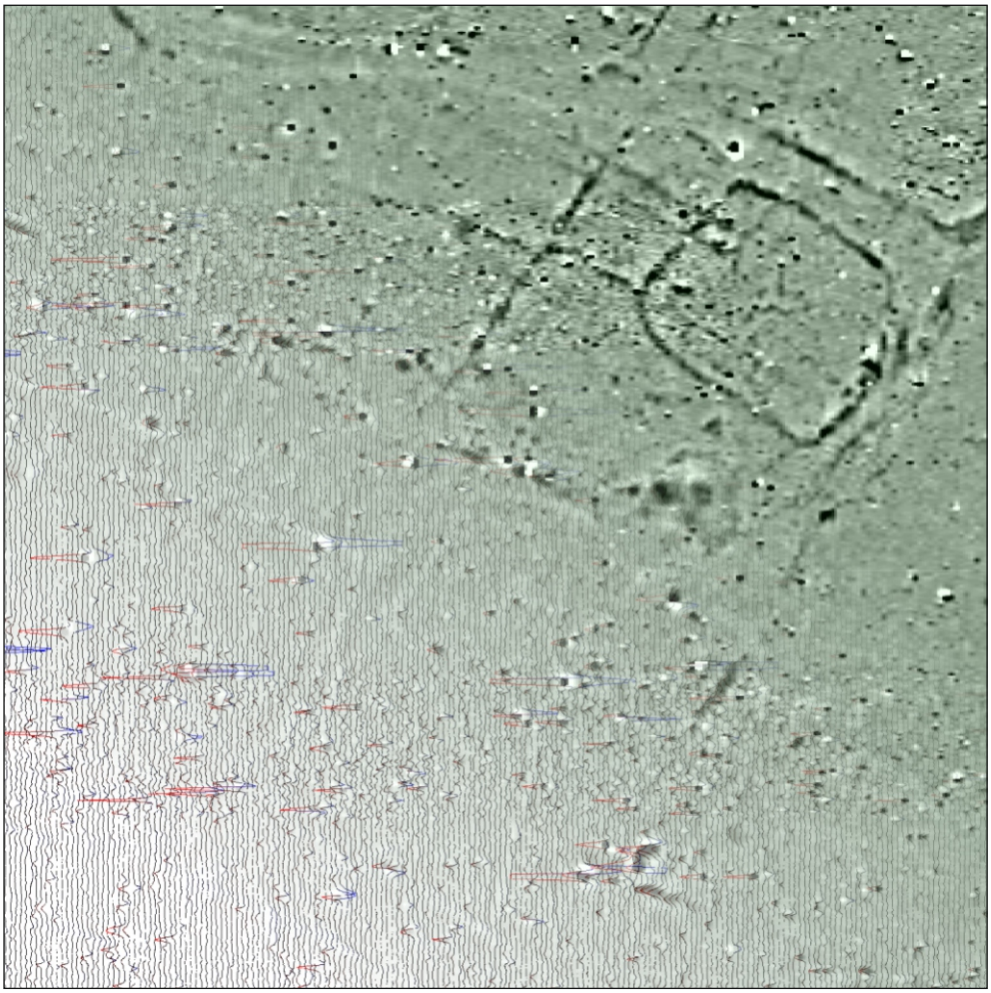
making sense of heritage

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report



Ref: 110130.02
October 2015

geoservices

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report

Prepared for:
GL Hearn Limited
280 High Holborn
London
WC1V 7EE

On Behalf of:
Henry Boot Ltd

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

www.wessexarch.co.uk

October 2015

Report Ref. 110130.02

Quality Assurance

Project Code	110130	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	586473, 189766		

Version	Status *	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*GJD*	*ECR*		28/08/2015
File:	\\projectserver\wessex\Projects\110130_Reports\110130_SouthendGEO_GJD_QC_ECR.docx				
v02	E	*ECR*	*LJL*		06/10/2015
File:	\\projectserver\wessex\Projects\110130_Reports\110130_SouthendGEO_QC_PAB.docx				
v03	E	*LJL*	*C Budd*		07/10/2015
File:	\\projectserver\wessex\Projects\110130_Reports\Submitted\Geo Report\110130_SouthendGEO_QC_PAB_CB_20151007.docx				
v04	F	*LJL*	*C Budd*		14/10/2015
File:	\\projectserver\wessex\PROJECTS\110130_Reports\Submitted\Geo Report\110130_SouthendGEO_v4.0_20151014.docx				

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

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report

Contents

Figures

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land associated with the proposed Airport Business Park, Southend, Essex (centred on NGR 586473, 189766). The project was commissioned by GL Hearn Limited, on behalf of their client Henry Boot Ltd, with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to inform a planning application for the development of the site.

The site comprised an area within arable fields located immediately to the northeast of Westcliff Rugby Club, covering an area of approximately 10 ha. This area is proposed for the relocation of the current Rugby Club and associated pitches. The geophysical survey was undertaken on 17th-21st August 2015. The detailed gradiometer survey, in conjunction with the results of previous trial trench evaluation work undertaken on a sample of the area, has demonstrated the presence of a number of anomalies of archaeological interest throughout the area.

The anomalies identified as being of archaeological interest are primarily ditch-like features with some evidence for associated pit features also evident. At least four enclosure systems have been identified, and finds recovered from the previous trial trenching evaluation in 1997 provide dating evidence to suggest occupation from the Late Bronze Age through to the Romano-British period.

To the north-east of the Site, complex areas of anomalies of archaeological interest are identified, including an Early Iron Age rectilinear enclosure comprised of ditch features. Surrounding this enclosure is evidence for an Iron Age/Romano-British field enclosure system. Centrally, a Late Iron Age/Early Romano-British banjo enclosure has been identified encircled by a potential double-ditch enclosure or trackway. To the south-west of the site a Late Bronze Age field enclosure system has also been identified.

