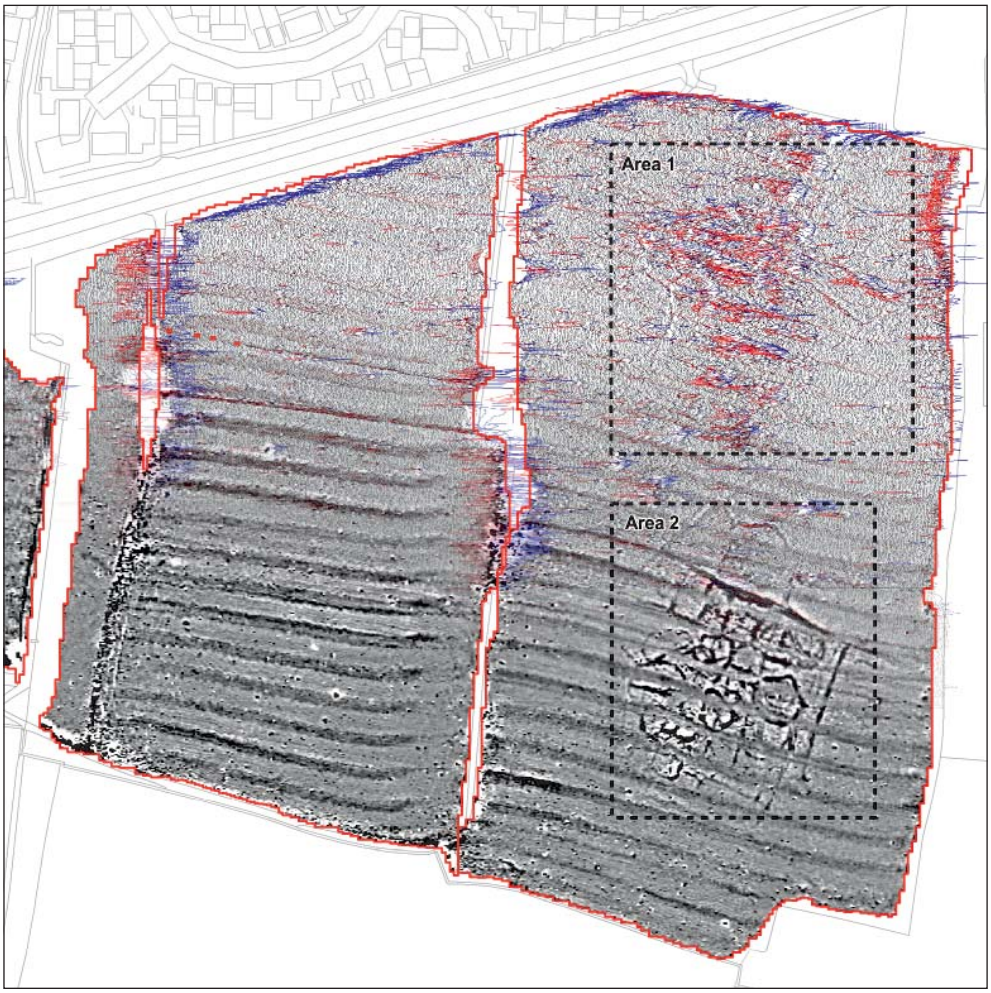
making sense of heritage

Land to the West of Vale Business Park, Evesham, Worcestershire

Detailed Gradiometer Survey Report



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geoservices

Land to the West of Vale Business Park, Evesham, Worcestershire

Detailed Gradiometer Survey Report

Prepared for:
St Modwen Properties PLC
Park Point
17 High Street
Longbridge
Birmingham
B31 2UQ

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

www.wessexarch.co.uk

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* I= Internal Draft; E= External Draft; F= Final

Land to the West of Vale Business Park, Evesham, Worcestershire

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land south of the A46, Evesham, Worcestershire (centred on NGR 403800, 241600). The project was commissioned by St. Modwen Properties PLC with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of an outline planning application for the proposed further expansion of business development at Vale Business Park, Evesham, to be submitted to Wychavon District Council.

The site comprises arable fields located to the south and east of the A46, covering an area of 21.8 ha. The geophysical survey was undertaken between 7th and 22nd September 2015. The detailed gradiometer survey has demonstrated the presence of a number of anomalies of potential archaeological with particular concentrations within the eastern field and westernmost area of the site.

Multiple phases of archaeological remains are thought to be present in the form of ditches, pits, postholes, some of which are thought to represent possible roundhouses and possible co-axial and ladder enclosures. These suggest at least two areas of settlement, possibly separated by a Roman road, most likely dating to the Iron Age or Romano-British period. Further, evidence suggesting the Scheduled Monument recorded as a Romano-British roadside settlement to the south of the site continues through the site.

Additionally, this archaeological investigation has detected former field boundaries, a possible trackway, areas of increased magnetic response and evidence for historic cultivation.

