

**GEOPHYSICAL SURVEYS  
OF LAND AT AREA 10,  
MILTON KEYNES  
WESTERN EXTENSION,  
BUCKINGHAMSHIRE**

**GEOPHYSICAL SURVEY REPORT**

**SP. No: 1500/11**

**21/06/2011**

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# NORTH PENNINES SURVEY CIC

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## *Quality Assurance*

This report covers works as outlined in the brief for the above-named project as issued by the relevant authority, and as outlined in the agreed programme of works. Any deviation to the programme of works has been agreed by all parties. The works have been carried out according to the guidelines set out in the Institute for Archaeologists (IfA) Standards, Policy Statements and Codes of Conduct. The report has been prepared in keeping with the guidance set out by North Pennines Survey CIC on the preparation of reports.

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## CONTENTS

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<b>SUMMARY .....</b>	<b>5</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>6</b>
<b>1 INTRODUCTION .....</b>	<b>7</b>
1.1 Circumstances of the Project (Figure 1) .....	7
<b>2 METHODOLOGY .....</b>	<b>9</b>
2.1 Project Design.....	9
2.2 Geophysical Surveys .....	9
2.3 Archive.....	11
<b>3 BACKGROUND .....</b>	<b>12</b>
3.1 Location and Geological Context .....	12
3.2 Historical and Archaeological Background .....	12
<b>4 THE GEOPHYSICAL SURVEYS .....</b>	<b>14</b>
4.1 Introduction (Figure 2).....	14
4.2 Area 1 (Figures 3-5) .....	14
4.3 Area 2a (Figures 6-8) .....	15
4.3 Area 2b (Figures 9-11) .....	15
4.4 Discussion.....	15
<b>5 CONCLUSIONS .....</b>	<b>17</b>
5.1 Conclusions .....	17
5.2 Recommendations .....	17
<b>6 BIBLIOGRAPHY .....</b>	<b>18</b>
6.1 Secondary Sources .....	18
<b>APPENDIX 1: PROJECT DESIGN .....</b>	<b>19</b>
<b>APPENDIX 2: FIGURES .....</b>	<b>8</b>

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## ILLUSTRATIONS

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### **FIGURES (APPENDIX 2)**

FIGURE 1: SITE LOCATION

FIGURE 2: LOCATION OF THE GEOPHYSICAL SURVEY AREAS

FIGURE 3: GEOPHYSICAL SURVEY OF AREA 1

FIGURE 4: GEOPHYSICAL INTERPRETATION OF AREA 1

FIGURE 5: ARCHAEOLOGICAL INTERPRETATION OF AREA 1

FIGURE 6: GEOPHYSICAL SURVEY OF AREA 2A

FIGURE 7: GEOPHYSICAL INTERPRETATION OF AREA 2A

FIGURE 8: ARCHAEOLOGICAL INTERPRETATION OF AREA 2A

FIGURE 9: GEOPHYSICAL SURVEY OF AREA 2B

FIGURE 10: GEOPHYSICAL INTERPRETATION OF AREA 2B

FIGURE 11: ARCHAEOLOGICAL INTERPRETATION OF AREA 2B



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## SUMMARY

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In June 2011, North Pennines Survey CIC, commissioned by Wardell Armstrong LLP, undertook geophysical surveys of land at Area 10, Milton Keynes Western Extension (centred on Ordnance Survey grid reference SP 8129 3745), prior to a proposed mixed use development to the west of Milton Keynes.

Two areas of archaeological intensity had been identified during an ongoing trial trench evaluation of the Phase 2 area. The objective of the geophysical survey was to determine the presence/absence, nature and extent of any further potential archaeological features within the selected areas, in order to clarify the results of the trial trench evaluation. The results of the project will be used to inform the need for further evaluation work and/or mitigation measures, should potential significant archaeological remains be identified during the project.

Geomagnetic surveys covering 3.93ha of land have been conducted within three separate fields covering the selected locations. Two modern service pipes including an aviation fuel pipe were detected by the surveys, as well as a series of anomalies interpreted as possible land drains or other agricultural features.

Evidence for medieval or later ridge and furrow cultivation was detected across the majority of the survey areas, although in Area 1 this appeared to have been partially removed by later agricultural practices.