Additionally, numerous discrete pits and ditches have been interpreted, along with a possible round house. Throughout the site other potential anomalies have been identified and defined as trends, areas of increased magnetic response and isolated ferrous responses, all of which have not been attributed with a clear archaeological potential. Given the very high archaeological potential, further archaeological remains than those which have been detected are considered likely to be present on the site. This theory is supported by the presence of additional features, largely discrete pits and postholes, which were recorded in the 1997 evaluation but are not visible within the geophysical data.

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report

Acknowledgements

Wessex Archaeology would like to thank GL Hearn Limited for commissioning the geophysical survey on behalf of their client Henry Boot Ltd. The assistance of Luke Davenport, Adrian Schofield and Chris Brake is gratefully acknowledged in this regard.

The fieldwork was undertaken by Alistair Salisbury and Becky Hall. Garreth Davey processed and interpreted the geophysical data whilst the report was written by Lucy Learmonth and Garreth Davey. The report was proof-read by Naomi Brennen. The geophysical work was quality controlled by Lizzie Richley and Dr Paul Baggaley. Illustrations were prepared by Kitty Foster. The project was managed on behalf of Wessex Archaeology by Caroline Budd.

Airport Business Park
Southend, Essex

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by GL Hearn Limited on behalf of Henry Boot Ltd (hereafter 'the Client') on behalf of their client Henry Boot Developments Limited to carry out a geophysical survey over land associated with the proposed Airport Business Park, Southend, Essex (**Figure 1**), hereafter 'the Site' (centred on National Grid Reference (NGR) 586473, 189766). This survey was designed to inform a planning application for the development of the Site.

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 following fieldwalking and evaluation works in 1997.

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 was located immediately to the northeast of Westcliff Rugby Club, approximately 1.4 km to the southeast of Rochford and approximately 3.7 km to the north of Southend-on-Sea.

1.2.2 The Site occupies an area of 10 ha of agricultural land, currently utilised for silage, which is proposed for the relocation of the Rugby Club and associated pitches in order to facilitate the proposed business park development. The Site is bounded by further agricultural land to the north, east and south whilst to the west is an area of open land and former buildings.

1.2.3 The Site is relatively flat, situated at an elevation of approximately 12 m above Ordnance Datum (aOD).

1.3 Soils and geology

1.3.1 The underlying geology of the Site is mapped as Eocene clay, silt, sand and gravel of the Thames Group Formation with superficial Quaternary sand and gravel river terrace deposits (British Geological Survey 2015).

1.3.2 The soils underlying the Site are likely to consist of typical argillic brown soils of the 571z (Hamble 2) association (SSEW 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 The archaeological background was assessed in detail within the *Historic Environment Assessment and proposed development framework for Westbarrow Hall Farm, Rochford* (Place Services 2012) and furthermore in the Historic Environment Settings Assessment undertaken by Wessex Archaeology (2015a). The results from these reports and the relevant Essex Historic Environment Record (EHER) entries are summarised below.

1.4.2 Neolithic artefacts were uncovered during quarrying around Cherry Orchard Farmhouse to the south-west of the Site during the 1970s (EHER 9746) and evidence for a Bronze and Iron Age enclosure has also been recorded in the vicinity within the Western Approaches (EHER 9113-4).

1.4.3 A field walking survey was undertaken over the wider development area in 1996 prior to brick-earth extraction. This work found an extensive spread of struck flint and burnt flint as well as concentrations of prehistoric pottery particularly within the area of the Site. A concentration of Roman pottery and tile was also found and thought to indicate a possible farmstead overlooking the river just to the north of the Site.

1.4.4 A trial trenching programme was then undertaken in 1997 (Essex County Council 2001). This comprised 31 trenches within the northern field, containing the survey area that this report is concerned with, and a further 30 trenches immediately to the south in the adjacent field. The results from the evaluation indicated considerable activity in the survey area dating from the Middle Bronze Age onwards. A small quantity of Saxon pottery recovered during the evaluation suggests activity from this time within or to the north of the Site and a number ditches on the north-eastern edge of the Site may be associated with the known medieval settlement of Partricheswyk.

1.4.5 The southern area of trenching, beyond the confines of the current survey area, revealed a much lower concentration of features, with little to no conclusive dating evidence. However, an additional area of possible prehistoric settlement was located adjacent to the Lancaster Business Park.

1.4.6 Excavations in the area of Cherry Orchard Farm in the 1950s located the remains of a Roman cemetery including an early 2nd century rich burial. A medieval or post-medieval kiln (EHER 9744) is also recorded to the east of the farmhouse which may be a precursor of the later brickworks which were situated to the west of the Site.

1.4.7 To the south-east of the Site was the location of Westbarrow Hall Farm which is documented from the 13th century and can be seen on late 19th century and early 20th century Ordnance Survey (OS) maps. Medieval occupation is also recorded to the north of the Site on a site later occupied by two 17th century cottages (EHER 13416). Cherry Orchard Farmhouse is itself a Grade II Listed Building and dates from the 17th century (list entry 1322397).

1.4.8 Given the proximity of the Site to London Southend Airport, a number of World War II structures were constructed in the region as perimeter defences (EHER 20712). These include an Anti-Aircraft gun emplacement (no longer existing), associated ammunition shelter, and three pillboxes. The ammunition shelter and one of the pillboxes lies within the southern 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 the 17th-21st August 2015.

2.1.2 Field conditions at the time of the survey were good, with mostly dry conditions during the survey. An overall coverage of 9.7 ha was achieved, the minimal reduction was due to the tree line encroaching from the field boundaries and the extant WWII feature in the southeast of the Site (**WA 39**, Wessex Archaeology 2015a).