Land to the West of Vale Business Park, Evesham, Worcestershire

Detailed Gradiometer Survey Report

Acknowledgements

Wessex Archaeology would like to thank St Modwen Properties PLC for commissioning the geophysical survey. The assistance of Peter Rudd is gratefully acknowledged in this regard.

The fieldwork was undertaken by Alistair Salisbury, Rebecca Hall, Garreth Davey and Matt Tooke. Garreth Davey and Alistair Salisbury processed and interpreted the geophysical data. Alistair Salisbury also wrote the report. The geophysical work was quality controlled by Elizabeth Richley and Lucy Learmonth. Illustrations were prepared by Richard Milwain. The project was managed on behalf of Wessex Archaeology by Alexandra Grassam.

Land to the West of Vale Business Park, Evesham, Worcestershire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by St Modwen Properties PLC to carry out a geophysical survey to the south of the A46, Evesham, Worcestershire (hereafter "the Site", centred on NGR 403800, 241600) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of an outline planning application for the proposed further expansion of business development at Vale Business Park, Evesham, to be submitted to Wychavon District Council.

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 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 south of the A46 Cheltenham Road, at its junction with the A4184 Cheltenham

1.2.2 The Site occupies an area of around 21.8 ha of agricultural land. It is bounded to the north and the west by the A46 trunk road, to the east by Vale Business Park and to the south by further agricultural land.

1.2.3 The Site is on a marginal incline sloping downwards from around 35 m above Ordnance Datum (aOD) at the western edge to approximately 33 m aOD at the eastern edge. A water course runs north-south through the Site.

1.3 Soils and geology

1.3.1 The solid geology comprises mudstone, siltstone, limestone and sandstone of Lias Group. No overlying superficial geological deposits were recorded (BGS 2015).

1.3.2 The soils underlying the Site are recorded as the loamy and sandy river terrace soils of the 571w association and stoneless clayey river alluvium soils of the 813b association (SSEW SE, 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

1.4 Archaeological background

1.4.1 An archaeological Desk-Based Assessment (DBA) undertaken by Wessex Archaeology (2015) examined the potential for the survival of buried archaeological remains within the development area and a 1 km Study Area. The following background is summarised from the DBA. Relevant records from the Worcestershire Historic Environment Record (HER) and National Heritage List for England (NHLE) are included where appropriate.

1.4.2 There are no World Heritage Sites, Registered Parks and Gardens, Conservation Areas, Historic Battlefields or Listed Buildings identified within the Study Area however a single Scheduled Monument (NHLE 1020257) is identified abutting the Site to the south. This comprises a cropmark complex interpreted as a Romano-British settlement.

1.4.3 A number of previous archaeological investigations have been undertaken within the Study Area. The majority of the finds indicate early occupation in the area with a strong Romano-British focus. These include a number of field walking surveys where Roman and medieval pottery scatters have been discovered (HER Reference: WSM06109, WSM06843). An evaluation and geophysical survey targeting known archaeological remains was undertaken to the west at Evesham Football ground. Linear features and fills indicating multiple stages of use and disuse were uncovered (HER Reference: WSM30784).

1.4.4 Given the quality and quantity of material recovered during these past excavations, the archaeological potential for the area has been categorised as high.

1.4.5 Little evidence for prehistoric settlement is seen within the Study Area determined by the DBA (Wessex Archaeology 2015). Although a single Palaeolithic hand axe was discovered west of Brooklands Farm to the north-west of the Site. Similarly little evidence for Bronze Age inhabitation within the Study Area was noted. Two possible ring ditches observed in aerial photography to the east of the Site were thought to potentially be Bronze Age in date but later field walking in this area discovered only Roman pottery.

1.4.6 The majority of the HER data recorded within the Study Area was dated Romano-British (Wessex Archaeology 2015). The Scheduled Monument recorded shares its southern boundary with the Site and has a second component to the west, across the A46. The Scheduled Monument has been identified as a series of small enclosures and building remains aligned either side of a Roman road from crop marks.

1.4.7 At the northern end of the Roman road is a complex of irregular enclosures surrounded by a curvilinear feature believed to be a ditch or bank enclosing a number of buildings and their associated courtyards. Additional courtyards and buildings lie to either side of the Roman road visible as smaller and more regular enclosures, whilst further east are several linear features believed to be banks and ditches enclosing small fields and allotments associated with the buildings. Towards the southern end of the Roman road is a junction with a second Roman road which runs east to west, thus forming cross-roads. To the west of the A46 and lying to the south of the second Roman road are the remains of at least two rectilinear enclosures with hut circles, which are believed to be small farmsteads, or possible shrines.

1.4.8 The western area of the cropmark complex appears to present a large triple ditch enclosure. During trial trench evaluations two of the three main ditches were confirmed as being of the Romano-British period however no evidence was found for the inner ditch. This enclosure is rectilinear in plan, and given its recorded shape and scale, it is likely that the western portion of the Site lies within the settlement boundary.

1.4.9 Field-walking has been conducted over the Scheduled Monument and the Site itself. During this, large quantities of Romano-British material were recorded largely consisting of pottery and building materials. Metal detecting surveys have also been conducted which has recovered 46 Romano-British brooches, 200 coins and a piece of bronze piping.

