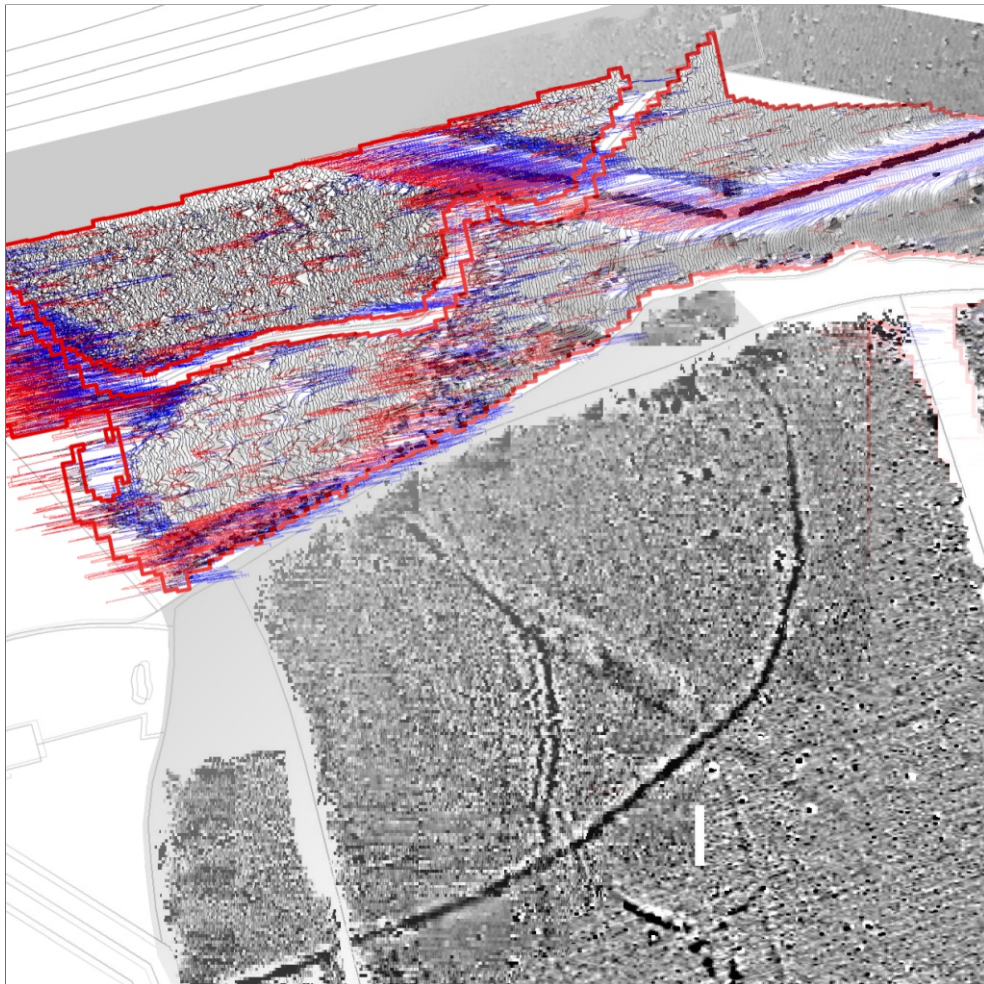




making sense of heritage

Land Off Tithebarn Lane Redhayes, Exeter, Devon

Detailed Gradiometer Survey Report



Ref: 109300.01
October 2015



**Land Off Tithebarn Lane
Redhayes, Exeter, Devon**

Detailed Gradiometer Survey Report

Prepared for:
CgMs Consulting
140 London Wall
London
EC2Y 5DN

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

www.wessexarch.co.uk



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Summary

A detailed gradiometer survey was conducted over land at Tithebarn Lane, Redhayes, Exeter, Devon (centred on 297600, 093800). The project was commissioned by CgMs Consulting with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for the site as residential housing development consisting of 412 new homes.

The survey area consists of several arable fields located to the north and south of Tithebarn Lane, covering an area of 33.6ha. It has a mixed use of arable and pasture. The geophysical survey was undertaken over five mobilisations between 11th May and 8th September 2015 using Bartington Grad601 instruments. The survey has demonstrated the presence of anomalies of likely, probable and possible archaeological interest along with former field boundaries, ploughing and other agricultural anomalies, areas of increased magnetic response, trends of uncertain origin and a modern service.

In the northern area of the site, the geophysical data revealed a concentration of several circular and linear anomalies, interpreted as ditches and enclosures as well as a number of probable pits mostly concentrated spatially around the ditches and enclosures. They indicate the likely presence of more than one phase of settlement of unknown date but archaeological evidence from previous evaluations and geophysical survey on land within the overall survey area and to the east and south of the site suggests origins across the prehistoric and medieval periods.

In the southern area of the site further ditches and enclosures, including two ring ditches, were identified but at a lower concentration and overall much weaker in magnetic response. There were fewer pit type anomalies detected but several larger areas of increased magnetic response which could possibly be of archaeological potential if they constitute spreads of debris and refuse from former settlement activity.

Within the central portion of the site, few pit-like features are observed. Of the anomalies present, most are continuations of linear features seen in the north and the south with some extending across the site horizontally which have been interpreted as possibly being former field boundaries.

Other features identified across the site include former field boundaries corresponding to in location and orientation to former field boundaries on historic mapping. As well as this were numerous ploughing trends and trends of uncertain origin which are too weak and ephemeral and considered to have low archaeological potential.



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The fieldwork was undertaken by Jen Smith, Diana Chard, Stewart Wareing, Phil Breach, Phil Maier, Mike Keetch, Becky Hall, Rachel Williams, Vi Pieteron and Alistair Salisbury. Jen Smith and Genevieve Shaw processed the geophysical data. Alistair Salisbury and Genevieve Shaw interpreted the data and also wrote the report. The geophysical work was quality controlled by Lizzie Richley and Lucy Learmonth. Illustrations were prepared by Richard Milwain. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.



Land Off Tithebarn Lane Redhayes, Exeter, Devon

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1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a geophysical survey over land off Tithebarn Lane, Redhayes, Exeter, Devon (hereafter “the Site”, centred on 297600, 093800) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the development of residential housing.

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-east of the village of Pinhoe and 6 km northeast of Exeter, in the county of Devon.

1.2.2 The Site occupies an area of 33.6ha of agricultural land, currently utilised for barley crop and some pasture. The Site is bounded to the north by the West of England Main Line Railway, agricultural land to the east, Honiton Road (A30) to the south and Langaton Lane to the west. Pinhow Brook runs through the northern area of the Site from approximately west to north-east.

1.2.3 The Site is on northeast facing slight incline sloping from approximately 15 m above Ordinance Datum (aOD) at the north-eastern corner to approximately 38 m aOD at the southern edge.

1.3 Soils and geology

1.3.1 The solid geology under the Site is variable given the expanse of area covered. The bedrock geology of the northern and southern areas of the survey is likely to comprise mudstone and sandstone of the Dawlish Sandstone Formation whilst areas of sandstone from the Monkerton Formation have been recorded across the centre of the site. Overlying superficial geological deposits of Head and River Terrace Deposits have been identified in patches to the north of the Site area in the vicinity of Pinhoe Brook (BGS 2015).

1.3.2 The soils underlying the Site are likely to consist of typical brown earths of the 551a (Bridgnorth) association (SSEW SE Sheet 5-2 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. Previous gradiometer surveys have been undertaken adjacent to the survey areas and they have detected archaeological remains (Stratascan 2006; Stratascan 2011).