2.1.3 The detailed gradiometer survey was conducted in accordance with Historic England guidelines (English Heritage 2008) and the Written Scheme of Investigation (WSI) (Wessex Archaeology 2015b).

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 recommendations (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 ferrous responses. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:1500 (**Figures 2** to **4**). The data are displayed at -2 nT (white) to +3nT (black) for the greyscale image and ±25 nT at 25 nT 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**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**. Where possible, the archaeological interpretation has been informed by evidence from the trial trenching undertaken in 1997 (Essex County Archaeology 2001). A correlation table which relates the results of the geophysical survey (by WA number) to the associated features and dating recorded by the trial trenching (by trench and context number) is provided in

Appendix 3 for ease of reference. Due to the complexity of the enclosures encountered, these have been phased by their probable periods and are illustrated in **Figure 5**. This figure also illustrates the locations of the previous trial trenches with their corresponding number. The location of the trial trenches is also shown on **Figure 4**.

3.1.3 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.

3.1.4 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.

3.1.5 Although no modern services have been identified within this dataset, 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 The clearest archaeological feature is evident at **4000** as a series of linear positive anomalies, characteristic of cut ditch-like features. These ditches are approximately 2-2.5 m wide and appear to form a rectilinear enclosure approximately 35 m by 45 m with an average magnitude of 2-3 nT. A possible break in the eastern ditch may denote an entrance. Evidence recovered during the trial trenching suggests that this enclosure dates to the Early Iron Age period.

3.2.2 Positive linear anomalies at **4001** appear to form a further later enclosure which, although on the same northeast/southwest alignment and also measuring approximately 2-2.5 m, appears to cut the enclosure identified at **4000**. The magnitude for this feature ranges from 0.5-2 nT. A wider range of dating evidence suggests that this feature may have been in use for an extended period, with numerous Early Iron Age, Middle Iron Age, Late Iron Age and Roman finds recovered, in conjunction with a residual medieval tile and a possible Late Bronze Age spindle whorl.

3.2.3 Due to their similar form, alignment and response, the ditches identified at **4002** and **4003** are likely to be related to **4001**. These have been identified by their own ID numbers due to their physical distance from **4001** (35 to 55 m). They have average magnetic responses of approximately 1.5 nT and 1.9 nT respectively. The dating evidence available from the trial trenching also dates **4003** to the Late Iron Age/early Romano-British period, however there were no finds recovered from **4002**. The extent of the overall enclosure (**4001**, **4002**, and **4003**) is approximately 75 m by 80 m.

3.2.4 There is a further ditch within the area of increased magnetic response associated with **4004** that may be related to the enclosure at **4000**, due to its form and alignment.

3.2.5 A group of positive anomalies also at **4004** have been interpreted as Probable Archaeology. Their magnitude range from 0.5-4 nT and their form suggests these are pit-like features within an enclosure ditch. Given the pattern and context, these anomalies at **4004** could potentially represent a gully denoting a possible roundhouse with a diameter of approximately 20 m but unfortunately there is no trenching evidence over these anomalies. However, Trench 19 approximately 20 m to the west is in an area where

a high concentration of pits and postholes was recorded. These features contained dating evidence ranging from Late Bronze to Late Iron Age.

3.2.6 Negative anomalies at **4005** have been identified as a pair of parallel ditch-like features some 7-8 m apart, orientated northwest-southwest and each approximately 2-3 m wide. At the north-western extent these ditches open up to form a circular shape approximately 32 m in diameter. The elongated trackway extending from this circular shape measures approximately 95 m. A possible break to the west is noted but this may simply be due to a much weaker response in this location. Given the scale and form of the feature, it is probable that this represents a banjo enclosure. These were originated around the middle of the 1st millennium BC but were most intensively used during the period from the Late Iron Age to the Roman invasion (100 BC to 43 AD) (English Heritage 2011), a date which is supported by Late Iron Age and Roman pottery which was recovered during the trial trenching.

3.2.7 A possible ditch identified as Probable Archaeology appears to be cut by the enclosure identified at **4005.** It is however not possible to identify full stratigraphic/context relationships between responses from gradiometer data alone. A number of smaller potential pits have also been identified in its vicinity

3.2.8 A series of negative linear features at **4006** appear to form a pair of fragmented parallel linear ditch-like features. These are aligned roughly east-west, and may turn gently to the north at the eastern extent. Whilst they appear to be quite fragmented and of irregular width, these anomalies do maintain a uniform separation and extend for over 200 m. They may represent a double-ditched enclosure or possibly delineate a trackway, which may be related to the banjo enclosure at **4005**. Late Iron Age and Early Roman pottery recovered from the trial trenching in 1997 supports the hypothesis that **4006** is contemporary with the **4005**.

3.2.9 Another pair of parallel weakly negative linear features has been identified at **4007**. These are more uniform in width, extending for just under 200 m, but are also fragmented within the dataset. These may form another segment of the possible double-ditched enclosure or trackway previously suggested to surround **4005**. These ditches respect the same orientation, scale and form as those found to the south at **4006** and are likely to be related. The only dating evidence available gives a Romano-British date which would place the ditches as roughly contemporary or later than **4006**.

3.2.10 A collection of north-east–south-west and southeast-northwest linear features are clear at **4008**. These ditches are relatively uniform and are all approximately 1.5-3 m wide. These meet at perpendicular angles and form an almost gridded area measuring approximately 130 m by 50 m.This feature appears toextend beyond the southern boundary of the survey area suggesting a continuation into the area to the south. These ditches appear to form a coaxial field enclosure system, of Late Bronze Age or earlier date based on the dating evidence available from the trial trenching.