A number of possible soil-filled ditches and pits were detected, some of which appear to relate to features revealed in the trial trench evaluation of the site. However, it is possible that the presence of other insubstantial archaeological features may have been masked by the presence of anomalies relating to the ridge and furrow cultivation and modern services.

Given that the geophysical surveys did not identify any areas of archaeological intensity, no further survey work is recommended. It is possible that, given the insubstantial nature of a number of the features revealed in the trial trench evaluation, further geophysical survey would only be effective if undertaken at a greater resolution than the present survey.

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## ACKNOWLEDGEMENTS

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North Pennines Survey CIC would like to thank Helen Martin-Bacon, Wardell Armstrong LLP for commissioning the geophysical surveys, and for all assistance throughout the project.

The geophysical surveys were undertaken by Angus Clark and Don O'Meara. The report was written and illustrated by Martin Railton. The project was managed by Martin Railton, Project Manager for NPS Ltd.

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## 1 INTRODUCTION

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### 1.1 CIRCUMSTANCES OF THE PROJECT (FIGURE 1)

- 1.1.1 Between 15<sup>th</sup> and 17<sup>th</sup> June 2011, North Pennines Survey CIC undertook geophysical surveys of land at Area 10, Milton Keynes Western Extension at the request of Wardell Armstrong LLP. This followed a planning application by Gallagher Estates Ltd for a mixed use development to the west of Milton Keynes and known as the Milton Keynes Western Extension. The archaeological work was undertaken in agreement with Nick Crank, Senior Archaeological Officer, Milton Keynes Council.
- 1.1.2 The overall development, for which outline planning consent has been granted, comprises 342ha of land which was subject to an Environmental Statement carried out in 2005 by Albion Archaeology. Subsequent to this the Milton Keynes Senior Archaeological Officer recommended a programme of archaeological evaluation be undertaken. This is in line with government advice as set out in the DoE Planning Policy Guidance on Archaeology and Planning (PPG 16), and its successor Planning Policy Statement 5 (Planning for the Historic Environment). Briefs were issued by the Milton Keynes Archaeological Officer for a programme of evaluation which was to comprise geophysical survey followed by trial trenching. The geophysical survey was carried out in 2007 (Stratascan 2007).
- 1.1.3 A Project Design was prepared by Albion Archaeology in 2008 for a programme of trial trenching distributed across the development area, targeted on geophysical anomalies, possible archaeological features identified in the Environmental Statement and on areas apparently devoid of archaeological remains. The general objective of the trial trenching was to provide information on any archaeological remains in the proposed development area in order for an informed decision to be made on appropriate mitigation measures intended to preserve any remains present either by preservation in situ or by excavation and recording. The Project Design and accompanying trench array were approved by the Milton Keynes Senior Archaeological Officer on behalf of the Local Planning Authority.
- 1.1.4 In 2008 Albion Archaeology undertook trial trenching in Phase 1 of Area 10 and this identified archaeological remains dating from the early Iron Age to medieval periods. Of most significance were two distinct areas of Iron Age settlement activity located on higher ground within the site. These comprised ditches and pits, as well as a large number of irregularly shaped features more characteristic of tree bowls. The pottery from both areas

dated overwhelmingly from the middle to late Iron Age period, with a small amount dating from the early to mid Iron Age and Romano-British periods. Other remains included a series of broadly parallel ditches containing pottery of possible Roman date. These appeared to be on a similar alignment to Roman Watling Street located approximately 300m to the north-west. The relative lack of artefacts and their character suggested the ditches were associated with agricultural activity (Albion Archaeology 2008).

- 1.1.5 Based upon the results of the trial trenching in Area 10, Phase 1 the Milton Keynes Senior Archaeological Officer requested a programme of open area excavation prior to development commencing. The mitigation work comprises three open area excavations totally 3ha targeted on possible Iron Age and Romano-British remains uncovered by the trial trenching. This was undertaken by North Pennines Archaeology Ltd in 2011 (report forthcoming).
- 1.1.5 A trial trench evaluation of Area 10, Phase 2 was also undertaken by North Pennines Archaeology Ltd, which revealed a number of undated archaeological features in the form of pits, gullies and ditches, which are likely to be of Iron Age or earlier date. As a result two areas of geophysical survey were agreed with the Milton Keynes Senior Archaeological Officer (which were not covered by the 2007 programme of geophysical survey), in order to clarify the extent and complexity of the archaeological features identified (centred on Ordnance Survey grid reference SP 8129 3745).
- 1.1.6 This report outlines the results of the geophysical surveys undertaken, and includes an interpretation of the geophysical survey results, in light of the archaeological and historical background of the site, with recommendations for further work where necessary.