1.4 Archaeological background

- 1.4.1 Aerial photography shows the site of a large, probably circular enclosure on either side of Langaton Lane to the north of Tithebarn Lane. It is interpreted as Prehistoric and has SHINE protected status relating to the single curvilinear ditched enclosure and also a ring ditch to the southwest and linears south east of Roblynn's Hideaway (Devon HER No. MDV28622).
- 1.4.2 A number of geophysical surveys and archaeological evaluations have been undertaken adjacent to the north, east and south of the Site. Gradiometer survey targeting the recorded cropmarks in the north of the Site identified the large, curvilinear enclosure ditch corresponding to the known cropmarks and also revealed further ditch and pit-type anomalies potentially showing more than one phase of settlement (Stratascan 2006; Stratascan 2011).
- 1.4.3 Gradiometer survey immediately adjacent to the east of the Site identified a number of rectilinear ditches forming enclosures and/or field systems and a possible ploughed out barrow (GSB Prospection 2014). A subsequent evaluation targeted several of the anomalies as part of the overall trenching scheme and dating evidence from the Neolithic/Bronze Age and the post-medieval period was confirmed from only two of the ditch anomalies. Of the geophysical anomalies targeted during the evaluation the majority were confirmed as archaeological. However, some of the linear ditch and pit-type anomalies were found to be natural in origin, being tree throws, a geological hollow and a periglacial channel aligned with one of the confirmed ditches. The possible ploughed out barrow was not targeted and is therefore unconfirmed (Ellis 2015).
- 1.4.4 To the south of the Site between Blackhorse Lane and Honiton Road (A30) a magnetometer survey was undertaken due to the possible presence of medieval strip fields and as many as six possible prehistoric ring ditches identified from aerial photography (Devon HER No. MDV64550). The survey identified anomalies relating to former agricultural activity including land boundaries and other linear and curvilinear anomalies which were interpreted as ditch-like features but of uncertain origin (Sabin & Donaldson 2007).
- 1.4.5 The types of features previously identified from the geophysical surveys outlined above primarily consist of large curvilinear and rectangular enclosure ditches, pits and ring ditches interpreted as possibly ploughed out round barrows.



2 METHODOLOGY

2.1 Introduction

- 2.1.1 The detailed gradiometer survey was conducted using a Bartington Grad 601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (English Heritage 2008).
- 2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team in four phases between the 11th May and 8th September 2015. Field conditions at the time of the survey were good, with dry conditions throughout the period of survey however areas of high mature crop were present onsite and as such certain areas of the Site were unsurveyable. An overall coverage of 29.3 ha was achieved out of a proposed 33.6ha.

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 English Heritage 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 English Heritage (now Historic England) guidelines (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 anomalies of likely, probable and possible archaeological interest across the Site, along with areas of increased magnetic response, former field boundaries, ploughing trends, areas of superficial geology and one modern service. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:2000 (**Figures 2 to 7**) with the results of the Stratascan 2006 and 2011 gradiometer surveys included in the overall Site interpretation (**Figures 8 to 9**). 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 (**Figures 4, 7 and 9**). The anomalies are numbered in the figures and described in the text in order of archaeological potential with Archaeology, Probable and Possible Archaeology the most significant and described first. Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.
- 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.
- 3.1.1 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

North: Fields A–F (Figures 2–4; Figures 8–9)

- 3.2.1 A number of anomalies of archaeological potential have been identified both within the cropmark enclosure and outside of it. The relative relationships between the anomalies cannot be identified from this geophysical survey alone but some differences between the types of features interpreted can be suggested.
- 3.2.2 A narrow linear positive anomaly at **4000** is a continuation of an enclosure ditch identified during a previous gradiometer survey (Stratascan 2006). There are at least four discrete circular anomalies of different sizes in a linear orientation at **4001** with further circular, positive anomalies either side of the ditch at **4000**. The larger pits are stronger in magnetic values typically between +6 and +12 nT.
- 3.2.3 Positive linear anomalies visible at **4002** and **4003** suggest further sections of ditches with two sets of anomalies perpendicular to each other. It cannot currently be ascertained whether these are part of a separate enclosure or potentially associated with the enclosure ditch at **4000**.



- 3.2.4 A section of linear positive anomaly is just visible at **4004** oriented south-west to north-east and this is a continuation of an anomaly identified from the previous adjacent survey. Although interpreted as ditch-type feature it does not continue towards the large circular enclosure ditch as expected to, this, however, could be due to the survival of the feature also. It is in the vicinity of a ring ditch which lies immediately to the west (Stratascan 2006) and could potentially be part of a larger overall feature associated with this.
- 3.2.5 A series of intermittent linear and curvilinear positive anomalies at **4005** form an overall 'Y' shaped or forked ditch feature. This does not seem to lead to or connect with any of the other larger ditch anomalies identified from previous geophysical survey (Stratascan 2011). It is large and irregular in layout and its morphology is more similar to the double-ditch feature that was identified within the larger circular cropmark enclosure.
- 3.2.6 A narrow linear positive anomaly at **4007** is interpreted as a ditch type feature which is oriented north-west to south-east. It is possibly associated with **4002** due to its proximity and similar orientation.
- 3.2.7 A very weak linear anomaly at **4009** is in the vicinity of the ditch enclosure at **4000** and potentially part of the same rectangular enclosure feature seen across the Wessex survey and Stratascan survey. The magnetic strength along the anomaly is less than +0.5 nT and it is broader in layout suggesting an ephemeral or lesser surviving feature especially when compared to the response of +9 nT of the ditch at **4000**. The southern extent of this enclosure is not distinguishable from the data. The pit type anomalies are discrete and not thought to represent intermittent sections of ditch although an association between these features is possible.
- 3.2.8 A strong linear positive magnetic anomaly is located at **4011** within a larger area of ferrous response that borders the current field boundary and Pinhoe Brook. Although possibly a ditch type anomaly it is within an area of ferrous and may be modern in origin and is therefore interpreted as Possible Archaeology.
- 3.2.9 Several approximately oval-shaped and short linear positive anomalies around **4012**, typical in response as pits or sections of ditch, have been grouped together due to their concentration within the possible enclosure ditches of **4002**, **4003** and **4007**. They vary in magnetic strength with the more oval-shaped pit type anomalies stronger in response and more characteristic of burning or industrial-type features.
- 3.2.10 A positive linear anomaly at **4013** is on a different orientation to the anomalies of Possible Archaeology in its vicinity. It is possibly a ditch oriented north-east to south-west but its date or relationship to other nearby features cannot be interpreted further.
- 3.2.11 A series of short linear positive anomalies within a larger area of ferrous response at **4014** is very similar in response and context to **4011** (see above). They are picked out against the ferrous background as they are formed of a series of positive magnetic anomalies as opposed to dipolar anomalies which are indicative of ferrous type material. However, they could be modern or geological in origin and have therefore been interpreted as Possible Archaeology.
- 3.2.12 Similar to the types of anomalies seen around **4012** there are further anomalies going eastwards around **4015** and **4016** along the route of Pinhoe Brook. Their location could be indicative of their function. They have been characterised as Possible Archaeology as some of the magnetic profiles of the pit-type anomalies are verging on ferrous in their response, it also cannot be ruled out that they may be of natural or geological origin.