3.2.11 A number of short lengths of positive anomalies at **4009,** to the north of the banjo enclosure, appear to represent further ditch-like features. These are approximately 2 m-2.5 m wide, each measuring approximately 15-20 m, and are aligned north-east–south-west or south-east–north-west. Given the form and the surrounding archaeological remains, it is possible that these anomalies may represent partial segments of an enclosure system.

3.2.12 Weak positive responses forming a linear feature at **4010** towards the eastern extent of the survey area may represent a possible isolated ditch-like feature. This feature is on a north-east–south-west alignment and measures approximately 50 m. This potential ditch does not have any obvious relationship with any previously discussed features as it lies on a slightly differing alignment and at a distance of over 50 m from any other identified feature. Despite the location of one of the trial trenches being situated over this feature there is no evidence recorded for a linear feature. This may be as a result of the very ephemeral nature of the feature or could suggest that the feature is natural in origin. However, the extremely regular nature of the features would indicate the former.

3.2.13 A number of magnetic anomalies identified at **4011** between **4000** and **4005** suggest an area of possible cut features which has been investigated by Trench 13. A number of these have been recorded as tree throws whilst others were recorded as pit and posthole features containing Early or Middle Iron Age pottery. Therefore, as the archaeological potential within the survey area is high, these have all been interpreted as Archaeology despite the potential for a proportion of them to be natural in origin.

3.2.14 Short positive linear anomalies measuring 15-20 m at **4012** in the north-east corner of the Site form isolated ditch-like features. These may be related to the enclosure activity surrounding **4000** and **4001,** however, they are more fragmented and weaker in magnetic response. The finds recovered in the vicinity were inconclusive and were simply recorded as Prehistoric pottery. These are located within a large area of increased magnetic response measuring 105 m by 45 m at its greatest extents, which may represent areas of occupational activity.

3.2.15 A number of oval shaped positive anomalies at **4013** have been interpreted as possible pit features given their grouping and proximity to further archaeological features. However, they may also be the result of natural variations in the superficial geology.

3.2.16 Positive magnetic responses at **4014** form an “L” shaped ditch-like feature. These are more difficult to interpret than other anomalies within this dataset as the response borders on that characteristic of ferrous. There is no evidence available from the 1997 investigations for this area; therefore, due to the very high archaeological potential of the Site, this anomaly has been interpreted as Possible Archaeology.

3.2.17 There are a number of weakly contrasting and indistinct linear and curvilinear trends present throughout the Site. These have been interpreted as trends of uncertain origin as their form or magnetic response is not defined clearly enough for accurate interpretation.

4 CONCLUSION

4.1.1 This is a complex, multi-period archaeological site, with features denoting separate periods of occupation apparent throughout the survey area. The detailed gradiometer survey has been successful in detecting anomalies of archaeological interest throughout the Site, and has provided additional context to the features excavated during the trial trenching investigations undertaken in 1997.

4.1.2 In addition to these features, anomalies interpreted as trends, areas of increased magnetic response and ferrous have also been identified. Previous experience gained from other sites of similar complexity would suggest that the geophysical survey will have identified a proportion of the actual number of archaeological features present. It is therefore considered likely that there will be additional present features on the Site. This theory is supported by the presence of additional features, largely discrete pits and

postholes, which were recorded in the 1997 evaluation but are not visible within the geophysical data.

4.1.3 The anomalies identified as being of archaeological interest are primarily ditch-type features forming a variety of enclosures dating to different periods. The most complex areas of archaeological interest are located in the north-east of the Site, where ditches form a rectilinear enclosure (**4000**), which appears to be cut by a later enclosure (**4001**). Located centrally is a further enclosure interpreted as a banjo enclosure (**4005**). In the south-west of the Site evidence for a probable field enclosure system (**4008**) has been identified.

4.1.4 It is clear from the dating evidence recovered during the trial trenching in 1997 that the Site was occupied over an extended period of time comprising a period from the Late Bronze Age through to the Romano-British period.

4.1.5 There are three main phases of archaeological occupation which are easily identifiable within this Site and likelihood that these would be further refined or added to should the Site be investigated further. The dating evidence available for **4001** and **4005** suggests that these enclosures were both in use during the Late Iron Age/Early Romano-British period. Similarly, the broad dating evidence for **4001** overlaps with **4000**. This evidence does not however conclusively prove that these enclosures were in use concurrently as the dating evidence spans hundreds of years. The remaining enclosure identified at **4008** is separated by clear dating evidence and has been dated to the Early Iron Age.

4.1.6 The earliest known activity on the Site is recorded at **4008**, thought to be a coaxial field system. During the previous trial trenching investigation, some of these features were recorded as Late Bronze Age due to dateable pottery recovered. The report states that some ditches within this probable field enclosure system may have been of an earlier date, although no material evidence was recovered to support this supposition.

4.1.7 The central enclosure (**4005**), interpreted as a banjo enclosure, has been dated to the Late Iron Age/Romano-British period. This places its occupation within the most intensive usage period for this style of enclosure. The Site however is beyond the geographical extents within which banjo enclosures are most common. Banjo enclosures have been interpreted as symbols of high status (English Heritage 2011) and it is therefore conceivable that this feature may have marked a higher status area or period in the occupation of the Site as a whole. This may indicate a connection with the Roman building suspected to be present to the north (Place Services 2012).

4.1.8 The enclosure identified as **4001** was dated to the Middle/Late Iron Age pottery although some Roman finds were also recovered which may signify its continued occupation.

4.1.9 Areas of increased magnetic response are located close to the areas of archaeological interest. Responses such as these are common in areas of occupation and are typically as a result of burnt materials or other debris and as such may be further evidence for occupation on the Site.

5 RECOMMENDATIONS

5.1.1 Following the results of the geophysical survey it is considered that, should the proposals for the relocation of the Rugby Club and pitches result in any below ground impacts to the Site further archaeological investigations will be required by the Senior Historic

Environment Officer for Essex County Council acting as archaeological advisor to Rochford District Council .