1.4.10 Medieval activity in the wider landscape is largely rural relating to the agricultural hinterland of surrounding settlements. Ridge and furrow has been identified through LiDAR to the south and east of the Site and is also visible throughout the Study Area and within the Site on satellite imagery.

1.4.11 The Site continued to be associated with farming and agricultural use during the post-medieval, 19th century and modern period. The 1889 First Edition Ordnance Survey (OS) map shows that the area has been divided into smaller landholdings with the centre and western areas recorded as orchards. This orchard had expanded by 1905 and is shown covering the majority of the Site.

1.4.12 The 1938 edition shows that multiple internal field boundaries have been removed, the orchard has been reduced and allotments have been established to the north-eastern part of the Site.

2 METHODOLOGY

2.1 Introduction

2.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 7th and 22nd September 2015. Field conditions at the time of the survey were good. An overall coverage of 21.8 ha was achieved.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30 m x 30 m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02 m and therefore exceeds Historic England (formerly English Heritage) recommendations (English Heritage 2008).

2.2.2 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 0.03 nT, in accordance with Historic England guidelines (English Heritage 2008). Data were collected in the zigzag method.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5 nT 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.

2.2.4 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 of archaeological interest across the Site, along with areas of increased magnetic response and a large amount of ferrous material. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:2500 (**Figures 2** to **4**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image and ±25 nT at 25nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**). Due to the dense concentration of potential archaeological remains in the eastern field and western survey extents, **Figures 5** to **7** depict **Areas 1** to **3** at a higher degree of magnification to allow the anomalies to be depicted with greater clarity. These plots have had agricultural anomalies removed in order to more clearly view the anomalies with archaeological potential. Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 The main concentration of potential archaeological remains can be found within the easternmost field where two areas of archaeological interest have been identified. Here it appears that multiple phases of occupancy are present; which is suggested by the overlapping features. Another smaller area of archaeological interest is present in the western field. The Site is overlain with evidence of ridge and furrow.

3.1.4 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.

3.1.5 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.

3.1.6 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.

3.2 Gradiometer survey results and interpretation

3.2.1 A large concentration of linear, rectilinear and sub-circular positive anomalies lie within **Area 1** to the north of the eastern field. At least two clear orientations are evident in the geophysical data, often intersecting one another suggesting continued use or differing phases of occupation. These features have been categorised as Archaeology, Probable Archaeology or Possible Archaeology depending on the strength of their magnetic signature, form and pattern but there is no doubt that the archaeological remains in this area are dense. These features are predominately characteristic of field systems and enclosures commonly identified from the Iron Age and Romano-British periods, although dating cannot be ascertained from geophysical data.

3.2.2 A rectilinear positive anomaly identified at **4000** measures *c*15 m in width. This would seem to be part of a co-axial enclosure system on a roughly north-east/south-west

orientation, and therefore probably represents settlement activity. This feature lies on a similar orientation to anomalies identified at **4002**, **4003**, and **4004**, which are similar in response, supporting the interpretation of a co-axial enclosure. It should be noted that, due to the overlying probable ridge and furrow, the form and relationship of these features remains unclear. A number of cut features to the immediate north of **4004** appear to form a curvilinear feature. The ridge and furrow activity has however distorted this possible feature preventing further interpretation.

3.2.3 The curvilinear cut feature measuring approximately 21 m in diameter identified at **4001** appears to be a ring ditch. Its form and size may represent a former dwelling, such as a round house which would be in line with the known archaeology of the area. This interpretation cannot be definitive prior to ground-truthing and as such it should be noted that, based on the form and the archaeological background, this feature may also represent an enclosure or round barrow.

3.2.4 A further circular cut feature measuring approximately 11 m identified at **4005** appears segmented in form. This sub-circular feature appears to lie towards the western extent of the settlement activity identified as **Area 1**. The relationship this feature has with the other potential settlement activity is unclear, but the magnetic response is similar in strength to the possible enclosure systems. To the east of **4005** (north of **4004** and at the southern end of **4008**), two further smaller probable ring ditches or gullies are identified. These may relate to settlement activity for instance as a drip gully for a roundhouse.

3.2.5 At **4006** incomplete rectilinear features are identified, on an alignment congruous with the anomalies to the north of **Area 1** identified as a possible co-axial enclosure system (**4000**, **4002**, **4003**, **4004**). This relationship appears to continue throughout this area, traversing circular features (eg **4001**, **4005**). These relationships cannot be discussed further with the currently available information.

3.2.6 Parallel linear anomalies identified as **4007** have been interpreted as Archaeology due to their form, response and proximity to probable field systems and enclosures. It should be noted the 1938 OS map (reproduced within the DBA) shows allotments in a similar orientation to these potential ditches at this location and therefore these may in fact represent modern features.