- 3.2.13 Two perpendicular linear anomalies at **4018** could potentially indicate another enclosure ditch but it cannot be shown whether this feature abuts the large circular cropmark enclosure as it does not appear in this area of survey. A second linear ditch anomaly at **4019** is in the same orientation as the east ditch at **4018** and may therefore be contemporary.
- 3.2.14 A weakly positive linear anomaly at **4020** is potentially a single ditch oriented northwest to southeast. Only when viewed together with the adjacent previous geophysical survey is it apparent that this is a continuation of a much larger ditch feature which extends further to the north-west and also appears connected to the double ditch feature seen in this data (Stratascan 2011). This ditch looks similar in response and is straight like the former field boundaries but it is on a completely different orientation and also appears to connect to a double ditch feature thought to be prehistoric (Devon HER No. MDV28622). This ditch at **4020** and its continuation further north-west also crosses the circular cropmark enclosure ditch.
- 3.2.15 A number of weakly positive linear and oval shaped anomalies around **4021** to **4025** have been interpreted as Possible Archaeology. They are pit and ditch type anomalies but which do not form more definite larger features such as enclosure ditches or strong pit responses. Their weaker strength could be indicative of their degree of survival but also their spatial location away from the circular cropmark enclosure; as they are outside the potential settlement core this could be due to the 'habitation effect' (Gaffney and Gater 2003).
- 3.2.16 A number of linear positive anomalies between **4026** and **4033** are characteristic in response of a cut feature and are interpreted as single linear ditches. They extend across the fields D, E and F and are oriented either east to west or north-west to south-east in a similar orientation to the current field boundaries, which date to at least the 19th century as demonstrated on historic mapping (Ordnance Survey 1889). The form, shape and similar orientation of the anomalies with the current field boundaries suggests that these are former internal field boundaries.
- 3.2.17 An area of bipolar and ferrous anomalies at **4034** corresponds to the location of a bridge across the Brook and could therefore relate to footings or area of debris or material related to the construction of the bridge. It has been characterised as Agricultural in function.
- 3.2.18 There are two areas of Increased Magnetic Response at **4035** which have been interpreted as associated with the modern service (at **4039**) and described below (**Section 3.3**). They are not considered to be of possible archaeological origin and are probably modern and associated with the construction of the modern service.
- 3.2.19 Numerous weakly positive linear and parallel anomalies extending the length or width of the fields have been identified and interpreted as ploughing trends. There are predominantly two orientations of ploughing trends, with particular concentrations at **4036** and **4037**, which follow the orientations of the current field boundaries and are probably post-medieval and modern in origin.
- 3.2.20 An irregular and broad area of weakly positive response around **4038** has been characterised as superficial geology..
- 3.2.21 A series of bipolar anomalies at **4040** are interpreted as a linear area of ferrous and corresponds to the location of a track..



- 3.2.22 The large area of ferrous response at **4041** is caused by an electricity pylon rather than below-ground disturbance; there are three more in a linear orientation to the southwest in the southern fields of the Site.
- 3.2.23 There are numerous weakly positive and ephemeral linear and curvilinear trends across the survey, such as at **4042** and these have been interpreted as trends of uncertain origin as their form and response means they cannot be characterised further. They are potentially archaeological in origin but could also be agricultural, natural or geological in origin.

South: Fields G–J (Figures 5–7; Figures 8–9)

- 3.2.24 In the south of the Site there are fewer anomalies of archaeological interest and the anomalies identified are generally weaker in their magnetic signatures in comparison to those identified in the northern half of the Site. .
- 3.2.25 The most significant anomalies are a positive circular anomaly at **4043** and three linear positive anomalies at **4044**, **4045** and **4047** which have been interpreted as Archaeology and Probable Archaeology depending on the strength of their response. The circular anomaly is interpreted as a ring ditch approximately 17 m in diameter and potentially corresponds to a barrow. It is adjacent to three ditch type features that are slightly curving in sections along their length and taken overall these three ditches bear a resemblance in layout to the 'Y' shaped or forked ditches to the northwest at **4005**.
- 3.2.26 A second and smaller ring ditch is identified at **4046** and it is approximately 10 m in diameter. To the south-west are an L-shaped positive anomaly and a short linear and parallel positive anomaly at **4048** and **4049** respectively which are interpreted as Probable Archaeology and most likely to be ditch type features.
- 3.2.27 Further anomalies at **4050** to **4056** are characterised as Possible Archaeology and take the form of positive linear, circular or oval-shaped positive anomalies typical of ditch and pit-type features. They are smaller and more dispersed features and not concentrated into one particular area or on overall larger feature such as an enclosure ditch. Their weaker responses and more ephemeral nature could suggest that they are less well-preserved or it could be due to a lack of contrast between the archaeological feature and the surrounding matrix outside of the possible main core habitation area, both inside and within the vicinity of the large curvilinear cropmark enclosure.
- 3.2.28 Anomalies **4057** to **4061** are long linear positive anomalies which correspond to the location of former field boundaries on historic mapping. They are single ditch type anomalies with two sets of parallel boundaries at **4057** – **4058** oriented approximately north to south and **4059** – **4061** oriented northwest to southeast.
- 3.2.29 A series of large and broad linear positive anomalies around **4062** to **4066** are identified in the southern two fields with the anomalies broadly oriented east to west. They are broader, less defined and overlap in proximity to each other which is in contrast to other ditch type anomalies across the Site. They have been interpreted within the broader category of Agricultural and possibly represent ground disturbance from modern farming activity or ploughing.
- 3.2.30 Anomalies **4067** to **4070** are all broad areas of elevated magnetic values that are characterised as Increased Magnetic Response. Anomaly **4067** is broadly curvilinear in shape whereas **4068** to **4070** are approximately oval-shaped areas. These areas are



difficult to assign archaeological potential as they could be anthropogenic or geological in origin. Anthropogenic causes could be from a wide range of features or activities such as a spread of magnetically enhanced debris produced by settlement activity through to spreads of modern rubbish deposited as part of agricultural practices.

- 3.2.31 There are numerous weak curving and linear trends visible across this area such as at **4071** and they have been characterised as trends of uncertain origin as they do not appear to form clear archaeological features and do not appear to represent ploughing trends.
- 3.2.32 Numerous weakly positive and closely spaced parallel linear anomalies have been identified across this area and interpreted as ploughing trends. There are broadly two different ploughing trend directions. A north to south orientation is seen around **4074** whereas anomalies **4072**, **4073** and **4075** indicates the approximately east to west orientation of the ploughing trends in three different fields.

Central: Fields F + E (Figures 5 to 9)

- 3.2.33 A linear trend and likely ditch, **4076**, appears to be a continuation from anomaly **4005** (see above; 3.2.5) in Field D. The reduced value of the readings may be more indicative of a change in surrounding soil structure than of the nature of the feature; as it appears to be a continuation from **4005** that has been bisected by the intervening road between the two fields.
- 3.2.34 Parallel linear anomaly **4077** appears to extend almost to the field boundary on the eastern extent towards the south of Field H. This is interpreted as a ditch or possible historic field boundary that predates 1889 OS mapping (Ordnance Survey, 1889). The feature appears to be associated with the anomalies seen in the survey to the north, **4005** and to the south **4047**.
- 3.2.35 Circular anomaly **4079** lies on a former field boundary dating back to at least the 19th century (Ordnance Survey, 1889). The highly ferrous nature of the readings (especially to the north), -8 nT to +13 nT, suggests that the anomaly is of a more modern provenance, potentially related to present-day agriculture. This feature warrants further investigation as these anomalies may represent two separate features. The circular or 'ring' form, which is clear to the south, may allude to a more archaeological provenance and has an appropriate diameter for a round barrow or ring ditch.
- 3.2.36 An interpreted ditch at **4080** is orientated approximately north to south, at variance with the other identified features in this area. The ditch appears to be segmented into a number of well-defined zones. Although this may be due to more modern farming methods, such as deep ploughing, physically altering the archaeology present and disturbing areas of the feature.
- 3.2.37 Two ditches that extend perpendicular to the eastern field boundary at **4081** and **4082** are thought to be related to each other. These could be a remnant of previous agricultural activity such as historic field boundaries.
- 3.2.38 A wide, weakly positive feature is described in the dataset at **4083** to **4091** with magnetic values ranging from -1 nT to +1 nT. The archaeological connotations for this feature may be that of a wide, shallow ditch extending east-west.