5.1.2 Given the complexity of the archaeological remains on the Site and of the development proposals for the Airport Business Park and Rugby Club in its entirety it is proposed that appropriate strategies are discussed and agreed with the Senior Historic Environment Officer for Essex County Council. This could, for example, comprise areas of strip, map and sample along with detailed excavation areas targeted on regions of archaeological potential where construction impacts are anticipated.

5.1.3 Once agreed these will be formalised via a Mitigation Strategy document which would provide clarity on the strategies to be applied to the development site as a whole. This would provide an appropriate means of mitigation in respect of the negative impacts to the archaeology by the proposed development. This document would inform the preparation of appropriate Written Schemes of Investigation for the different elements of the construction programme.

6 REFERENCES

6.1 Bibliography

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

English Heritage, 2011. *Introductions to Heritage Assets*, *Banjo Enclosures*. Guidelines/Standards.

Essex County Council Planning – Field Archaeology Unit, 2001 *Westbarrow Hall Farm, Rochford, Essex – Archaeological Evaluation*.

Place Services, 2012, *Historic Environment Assessment and proposed development framework for Westbarrow Hall Farm, Rochford*

Wessex Archaeology, 2015a, *Airport Business Park, Southend, Essex. Historic Environment Settings Assessment.*

Wessex Archaeology, 2015b, *Airport Business Park, Southend. Written Scheme of Investigation for Archaeological Geophysical Survey.*

6.2 Cartographic and documentary sources

Soil Survey of England and Wales, 1983. *Sheet 4, Soils of Eastern 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.

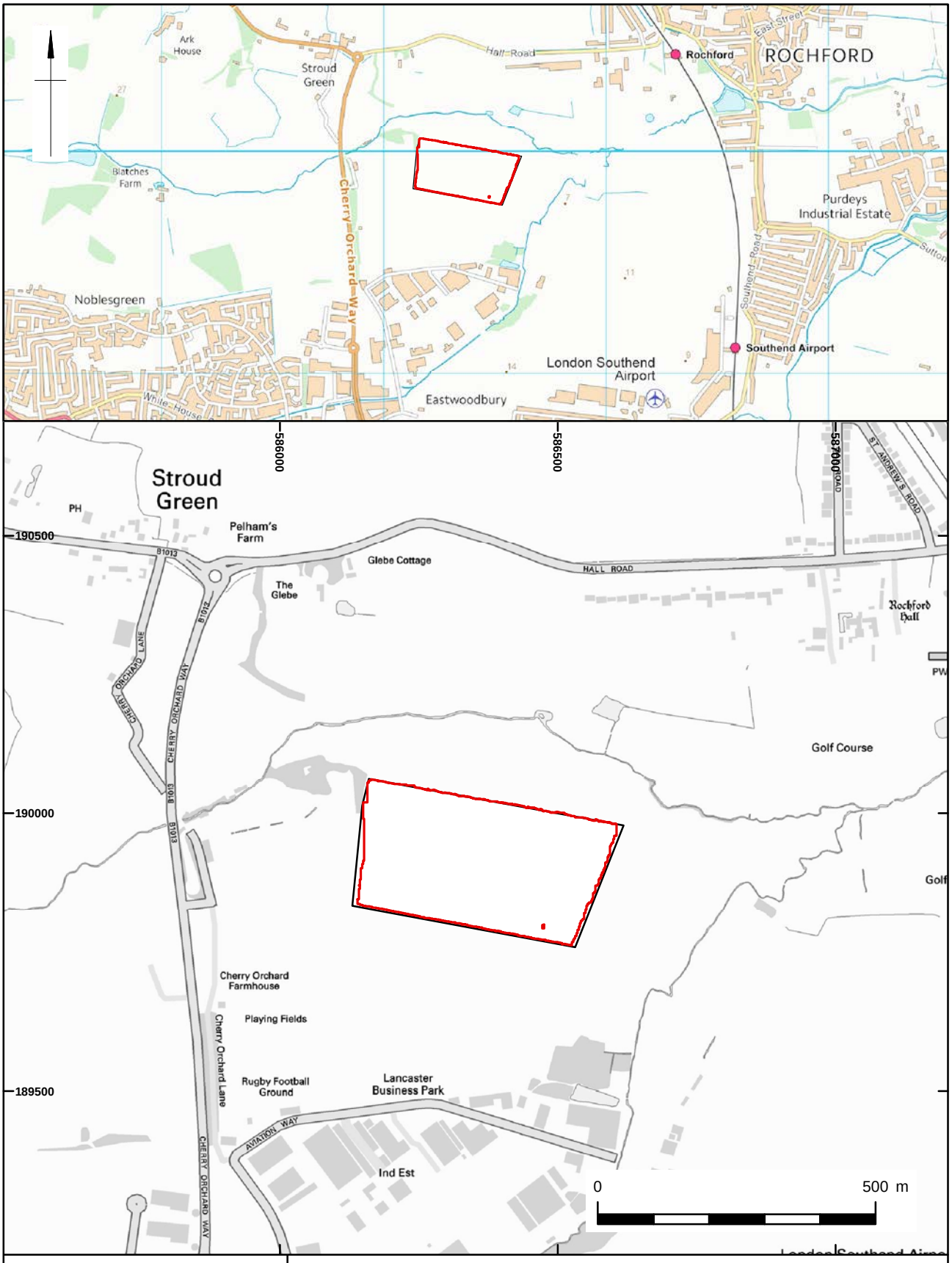
The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- 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.