3.2.7 Strong positive linear anomalies identified at **4008** orientated parallel to those directly to the east at **4002** are interpreted as Archaeology. These are likely to relate to the probable co-axial enclosure. These have not been discussed in relation to **4000**, **4002**, **4003**, **4004** due to the uncertainty surrounding the relationship these linears share with **4007**.

3.2.8 A fragmented linear anomaly at **4009** is bisected by the probable ridge and furrow common across the Site. Ridge and furrow is typical of the medieval period and therefore this probable ditch is likely to predate this. It is inferred that the north-east/south-west section of **4007** may be another component of this feature, in addition to linears identified at 4**015**. This linear appears to determine the extent of this area of archaeological activity to the south-west.

3.2.9 A number of weaker responses identified at **4010** to **4011** are interpreted as possible ditches. These are on a differing alignment to previously discussed potential enclosure and field systems, there is no obvious relationship to other features. **4013** and **4014** are similar responses on the opposite side of **Area 1** also with no apparent relationships with previously identified features.

3.2.10 A long anomaly **4014** almost bisects the western field in a north-east/south-west orientation, starting at **4036** and apparently ending at **4037**. It is interpreted as Possible Archaeology and may be where a past path or trackway once extended, no evidence is available within the historic mapping. Previous excavations have revealed that the north/south Roman road had another road crossing it. Given the width between **4009** and **4014** of approximately 30 m, an apparent lack of archaeological remains between these linears, and that this appears to separate the two areas of archaeological activity within this field there is a chance that this may represent a segment of Roman road.

3.2.11 A well-defined zone of increased magnetic response **4015**, is similar to that often interpreted as representing settlement activity. This can be associated with burning or debris.

3.2.12 Small pits are scattered throughout the area. Due to the local context and archaeological background these are interpreted as possible pits or postholes, which may relate to potential Iron Age and Romano-British features previously discussed.

3.2.13 **Area 2** to the south has similar characteristics to **Area 1.** It appears to be bounded by a clear ditch feature on the north and east extent (**4016** and **4017**) and there seems to be two or more phases of activity. There are a greater number of sub-circular and circular anomalies which may denote a different purpose or date for **Area 2**. Many of the features have been subject to damage from ridge and furrow activity.

3.2.14 At least ten possible ring ditches are present within **Area 2** as intersecting and overlapping circular and sub-circular anomalies. The largest of these measures 21 m in diameter and the smallest 10 m. Like those in **Area 1**, these are interpreted as enclosures, possibly related to past living spaces or farming areas.

3.2.15 To the north of **Area 2**, a strongly positive linear feature seems to denote the northernmost border of this area of settlement. The feature extends east from **4016** and appears to join with perpendicular feature **4017**, with typical readings ranging from +2 nT to +7 nT. The orientation closely matches that of the ridge and furrow seen across the the Site but also is a similar alignment to allotments known to have existed in this location, as shown on the 1938 OS map. Given the complexity of the archaeological activity within this area this should still however be treated as high archaeological potential.

3.2.16 **4018** shows a good example of two potential enclosure ditches superimposed on top of one another. These features measure approximately 9 m and 16 m in diameter. These relatively small ring ditches are more likely to represent domestic activities as opposed to farming activity. Immediately to the east, **4019**, a similar ring ditch measuring approximately 13 m intersects with **4018**.

3.2.17 Two larger ring ditches are identified at **4020** and **4021**. These lie centrally within the **Area 2** and although their extents are unclear they appear to be the largest examples within the area.

3.2.18 Straight-edged rectilinear anomalies at **4022** appear towards the northern boundary of this area of activity. They are interpreted as Archaeology but there is no clear relationship with the surrounding features. These appear to form a “ladder” enclosure, which commonly date to the Romano-British period, which corresponds to the potential for the Site.

3.2.19 A segmented linear feature extending from **4023** to beyond feature **4016** crosses the central concentration of archaeological ring ditches. Similarly, a segmented linear

anomaly orientated parallel to this extends along **4017** plus further north-east/south-west sections on the western extents of this archaeological activity**,** all of which appear to denote the extents of settlement area.

3.2.20 Anomaly **4024** lies outside of the main extents of **Area 2**. This appears to be a curvilinear cut feature with some similar archaeological remains to the west and south but with no clear relationships.

3.2.21 **Area 3** on the western border of the Site is different to the previous two areas with two apparently discreet and clear rectangular features. It is acknowledged within the DBA that the Scheduled Monument is expected to extend into this part of the Site.

3.2.22 The positive linear trends at **4025** appear to be one segmented rectangular feature. The proximity of the A46 to the north and west may also have adversely affected the potential preservation of these archaeological remains. The full extent of this feature is not clear as it continues outside the survey boundaries.

3.2.23 To the south-west of **Area 3** there is a similarly segmented rectangular feature identified by **4026** and **4027**. This feature has no physical relationship with **4025** but the form and response of these two features is comparable.

3.2.24 Two large positive anomalies identified at **4028** and interpreted as possible pits appear distinct from the previously identified features within **Area 3**. However, they have similar values ranging between +6 nT and +8 nT and their proximity to the two rectangular features suggests a possible relationship.