- 3.2.39 A further double-ditch feature is present at **4084**. Although not close in proximity to those seen elsewhere (see above; **3.2.14**) the shape and form bears a resemblance to the potentially prehistoric features seen at **4020** and may have a similar origin.
- 3.2.40 Numerous weakly magnetic linear features are present parallel to the boundaries of fields surveyed. Examples of these can be seen at **4084** and elsewhere on the Site.
- 3.2.41 As with other areas of the Site, horizontal plough scars are prevalent in the central field, as seen at **4086** and **4079**. From the data collected it is not possible to ascertain whether these are modern or historic in nature.
- 3.2.42 Numerous former field boundaries can be seen throughout the geophysical survey. **4087** shows a weakly defined ditch that is aligned with a previous field system as seen in Ordnance Survey mapping dating to 1889 (Ordnance Survey, 1889).
- 3.2.43 An additional circular anomaly to those seen at **4043** and **4046** is located on the western extent of Field F at **4089**. It has been interpreted as possible archaeology as the feature has much weaker geophysical response compared with the circular anomalies in the south. It is bounded by two, equally weakly defined, linear anomalies **4088** which are thought to be related. The feature may describe a barrow of c.25 m in diameter; making it the larger of the three present.
- 3.2.44 A north to south orientated linear anomaly **4090** is interpreted as a former field boundary. The positive anomaly has well-defined, straight extents both of which point to a former field boundary although it does not appear in historic mapping dating back to 1889 (Ordnance Survey). The linear anomaly may have a relationship with the double-ditch feature present in the geophysical survey undertaken to the north (Stratascan, 2011). They both lie in on a roughly north – south alignment with the northernmost feature being more sinuous.

3.3 Modern Services

- 3.3.1 There is one modern service identified in the north of the survey area at **4039**. It was installed after 2006 as it is not present in the previous survey data immediately to the north of the survey area boundary (Stratascan 2006). There are two areas of Increased Magnetic Response at **4035** to the north and south of the modern service, they correspond to a break in the modern service and are probably associated with its construction and interpreted as modern.
- 3.3.2 Overhead power cables span from the north-eastern extent of Field E, **4085**, to southern extent of Field J, **4055**. These have interfered with the geophysical survey in a c40m band that is visible as swathe of weakened readings.

4 CONCLUSION

- 4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of archaeological interest across the Site both within the cropmark enclosure in the northern half of the survey and also to the south two possible ring ditches. In addition to these further enclosure ditches, former field boundaries, ploughing trends and areas of increased magnetic response have also been identified.
- 4.1.2 With a larger survey area undertaken and the added information from previous archaeological work in the vicinity a number of larger features have been identified at a landscape scale. From previous archaeological work and geophysical survey some broad



observations can be made on the types of features identified and their geophysical responses. To the south of the Site a number of clearly defined rectangular ditch enclosures were identified with one ditch enclosure dated by pottery to the Iron Age. In the northern area of this Site a number of clearly defined curvilinear and linear ditches were identified through geophysical survey corresponding to recorded cropmark features. These surveys show clear survival of archaeological features. To the south of the Site between the survey area and the A30 previous geophysical survey identified a number of features which were much weaker and ephemeral in response with the majority characterised as of possible archaeological origin. Although this could indicate the potential for the survival of archaeological features it could also be indicative of other factors such as the habitation effect where archaeological features exist but have been less magnetically enhanced away from the core of settlement activity and occupation (Gaffney and Gater 2003).

- 4.1.3 The area under survey here is characterised by large curvilinear and more irregular and 'Y' shaped ditch enclosures. There are also at least three ring ditches in this and the previous Stratascan survey data and numerous smaller pits and potentially fired/burnt or industrial features located along the route of Pinhoe Brook. Former field boundaries showing internal divisions potentially inform on post-medieval agricultural practices. However, these are not necessarily contemporary, the linear ditch feature at **4020** is on a different alignment to all the other former field boundaries and is possibly a continuation of a ditch feature identified within the cropmark enclosure and thought to be prehistoric in date.
- 4.1.4 Previous geophysical survey defined part of the southern and eastern extents of the recorded large curvilinear cropmark enclosure and this geophysical survey has identified further anomalies of archaeological potential within and adjacent to this enclosure in the form of ditches, enclosure ditches and potential pits (Stratascan 2006; Stratascan 2011). However the full extent of this large ditch enclosure is unknown as it is not detected to the north on the other side of the brook nor to the south-west where further targeted survey could add to our knowledge.
- 4.1.5 The survey area undertaken over Field C did not locate the cropmark feature in this area but there are further linear ditch type anomalies to the north at **4000** and **4009** and to the southwest at **4018** which could represent partial rectangular, rather than circular enclosures. The most obvious feature that may be a continuation of the cropmark enclosure is not from the geophysical data but the current curvilinear portion of the field boundary to the north of Pinhoe Brook.
- 4.1.6 Within the large circular cropmark enclosure are several pit and ditch type anomalies primarily around **4000** to **4003** and **4007** to **4017** which could represent settlement activity within the enclosure with some irregular and potentially burnt/fired/industrial type features along the route of Pinhoe Brook. The relationship between these different features cannot be identified from the geophysics alone though. It can be observed though that there is a greater concentration of potential archaeological features to the north.
- 4.1.7 The 'Y' shaped or forked ditch at **4005** is irregular in shape compared to the other ditch features identified across the Site. The anomaly is intermittent with breaks in the feature potentially deliberate rather than an indication of different levels of survival of the ditch. While it's more irregular shape is suggestive of an association with double ditch feature identified to the north-west, in the data they do not appear to continue as the same feature (Stratascan 2011). What is noticeable however and possibly significant is that a second



'Y' shaped ditch feature is identified to the southeast at **4044**, **4045** and **4047** with the ditch at **4047**, **4077** and **4076** on the same trajectory as **4005**.

- 4.1.8 From previous archaeological work there was an emphasis on a number of ring ditches or round barrows being identified across this area to the east and on land adjacent to the south of the Site (Sabin & Donaldson 2007). Two further ring ditches have been identified from this survey. To date none of the ring ditches identified has been excavated. All instances here have been identified as having a continuous ditch and are weak but regular in their response possibly adding weight to their interpretation as truncated barrows.
- 4.1.9 Frequent ploughing trends are visible across the Site on differing alignments. This is likely due to variable boundaries and different farming processes but these are likely to be medieval, post-medieval and modern in provenance.



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5.2 Cartographic and documentary sources

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Ordnance Survey, 1889: Exeter 1:2500

5.3 Online resources

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



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 ± 100 nT 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.



APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

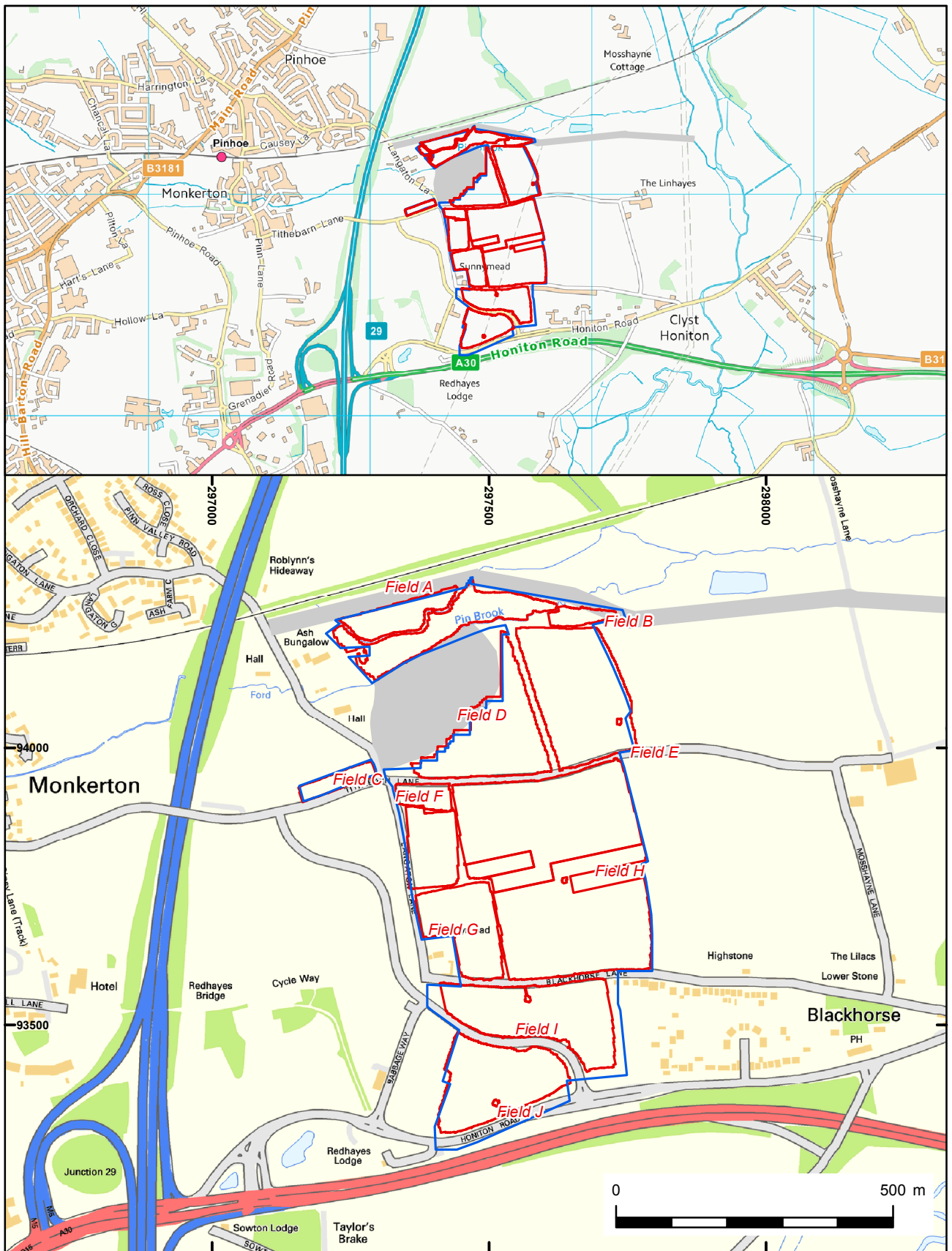
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided 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 unidentified 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.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

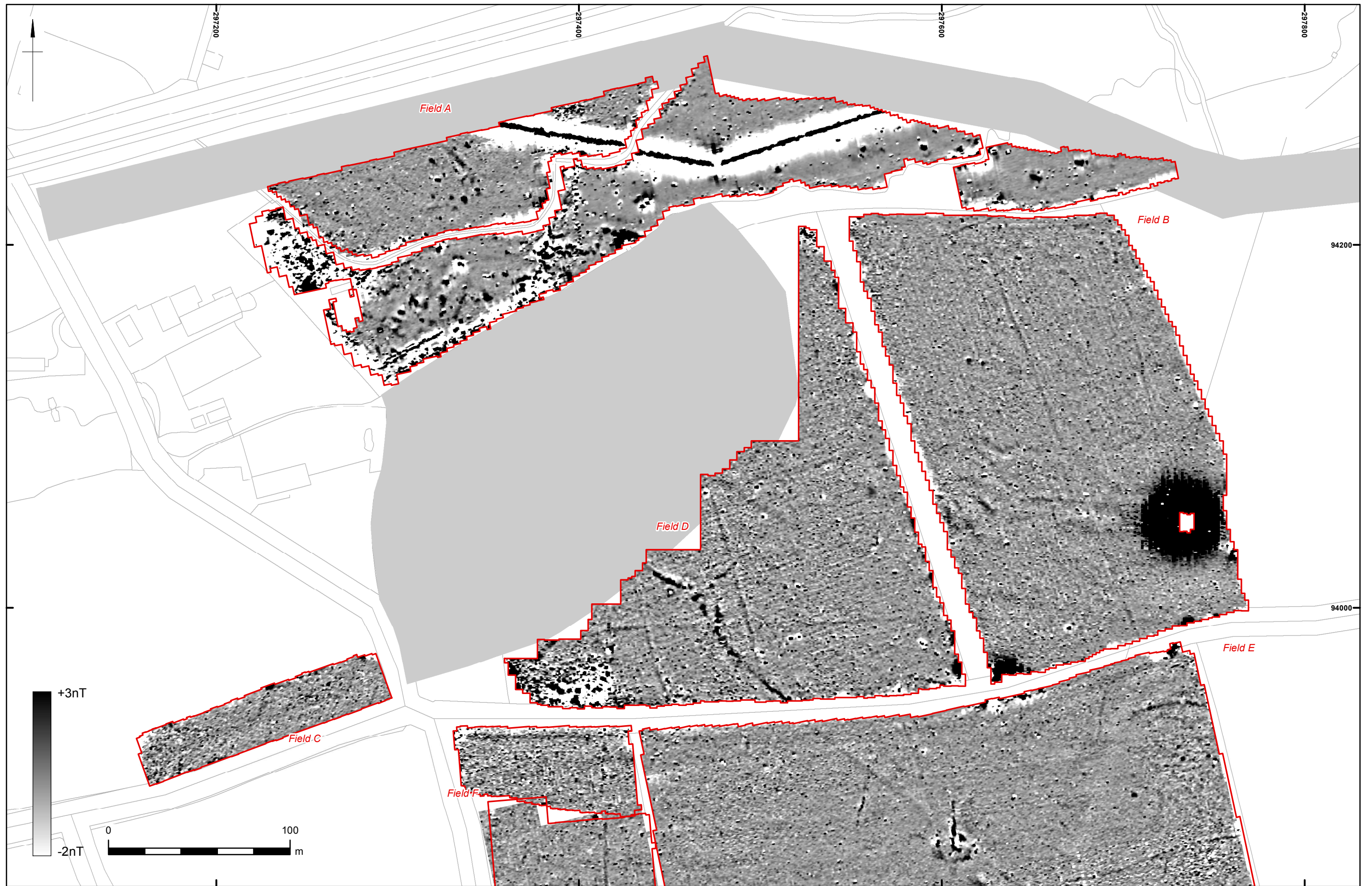
Finally, services such as water pipes are marked where they have been identified



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Site location and survey extents