APPENDIX 3: GAZETTEER OF 1997 TRIAL TRENCHING RESULTS CORRELATED TO GEOPHYSICAL ANOMALIES

WA ID	WA Interp	Trench	ECC Context	Eval Feature	Fill Description	Dating evidence
4000	Enclosure	23	318	Linear aligned E-W, sloping sides, flat base, 0.88m wide	Dark brown orange clay silt, occasional charcoal flecks and burnt flints. Dark brown black clay silt containing occasional charcoal flecks and burnt flints. Mid orange brown clay silt containing occasional flecks of daub and burnt flints (Primary).	Early Iron Age and undiagnostic prehistoric pottery
			1174	Linear aligned E-W, sloping sides, flat base, 1.32m wide - recut of [318].	Mid brown orange silty clay, bioturbation.	None provided/available.
		25	496	Unexcavated linear aligned NW-SE, 1.83m wide.	None provided/available.	Prehistoric pottery
4001	Enclosure	24	385	Unexcavated linear aligned NW to SE, 0.35m wide.	None provided/available.	None provided/available.
			398	Unexcavated linear aligned E-W, 2.2m wide.	None provided/available.	Early-Middle Iron Age and Roman pottery
		18	281	Linear aligned NE -SW, 3m wide, sloping sides, flat base.	Black sandy clayey silt containing charcoal, burnt clay and small stones.	Middle Iron Age pottery and a fragment of a triangular loomweight of Early or Middle Iron Age date.
		19	1233	Linear aligned NW-SE, excavated in two segments. Extended beyond trench to NW and terminated to the SE within it. Sloping sides, flat base, 1m wide.	Dark grey brown silt containing frequent charcoal flecks and occasional daub, chalk and burnt flints. Grey brown silty clay containing common charcoal and rare chalk and small stones.	Early Iron Age pottery and a fragment of residual post-medieval tile.
			443	Linear feature, aligned NW-SE, extending beyond trench. Convex sides, greater than 2m wide, not fully excavated.	Mid yellow brown silt containing occasional charcoal and daub flecks, and small flints. Mid yellow brown silt containing occasional chalk and charcoal fleck.	Early Iron Age pottery in lowest excavated fill, late Iron Age pottery upper fill. An unusual reel-shaped object, possibly a spindle whorl, of late Bronze Age to early Iron Age date.
4002	Enclosure Ditch	22	1186	Unexcavated, possible linear, 8m wide.	None provided/available.	None provided/available.
4003	Enclosure Ditch	25	520	Linear feature, 3.15m wide, aligned E-W, sloping sides, not fully excavated,	Filled by a succession of mid to dark brown silty clays containing varying quantities of charcoal. The lowest excavated fill comprised a green brown silt containing frequent shell fragments and had a high organic content. This fill was partially water-logged.	Undiagnostic prehistoric and Late Iron Age or early Roman pottery (upper fill).
4004	Potential Roundhouse	Not trenched.				
4005	Probable Banjo Enclosure	7	60	Linear aligned E-W extending beyond trench. Concave sides, concave base, 3.35m wide.	Light orange brown sandy silt that contained occasion charcoal and manganese flecks.	Late Iron Age pottery (possibly residual).
		10	76	Linear aligned N-S and extending beyond the edges of the trench. V-shaped profile, 1.15m wide.	Light orange brown silt containing occasional charcoal flecks.	Prehistoric pottery.
			78	Linear terminating to N and extending beyond trench. Sloping sides with flat base, 1.05m wide.	Light grey brown silt containing occasional charcoal and manganese flecks.	Prehistoric pottery.
			80	Linear feature, terminating to S and extending beyond trench. Steeply sloping sides, flat base, 0.53m wide.	Light grey brown silt containing frequent charcoal and manganese flecks and rare small stones	Roman pottery.
4006	Possible double ditch enclosure or trackway	8	128	Linear aligned E-W and extending beyond trench, 1.61m wide.	Light yellow red silty clay with rare chalk flecks and small stones.	Prehistoric pottery
		9	68	Linear aligned NW-SE, 2.05m wide.	Light yellow brown clay silt containing rare charcoal flecks. Primary was dark red brown silt with rare charcoal flecks.	Late Iron Age pottery (primary fill). Late Bronze Age, early Roman and medieval pottery (secondary fill).
		14	265	Linear aligned NE to SW extending beyond trench. Steeply sloping sides, 2m wide, not fully excavated.	Filled by a series of grey brown silts containing charcoal flecks and manganese stains.	Late Iron Age pottery (secondary fill).