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## 2 METHODOLOGY

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### 2.1 PROJECT DESIGN

- 2.1.1 A project design was submitted by North Pennines Archaeology Ltd in response to a request by Wardell Armstrong LLP, on behalf of their client Gallagher Estates Ltd, for a geophysical survey of the study area. Following acceptance of the project design by the Senior Archaeological Officer at Milton Keynes Council, the client commissioned North Pennines Survey CIC to undertake the work. The project design was adhered to in full, and the work was consistent with English Heritage guidelines (English Heritage 2008), and in accordance with the draft standard and guidance of the Institute for Archaeologists (IfA 2010).
- 2.1.2 Two areas of archaeological intensity were identified during the ongoing trial trench evaluation of the Milton Keynes Western Expansion Area 10, Phase 2. The objective of the geophysical survey was to determine the presence/absence, nature and extent of any further potential archaeological features within the selected areas, in order to clarify the results of the trial trench evaluation. The results of the project will be used to inform the need for further evaluation work and/or mitigation measures, should potential significant archaeological remains be identified during the project.

### 2.2 GEOPHYSICAL SURVEYS

- 2.2.1 *Technique Selection:* geomagnetic survey was selected as the most appropriate technique, given the non-igneous environment, and the expected presence of cut archaeological features at depths of no more than 1.5m. Geomagnetic survey has also proved to be successful in the previous geophysical surveys at the site (Stratascan 2007). This technique involves the use of hand-held gradiometers, which measure variations in the vertical component of the earth's magnetic field. These variations can be due to the presence of sub-surface archaeological features. Data were recorded by the instruments and downloaded into a laptop computer for initial data processing in the field using specialist software.
- 2.2.2 *Field Methods:* geophysical survey was undertaken over two areas (Area 1 & Area 2) comprising 3.93ha in total. Area 1 measured 1.45ha, and was situated on the western boundary of the site covering the area of Trenches 95-103. Area 2 measured 2.48ha in total was situated immediately to the east of Whitehouse Farm, covering portions of two fields and the areas of Trenches 35-47 (Figure 1). This area therefore was subdivided into two surveys (Areas 2a and Area 2b). A 30m grid was established in each area,

and tied-in to known Ordnance Survey points using a Trimble 3605DR Geodimeter total station with datalogger.

2.2.3 Geomagnetic measurements were determined using a Bartington Grad601-2 dual gradiometer system, with twin sensors set 1m apart. It was expected that significant archaeological features at a depth of up to 1.5m would be detected using this arrangement. The survey was undertaken using a zig-zag traverse scheme, with data being logged in 30m grid units. A sample interval of 0.25m was used, with a traverse interval of 1m, providing 3600 sample measurements per grid unit. The data were downloaded on site into a laptop computer for processing and storage.

2.2.4 **Data Processing:** geophysical survey data were processed using ArchaeoSurveyor II software, which was used to produce 'grey-scale' images of the raw data. Positive magnetic anomalies are displayed as dark grey, and negative magnetic anomalies are displayed as light grey. A palette bar shows the relationship between the grey shades and geomagnetic values in nT.

2.2.5 Raw data were processed in order to further define and highlight the archaeological features detected. The following basic data processing functions were used:

*Despike:* to locate and suppress random iron spikes in the gradiometer data.

*Clip:* to clip data to specified maximum and minimum values, in order to limit large noise spikes in the geophysical data.

*Destagger:* to reduce the effect of staggered gradiometer data, sometimes caused by difficult working conditions, topography, or operator error.

*Interpolate:* to match the traverse and sample intervals in the gradiometer data.

2.2.6 **Interpretation:** three types of geophysical anomaly were detected in the gradiometer data:

*positive magnetic:* regions of anomalously high or positive magnetic data, which may be associated with the presence of high magnetic susceptibility soil-filled features, such as pits or ditches.

*negative magnetic:* regions of anomalously low or negative magnetic data, which may be associated with features of low magnetic susceptibility, such as stone-built features, geological features, land-drains or sub-surface voids.