Figure 1



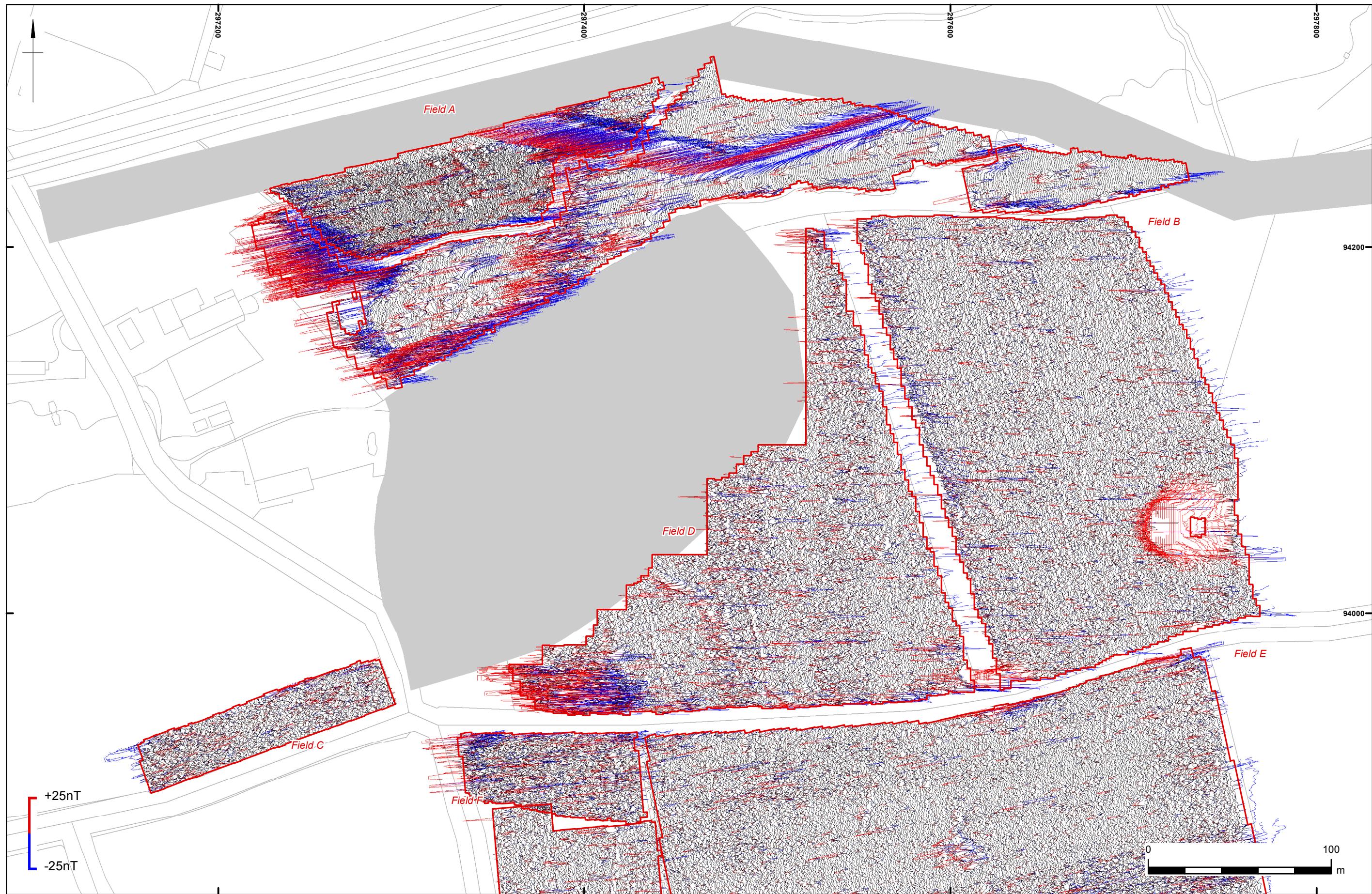
Detailed Survey Extents
 StrataScan Survey Extents

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Greyscale plot: North Fields A-F

Figure 2



+25nT
-25nT

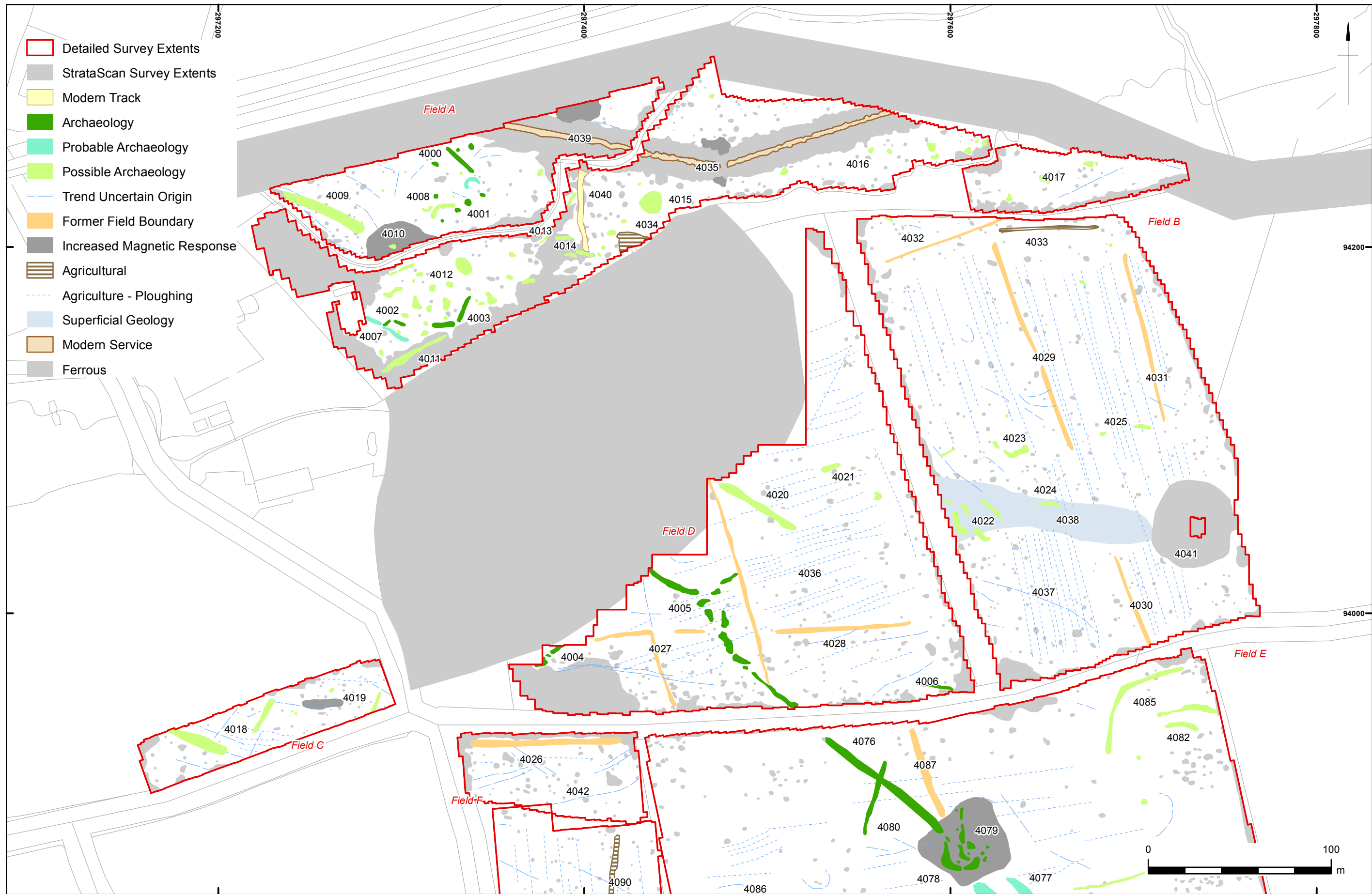
 Detailed Survey Extents
 StrataScan Survey Extents

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XY Trace plot: North Fields A-F