WA ID	WA Interp	Trench	ECC Context	Eval Feature	Fill Description	Dating evidence
4007	Possible double ditch enclosure or trackway	5	100	Linear aligned E-W. Steeply sloping sides, flat base, 1m wide.	Primary was mid reddish brown sandy clay with common iron panning and occasional small stones. Secondary was mid red brown silty sand with no inclusions.	A spindle whorl made from a Roman potsherd.
		4	24	Linear aligned NE-SW. Convex sides to W, steeply sloping to E, flat base, 0.98m wide.	Dark grey brown silty clay, which contained common charcoal flecks and rare small flints.	Abraded residual prehistoric pottery.
4008	Enclosure	1	38	Linear feature that terminated to the south-west and extended beyond the edge of the trench to the north-east. Concave sides, flat base, 1.17m wide.	Light yellow brown clayey silt with occasional flecks of charcoal and daub, and rare burnt flint.	Late Bronze Age pottery.
			56	Linear feature aligned north-east to south-west. V-shaped profile, 0.72m wide.	Light yellow brown clayey silt with occasional flecks of charcoal.	Late Bronze Age or earlier as cut by [38]
			65	Linear feature aligned north to south. V-shaped profile, 0.98m wide.	Light yellow brown silt with occasional flecks of charcoal and daub.	None provided/available.
			106	Linear feature aligned east to west, which extended beyond the edges of the trench. Steeply sloping sides, concave base, 0.92m wide.	Light yellow brown silt with occasional flecks of charcoal.	None provided/available.
4009	Possible Enclosure System	Not trenched.				
4010	Possible Ditch	29	Not evident in trench.			
4011	Pits	13	121	Irregular cut aligned E-W extending beyond the trench. Irregular sides and base, 1.8m wide. Interpreted as tree-throw disturbing earlier features.	A series of yellow brown silty clays containing varying quantities of charcoal and flints.	Early to Middle Iron Age potsherds.
			283	Irregular feature 0.9m by 0.6m. Steeply sloping sides, not fully excavated. Likely tree-throw.	Sterile mid yellow brown sandy silt.	None provided/available.
			381	Sub-rectangular aligned N-S and extending beyond the trench. Steeply sloping sides, base not excavated, 0.74m by 0.31m.	A series of orange brown silty fills containing rare to occasional burnt flints.	Early to Middle Iron Age pottery.
			1196	Irregular feature aligned E-W, extending beyond the trench. 1.25m long by 0.90m wide. interpreted as tree-throw disturbing earlier features.	Dark orange brown silty clay, over mid yellow brown sandy silt.	Early Iron Age pottery.
4012	Probable ditches	32	654	Linear aligned W-E. 3.60m wide, concave sides, not fully excavated.	Mid grey brown clay silt over mid grey brown silty clay containing occasional small stones. The lowest excavated fill was mid orange grey clay silt containing occasional manganese stains and iron panning.	None conclusive.
		31	1190	Unexcavated linear feature, 6.50m wide, aligned east to west, which extended beyond the edges of the trench.	None provided/available.	Prehistoric pottery.
		31	612	Linear 1.42m wide, aligned SE-NE extending beyond trench. Steeply sloping sides, irregular base..	Dark grey brown silty clay containing occasional small stones and shell fragments.	Late Iron Age/Early Roman pottery.
4013	Pits	Not targeted by trenching.				
4014	Possible Ditch	Not trenched.				



Site Boundary

Detail Survey Extents

Date:	04/09/2015	Revision Number:	0
Scale:	1:25000 & 1:10,000 at A4	Illustrator:	KJF
Path:	X:\PROJECTS\110130\GIS\FigsMXD\Geophys\2015_09_04		

Site location

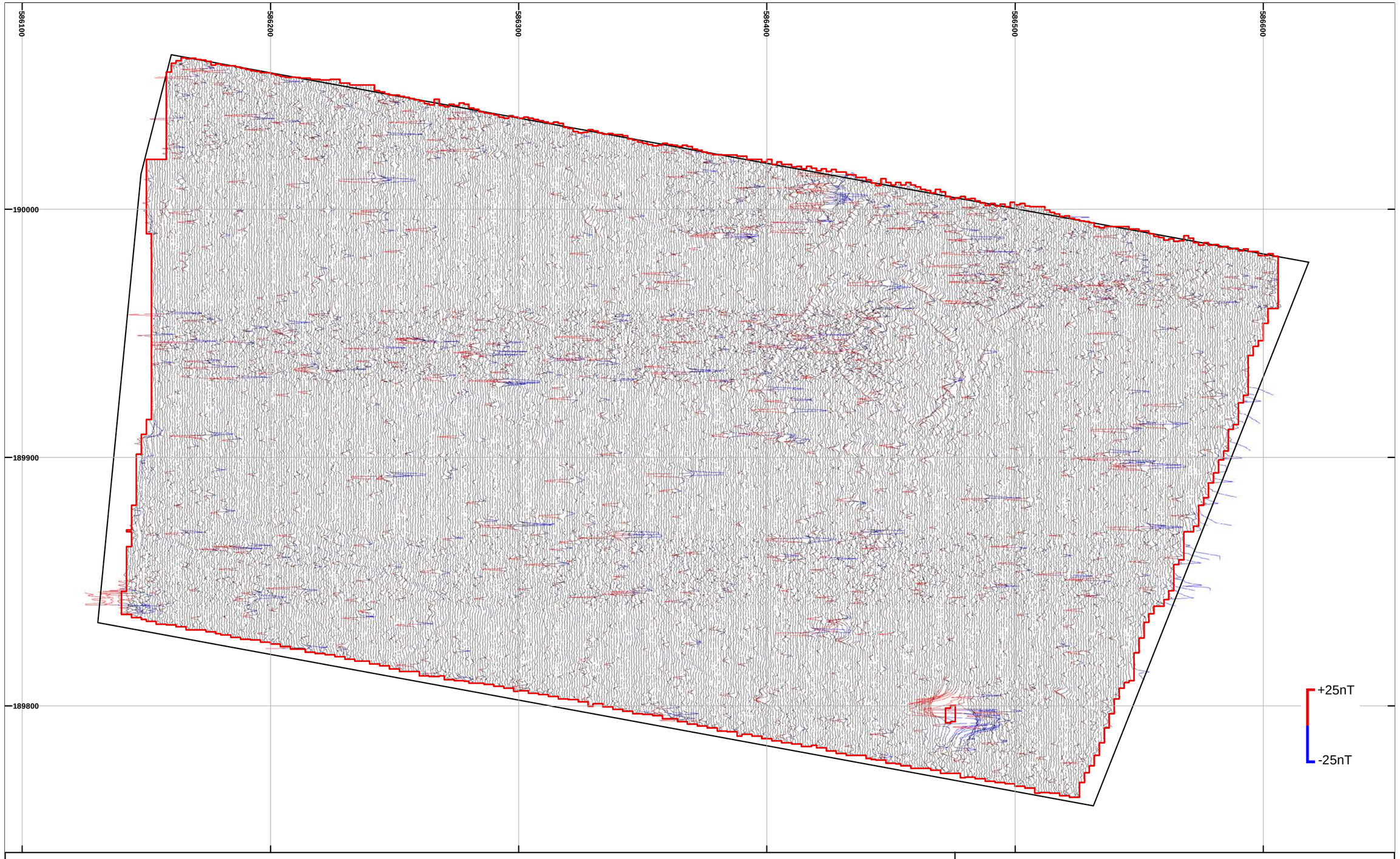
Figure 1

586100
586200
586300
586400
586500
586600
190000
189900
189800
+3nT
-2nT
Site Boundary
Detail Survey Extents
0
50 m