3.2.25 Faint linear trends can be seen throughout the dataset in **Area 3**. These are likely to represent ditch-like or small cut features.

3.2.26 Large bands of weakly positive anomalies extend across three quarters of the Site. They are present in each of the fields and examples have been identified at **4029, 4030** and **4031**. They measure typically between 6 m and 7 m in width and vary in length depending on the size of the field. They have been interpreted as being of agricultural origin, most likely that of ridge and furrow.

3.2.27 A north-south linear trend is visible at **4032**. It lies directly parallel to field boundary to the east. It is interpreted as being a possible trackway or ditch relating to the field boundary. Previous trackways have been noted within the DBA, including a north-south Saxon trackway thought to be in the vicinity of this anomaly.

3.2.28 A former field boundaries depicted in historic maps dating to at least 1777 (Wessex Archaeology 2015) can be seen at **4033**, and although **4034** is currently a track it is highlighted as having archaeological potential. **4033** appears to continue west into the adjacent field where it is identified as **4035** but a large amount of ferrous begins to obscure the data.

3.2.29 Other sinuous anomalies can be seen within the geophysical dataset such as those at **4038**. These are indistinct to provide any accurate interpretation at this time.

3.2.30 Agricultural activity with varied provenance, from medieval to modern, is demonstrated across the Site as linear trends of varying magnitude. Those orientated approximately north-south at **4039** appear to be faint traces of ridge and furrow. This is evident in the wide spacing and regular form. Pairs of linear trends, such as **4040**, extend perpendicular

to **4039** and are also thought to denote ridge and furrow, their difference in response is attributed to the direction in which the data were acquired. Those at **4041** follow the previously identified ridge and furrow but are more modern in appearance. Further examples are identified at **4042** and **4043**.

3.2.31 Clusters of sub-circular anomalies at **4044** and **4045** show values ranging between +1 nT and +8 nT. These are suggestive of pits or postholes and may associated with nearby activity.

3.2.32 Superficial geology is identified on the Site at **4046**. This shows as an indistinct zone of positive relief against the magnetic background. Given the dense archaeology throughout the Site this anomaly should also be attributed interest.

4 CONCLUSION

4.1 Summary

4.1.1 A large concentration of linear, rectilinear and sub-circular positive anomalies lie within Area 1 to the north of the eastern field. At least two clear orientations are evident in the geophysical data, often intersecting one another suggesting continued use or differing phases of occupation. These features have been categorised as Archaeology, Probable Archaeology or Possible Archaeology depending on the strength of their magnetic signature, form and pattern but there is no doubt that the archaeological remains in this area are dense. These features are predominately characteristic of field systems and enclosures commonly identified from the Iron Age and Romano-British periods, although dating cannot be ascertained from geophysical data

4.1.2 The detailed gradiometer survey has been successful in detecting anomalies of archaeological interest across the Site, especially on the eastern field and the western survey extent. In addition to these, anomalies interpreted as ridge and furrow, ploughing, former field boundaries and superficial geology have also been identified.

4.1.3 The DBA for this Site suggests a high potential for archaeological remains related to the Scheduled Monument, interpreted as a Romano-British road side settlement complex located adjacent to the south-eastern survey boundary. The results of the survey support the suggestion that this activity continues into the survey area, with two rectilinear anomalies (**4025**, **4026**) being identified to the immediate north of the Scheduled Monument boundary.

4.1.4 The eastern field has two clear areas of archaeological activity. These appear to represent settlement activity consisting of possible co-axial and ladder enclosures, numerous ring ditches likely relating to roundhouses and smaller livestock enclosures. There are no obvious structural remains. These areas of activity are divided by linear anomalies and an area devoid of features which has been highlighted as being a possible segment of the Roman road previously identified as crossing the known north-south Roman road through excavation. As the features identified in this field are typical of the Iron Age and Romano-British period this could suggest a further roadside settlement.

4.1.5 It should be noted that the eastern field identified as having dense archaeological remains may be compromised by allotments identified from a 20th century OS map. The construction of the A46 may have compromised the archaeological remains to the west relating to the Scheduled Monument.

4.1.6 Frequent ploughing trends are visible across the Site on differing alignments. This is likely due to variable boundaries and different farming processes but are likely to be medieval, post-medieval and modern in provenance.

4.2 Recommendations

4.2.1 Given the high potential for the presence of archaeological remains within the proposed development area, an archaeological trial trench evaluation is recommended the aims of which will be to:

- *clarify the presence/absence and extent of any buried archaeological remains within the Site that may be disturbed by development;*
- *identify, within the constraints of the investigation, the date, character, condition and depth of any surviving remains within the Site;*

- *assess the degree of existing impacts to sub-surface horizons and to document the extent of archaeological survival of buried deposits; and*
- *to inform/decide upon an appropriate strategy for mitigation should any significant archaeological remains be encountered.*

4.2.2 It is recommended that the scale, scope and timing of any further evaluation will be set out in a Written Scheme of Investigation produced in consultation with the Worcestershire County Council Archaeologist.