Figure 3

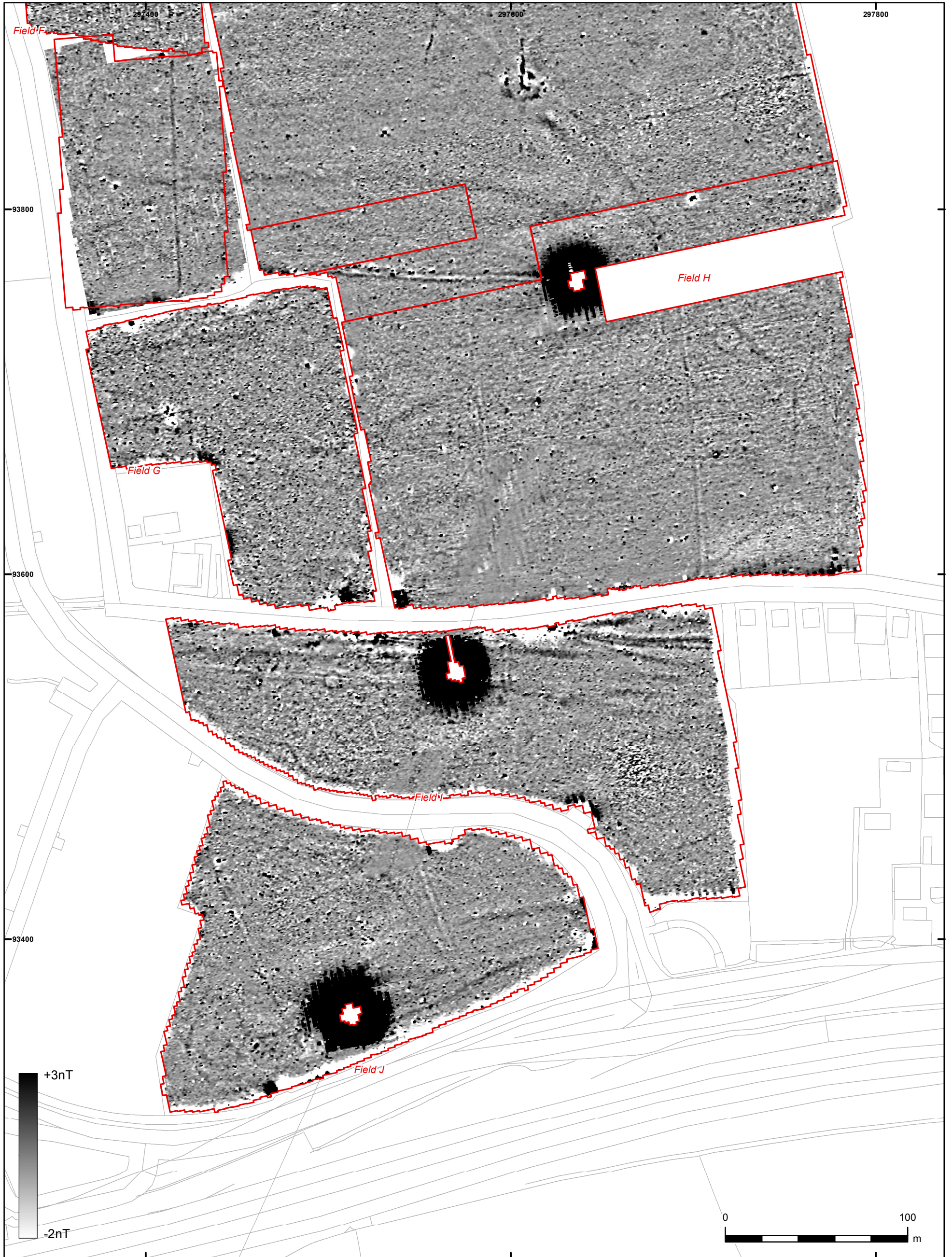


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Archaeological Interpretation: North Fields A-F

Figure 4



Detailed Survey Extents

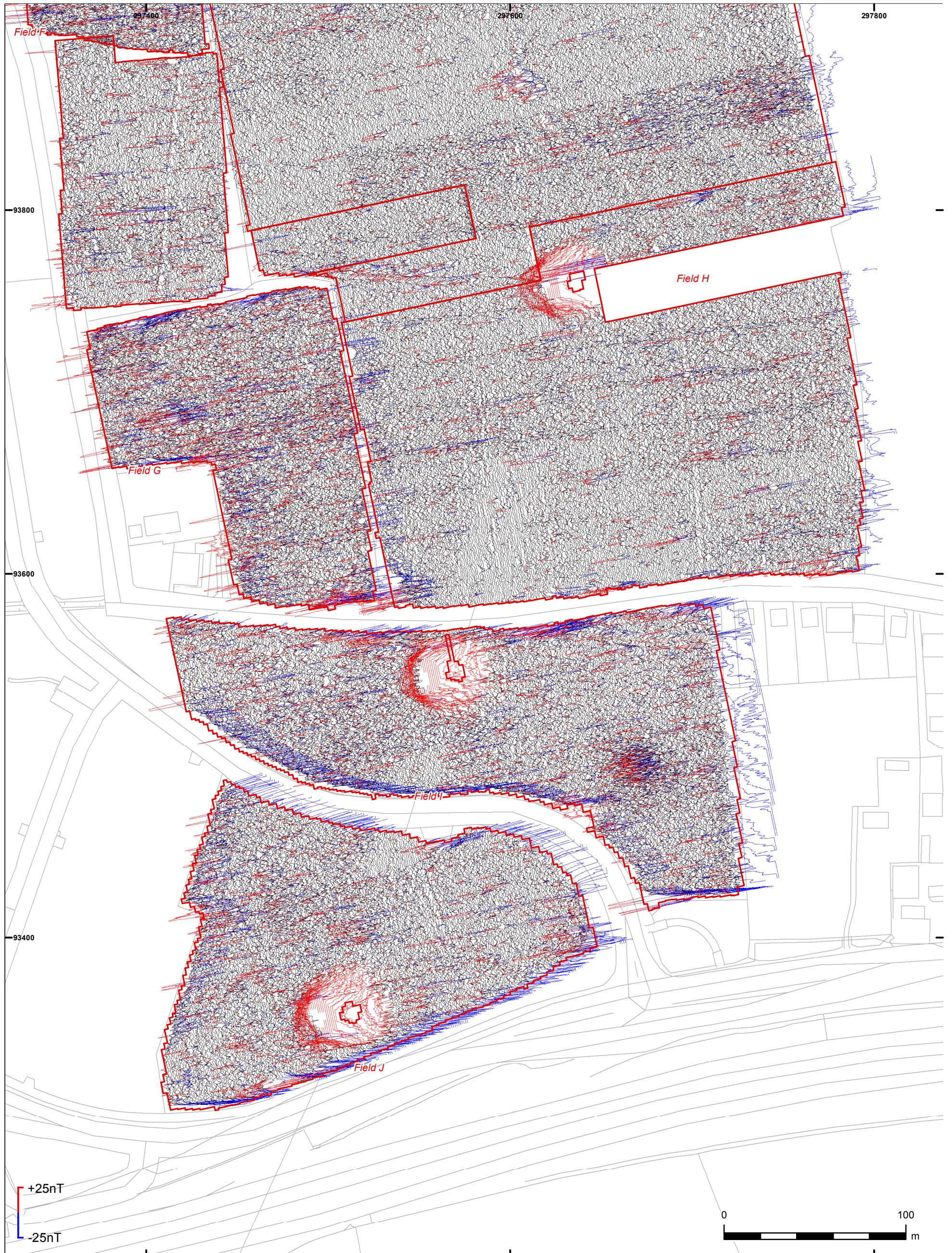




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Greyscale plot: South Fields G-J