*dipolar magnetic:* regions of paired positive and negative magnetic anomalies, which typically reflect ferrous or fired materials, including

fired/ferrous debris in the topsoil, modern services, metallic structures, or fired structures, such as kilns or hearths.

- 2.2.7 **Presentation:** the grey-scale images were combined with site survey data and Ordnance Survey data to produce the geophysical survey plans. Colour-coded geophysical interpretation diagrams are provided, showing the locations and extent of positive, negative, dipolar, geomagnetic anomalies, and areas of anomalously high or low resistance.
- 2.2.8 Archaeological interpretation diagrams are provided, which are based on the interpretation of the geophysical survey results, in light of the archaeological and historical background of the site.
- 2.2.9 Trace plots of the unprocessed geophysical data are available if required.

### 2.3 ARCHIVE

- 2.3.1 The data archive for the geophysical survey has been created in accordance with the recommendations of the Archaeology Data Service (ADS 2001). This archive is currently held at the company offices at Nenthead, Cumbria.
- 2.3.2 One copy of the final report will be deposited with the County Historic Environment Record, where viewing will be available on request. The project is also registered with the **Online AccesS to the Index of archaeological investigationS (OASIS)**, where a digital copy of the report will be made available.
- 2.3.3 The OASIS reference for this project is **northpen3-103584**.

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## 3 BACKGROUND

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### 3.1 LOCATION AND GEOLOGICAL CONTEXT

- 3.1.1 The proposed development site lies on the western edge of Milton Keynes, to the south-west of Roman Watling Street. The current land use is a mix of arable and pasture, comprising a number of fields enclosed by hedges and drainage ditches. The height of the land fluctuates between 90m OD and 103m OD, the highest points tending to lie towards the south-west of the site.
- 3.1.2 The underlying solid geology comprises Oxford Clay and Kellaways Beds (BGS 2001). The overlying soils for the majority of the site are slowly permeable calcareous soils, known as Hanslope soils which are chalky till (SSEW 1980). The soils in the south east of the site and around Calverton Lane roundabout are known as Wickham 3 soils which are drift over cretaceous clay and sandstone, these consist of slowly permeable seasonally waterlogged fine loamy over clayey soils and coarse loamy over clayey soils.

### 3.2 HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

- 3.2.1 The historical background of the study area has been assessed by Wardell Armstrong LLP, a summary of which is presented here. This background is compiled mostly from secondary sources, and is intended only as a brief summary of historical developments specific to the study area.
- 3.2.2 There are no known remains of antiquity within the proposed development site although the area was clearly favourably placed for past human exploitation with reliable water sources, clay deposits and probably extensive woodlands for fuel and building. The proximity of Watling Street would have provided good access to markets certainly in the Roman period and later periods (Wardell Armstrong 2011).
- 3.2.3 Excavations in the locality have uncovered multi-period remains dating from the Neolithic period onwards and it seems reasonable to conclude that there is good potential within the development area for buried archaeological remains of various periods to be present. Fieldwork over the last two decades has indicated the potential for Iron Age occupation in the vicinity and demonstrated that Iron Age occupation in the Milton Keynes area was generally more widespread than previously thought (*ibid*). The presence of Iron Age and Romano-British remains has been confirmed by trial trenching in Area 10.



- 3.2.4 The Roman period in the area is well-attested in the form of Watling Street, which as a main route from urban centres such as Londinium and Verulamium to the north-west of the country is likely to have attracted occupation and/or stations along its length. It is also likely that there were associated networks of minor roads diverging from the main route and servicing farmsteads and fieldsystems (*ibid*).
- 3.2.5 There is a suggestion from placename evidence that during the later Roman and earlier Saxon periods the heavy claylands may have reverted to woodland although some Saxon settlement in the area is evidenced by archaeological finds in the area (*ibid*).
- 3.2.6 From the medieval period onwards the land within the proposed development area was essentially agricultural and was situated between main centres of medieval settlement. The medieval landscape of the area was characterised by small farmsteads and nucleated settlements set within open fields and ridge and furrow is still visible as undulations across the proposed development site.
- 3.2.7 Map regression has shown that many of the modern field boundaries reflect the pattern of fields laid out at Enclosure (*ibid*).