Date:	04/09/2015	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	KJF
Path:	X:\PROJECTS\110130\GIS\FigsMXD\Geophys\2015_09_04		

Greyscale plot

Figure 2



Site Boundary

Detail Survey Extents

0 50 m

Date:	04/09/2015	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	KJF
Path:	X:\PROJECTS\110130\GIS\FigsMXD\Geophys\2015_09_04		

XY trace

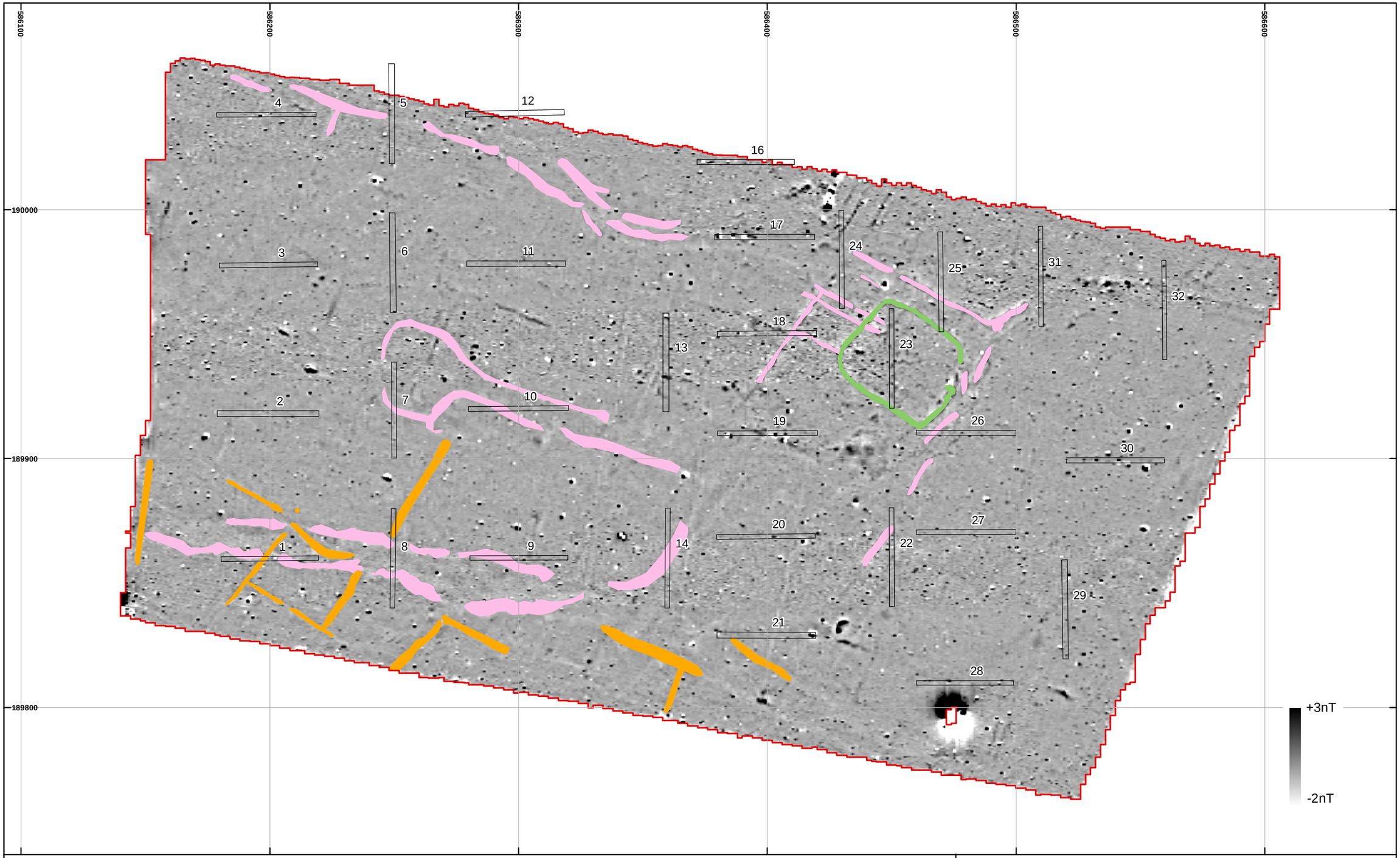
Figure 3

586100
586200
586300
586400
586500
586600
190000
189900
189800
4007
4013
4009
4003
4012
4001
4000
4011
4005
4004
4002
4006
4010
4008
4014
Detail Survey Extents
Archaeology
Probable archaeology
Possible archaeology
Ferrous
Increased Magnetic Response
Trend
Agricultural
Essex County Archaeology 1997 Trial Trenches
0
50 m

Date:	02/10/2015	Revision Number:	1
Scale:	1:1500 at A3	Illustrator:	GJD
Path:	X:\PROJECTS\110130\GIS\FigsMXD\Geophys\2015_10_02		

Interpretation

Figure 4



Detail Survey Extents

Late Bronze Age

Early Iron Age

Late Iron Age/Early Romano-British

Essex County Archaeology 1997 Trial Trenches

0 50 m

Date:	02/10/2015	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	RAM
Path:	X:\PROJECTS\110130\GIS\FigsMXD\Geophys\2015_10_02		

Proposed phasing

Figure 5

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