5 REFERENCES

5.1 Bibliography

Wessex Archaeology, 2015. *Evesham, A46, Worcestershire*. *Desk Based Assessment*. Unpublished Client Report.

English Heritage, 2008.*Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Service Guideline No 1, 2nd edition.

5.2 Cartographic and documentary sources

1777 Great and Little Hampton Inclosure Map

1889 Ordnance Survey 6” (1:10.560)

1905 Ordnance Survey 6” (1:10.560)

1938 Ordnance Survey 6” (1:10.560)

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

Soil Survey of England and Wales, 1983.*Sheet 3, Soils of Midland and Western England*. Ordnance Survey: Southampton.

APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey methods and equipment

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 Historic England (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 Historic England (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.

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:

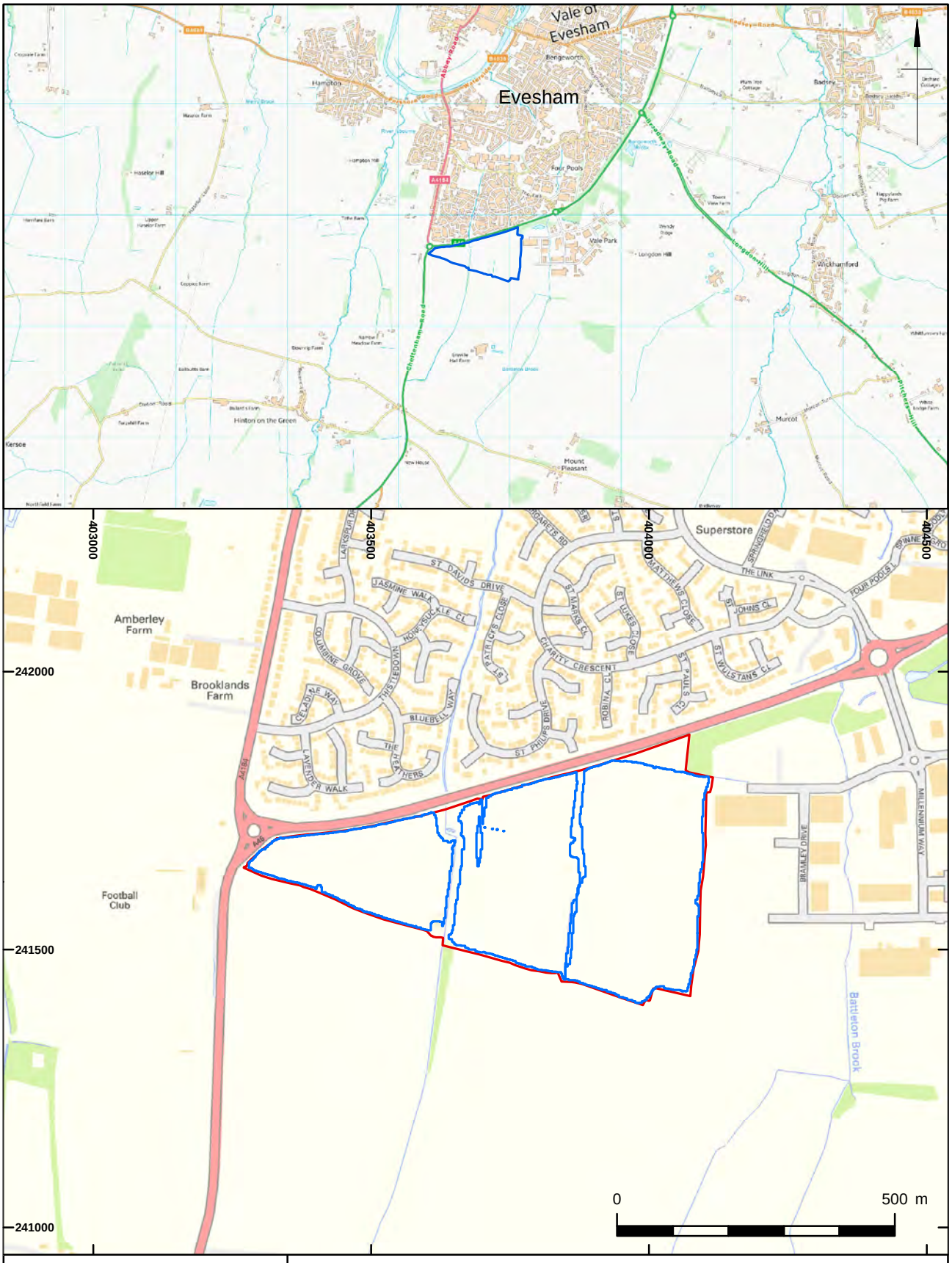
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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



Detailed Survey Extents

Site

Date:	06/10/15	Revision Number:	0
Scale:	1:25000 and 1:10000 at A4	Illustrator:	RAM
Path:	S:\PROJECTS\108091\GIS\FigsMXD\2015_10_06\108091_Fig01.mxd		