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## 4 THE GEOPHYSICAL SURVEYS

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### 4.1 INTRODUCTION (FIGURE 2)

4.1.1 The geophysical surveys were undertaken between 15<sup>th</sup> and 17<sup>th</sup> June 2011. Geomagnetic survey was undertaken over two separate locations (Areas 1 & 2) within the study area (Figure 2). Area 2 lay within two separate fields, so by necessity was further subdivided into two survey areas (Area 2a and Area 2b). Each area was subdivided by field boundaries consisting of mature hedgerows, some of which incorporated post and wire fences.

4.1.2 Small discrete dipolar magnetic anomalies were detected across the whole of the study area. These are almost certainly caused by fired/ferrous litter in the topsoil, which is typical for modern agricultural land. These anomalies are indicated on the geophysical interpretation drawings, but not referred to again in the subsequent interpretations.

### 4.2 AREA 1 (FIGURES 3-5)

4.2.1 A strong dipolar linear magnetic anomaly was detected on the east side of Area 1, aligned south-southwest to north-northeast. This was almost certainly due to the presence of a modern service pipe, probably an iron water pipe. A strong dipolar discrete magnetic anomaly was also detected at the northwest corner of Area 1, which was due to the presence of nearby metal feeding troughs.

4.2.2 A parallel series of positive and negative linear magnetic anomalies were detected at the centre of Area 1, aligned northwest to southeast, which are interpreted as the remains of ridge and furrow cultivation. The ridges and furrows were spaced on average *c.*8m apart and are likely to relate to medieval or later cultivation practices.

4.2.3 A number of weak negative linear magnetic anomalies were detected crossing Area 1, aligned northwest to southeast and northeast to southwest, which may also be agricultural features, such as land drains.

4.2.4 A number of weak positive linear magnetic anomalies were also detected crossing Area 1, which may relate to soil-filled features such as ditches. A small number of positive discrete magnetic anomalies were also detected which are interpreted as possible soil-filled pits.

4.2.5 Two strong positive discrete magnetic anomalies were also detected, one towards the centre of the survey area, and one on the southern edge of Area 1. These anomalies measured *c.*7m across and were very strongly magnetic (*c.*100nT), suggesting that these may relate to modern fired/ferrous features.

The magnetic strengths were greater than one would expect for archaeological soil-filled features, but this is not certain.

#### **4.3 AREA 2A (FIGURES 6-8)**

4.3.1 A very strong dipolar linear magnetic anomaly was detected on the north side of Area 2a, aligned northwest to southeast, which corresponds to the location of a known aviation fuel pipe. The strength of this anomaly masked other potential geophysical anomalies in this area.

4.3.2 A parallel series of positive linear magnetic anomalies were detected across the majority of Area 2a, aligned northeast to southwest, which are interpreted as the remains of ridge and furrow cultivation. The ridges were spaced on average c.5m apart and are likely to relate to medieval or later cultivation practices.

4.3.3 A number of weak positive linear magnetic anomalies were also detected crossing Area 2a, aligned northwest to southeast, spaced between c.5m and c.13m apart, which may also be agricultural features, such as plough furrows or land drains.

4.3.4 A weak positive linear magnetic anomaly was detected on the south side of the survey area, which is interpreted as a possible soil-filled feature.

#### **4.3 AREA 2B (FIGURES 9-11)**

4.3.1 Two weak negative linear magnetic anomalies were detected crossing Area 2b, aligned east to west, which may also be agricultural features, such as land drains.

4.3.2 A parallel series of very weak positive linear magnetic anomalies were detected on the south side of Area 2b, aligned northeast to southwest, which are interpreted as the possible remains of further ridge and furrow cultivation.

4.3.3 Two weak positive linear magnetic anomaly were also detected, aligned northeast to southwest, which is interpreted as a possible soil-filled features.

#### **4.4 DISCUSSION**

4.4.1 Linear geophysical anomalies, reflecting the remains of ridge and furrow cultivation, were detected across the central part of Area 1, and the majority of Area 2. These anomalies were absent from the east and west sides of the Area 1, suggesting that the ridges and furrows had been removed by later agricultural activity in these areas. This may be evidence for a later field system, which has resulted in the differential preservation of the ridge and

furrow in the central part of Area 1 only, it having been removed to the east and west.