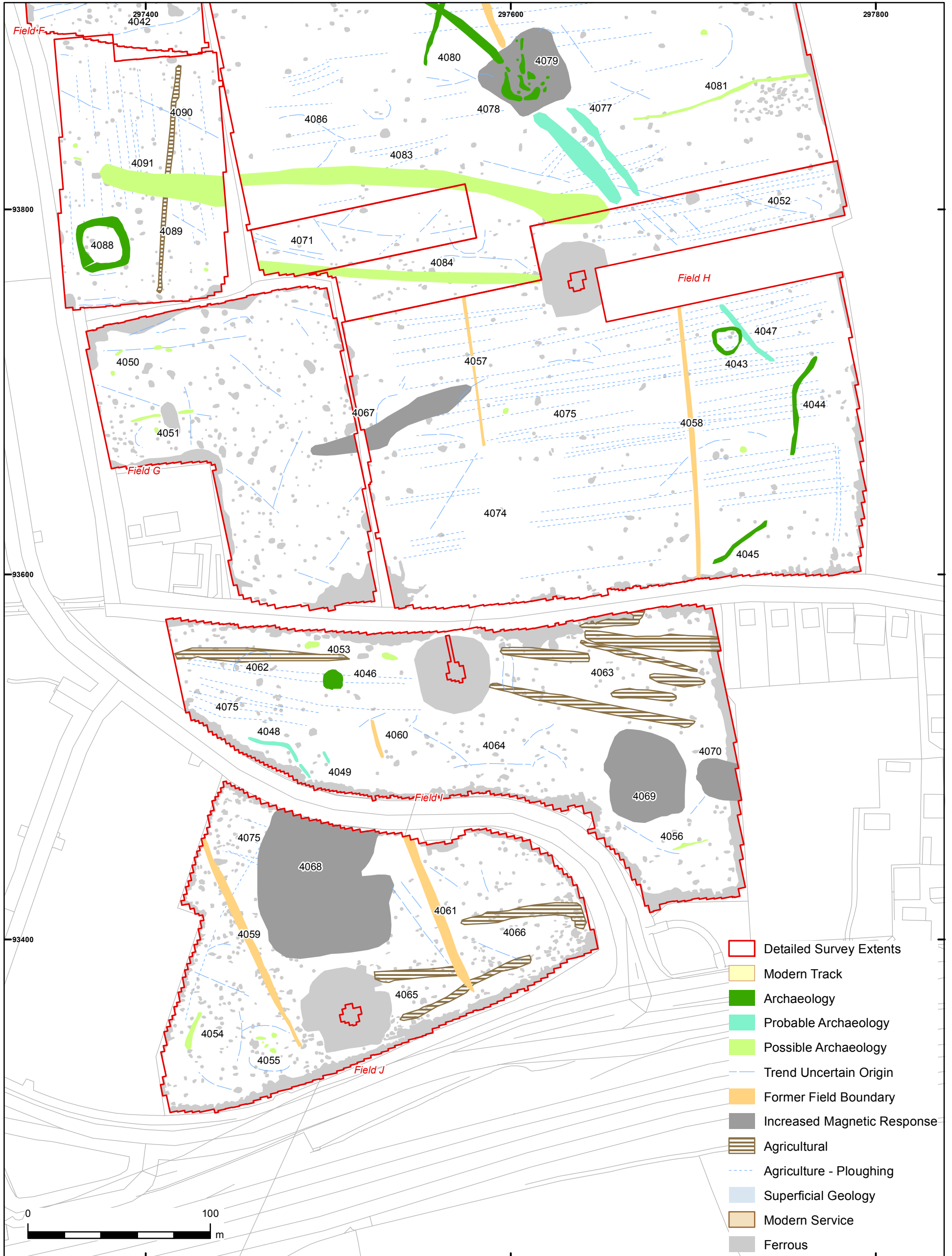
Figure 5



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XY Trace plot: South Fields G-J

Figure 6



- Detailed Survey Extents
- Modern Track
- Archaeology
- Probable Archaeology
- Possible Archaeology
- Trend Uncertain Origin
- Former Field Boundary
- Increased Magnetic Response
- Agricultural
- Agriculture - Ploughing
- Superficial Geology
- Modern Service
- Ferrous


Detailed Survey Extents

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Archaeological Interpretation: South Fields G-J

Figure 7

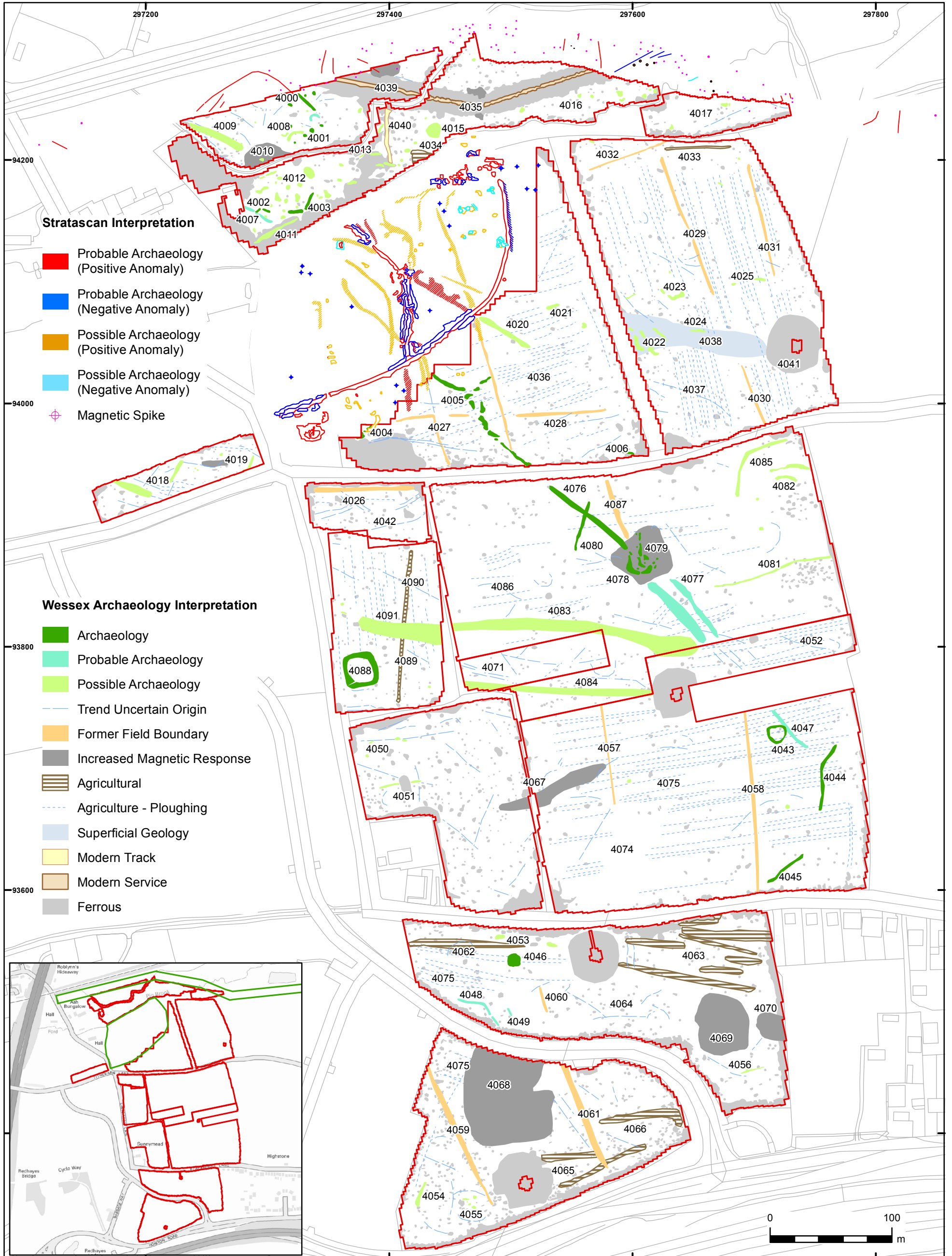
▭ Detailed Survey Extents
▭ StrataScan Survey Extents

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Overall greyscale plot including previous geophysical surveys

Figure 8



Detailed Survey Extents
 Stratascan Survey Extents

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Overall archaeological interpretation

Figure 9



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



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