Site location and survey extents

Figure 1

403250
403500
403750
404000
241750
241500
+3nT
-2nT
0
100 m
Detailed Survey Extents

Date:	06/10/2015	Revision Number:	0
Scale:	1:2500 at A3	Illustrator:	RAM
Path:	S:\PROJECTS\108091\GIS\FigsMXD\2015_10_06\108091_Fig02.mxd		

Greyscale plot

Figure 2

403250

403500

403750

404000

241750

241500

+25nT

-25nT

0 100 m

Detailed Survey Extents

Date:	06/10/2015	Revision Number:	0
Scale:	1:2500 at A3	Illustrator:	RAM
Path:	S:\PROJECTS\108091\GIS\FigsMXD\2015_10_06\108091_Fig02.mxd		

XY Trace plot

Figure 3

403250
403500
403750
404000
241750
241500

Area 1
Area 2
Area 3

4000
4001
4002
4003
4004
4005
4006
4007
4008
4009
4010
4011
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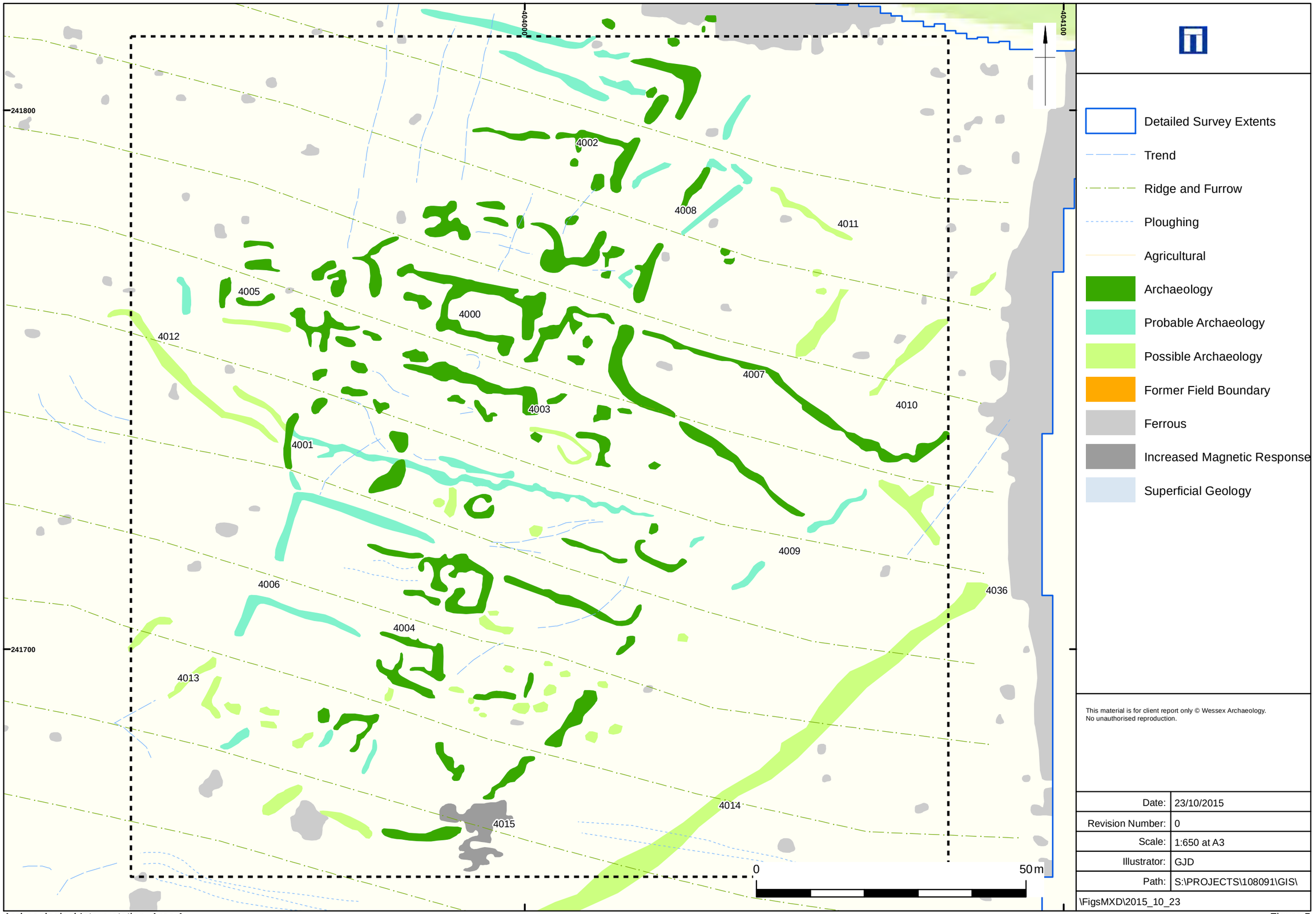
Detailed Survey Extents
Archaeology
Probable Archaeology
Possible Archaeology
Trend
Ridge and Furrow
Ploughing
Agricultural
Former Field Boundary
Ferrous
Increased Magnetic Response
Superficial Geology

0
100 m

Date:	23/10/2015	Revision Number:	0
Scale:	1:2500 at A3	Illustrator:	RAM
Path:	S:\PROJECTS\108091\GIS\FigsMXD\2015_10_23\108091_Fig04.mxd		

Archaeological Interpretation

Figure 4



Date:	23/10/2015
Revision Number:	0
Scale:	1:650 at A3
Illustrator:	GJD
Path:	S:\PROJECTS\108091\GIS\
\FigsMXD\2015_10_23	

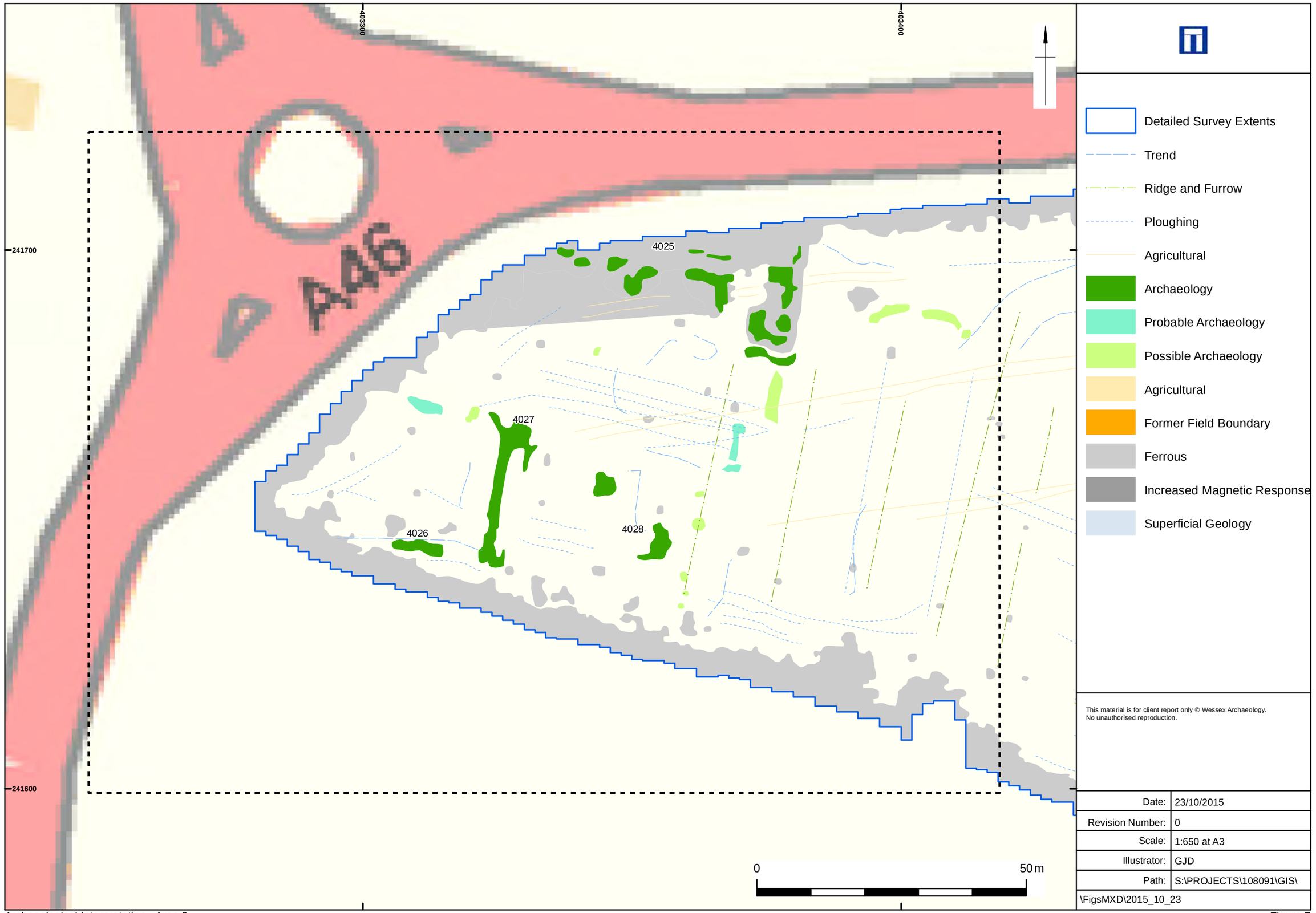
Archaeological Interpretation- Area 1

Figure 5

Date:	23/10/2015
Revision Number:	0
Scale:	1:650 at A3
Illustrator:	GJD
Path:	S:\PROJECTS\108091\GIS\
\FigsMXD\2015_10_23\	

Archaeological Interpretation - Area 2

Figure 6



Date:	23/10/2015
Revision Number:	0
Scale:	1:650 at A3
Illustrator:	GJD
Path:	S:\PROJECTS\108091\GIS\
\FigsMXD\2015_10_23	

Archaeological Interpretation - Area 3

Figure 7

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