- 4.4.2 It is possible that these anomalies may have masked the presence of other insubstantial archaeological soil-filled features in the areas of ridge and furrow cultivation.

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## 5 CONCLUSIONS

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### 5.1 CONCLUSIONS

- 5.1.1 Geomagnetic surveys covering 3.93ha of land have been conducted within two areas (Area 1 and Area 2) within the Milton Keynes Western Expansion Area 10, Phase 2. The objective of the geophysical survey was to determine the presence/absence, nature and extent of any potential archaeological features within the selected areas, in order to clarify the results of a trial trench evaluation at the site.
- 5.1.2 Two modern service pipes including an aviation fuel pipe were detected by the surveys, as well as a series of anomalies interpreted as possible land drains or other agricultural features.
- 5.1.3 Evidence for medieval or later ridge and furrow cultivation was detected across the majority of the survey areas, although in Area 1 this appeared to have been partially removed by later agricultural practices.
- 5.1.4 A number of possible soil-filled ditches and pits were detected, some of which appear to relate to features revealed in the trial trench evaluation of the site. However, it is possible that the presence of other insubstantial archaeological features may have been masked by the presence of anomalies relating to the ridge and furrow cultivation and modern services.

### 5.2 RECOMMENDATIONS

- 5.2.1 Given that the geophysical surveys did not identify any areas of archaeological intensity, no further survey work is recommended. It is possible that, given the insubstantial nature of a number of the features revealed in the trial trench evaluation, further geophysical survey would only be effective if undertaken at a greater resolution than the present survey.

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APPENDIX 1: PROJECT DESIGN

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Project Design No.CP1500/11

June 2011

**WRITTEN SCHEME OF  
INVESTIGATION  
FOR A  
GEOPHYSICAL SURVEY  
ON LAND AT  
AREA 10, MILTON KEYNES  
WESTERN EXPANSION**

**FOR**

**WARDELL ARMSTRONG LLP**

**NGR SP 81291 3745**

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# North Pennines Archaeology Ltd.

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## CONTENTS

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1.	INTRODUCTION.....	2
2.	METHODOLOGY .....	4
3.	HEALTH AND SAFETY.....	6
4.	THE COMPANY .....	6
5.	WORK PROGRAMME .....	6
6.	REFERENCES .....	7



## 1. INTRODUCTION

### 1.1 Background

- 1.1.1 The following document outlines a Written Scheme of Investigation (WSI) for a geophysical survey of land at Milton Keynes Western Expansion (Area 10, Phase 2), Buckinghamshire. The WSI discussed below was produced for Wardell Armstrong LLP, on behalf of their client Gallagher Estates Ltd. The geophysical survey is to be undertaken in agreement Nick Crank, Archaeological Officer, Milton Keynes Council. This follows an application for a mixed use development on to the west of Milton Keynes and known as the Milton Keynes Western Expansion.
- 1.1.2 The overall development, for which outline planning consent has been granted, comprises 342ha of land which was subject to an Environmental Statement carried out in 2005 by Albion Archaeology. Subsequent to this the Milton Keynes Archaeological Officer recommended a programme of archaeological evaluation be undertaken. This is in line with government advice as set out in the DoE Planning Policy Guidance on Archaeology and Planning (PPG 16), and its successor Planning Policy Statement 5 (Planning for the Historic Environment). Briefs were issued by the Milton Keynes Archaeological Officer for a programme of evaluation which was to comprise geophysical survey followed by trial trenching. The geophysical survey was carried out in 2007 (Stratascan 2007).
- 1.1.3 A Project Design was prepared by Albion Archaeology in 2008 for a programme of trial trenching distributed across the development area, targeted on geophysical anomalies, possible archaeological features identified in the Environmental Statement and on areas apparently devoid of archaeological remains. The general objective of the trial trenching was to provide information on any archaeological remains in the proposed development area in order for an informed decision to be made on appropriate mitigation measures intended to preserve any remains present either by preservation in situ or by excavation and recording. The Project Design and accompanying trench array were approved by the Milton Keynes Archaeological Officer on behalf of the Local Planning Authority.
- 1.1.4 In 2008 Albion Archaeology undertook trial trenching in Phase 1 of Area 10 and this identified archaeological remains dating from the early Iron Age to medieval periods. Of most significance were two distinct areas of Iron Age settlement activity located on higher ground within the site. These comprised ditches and pits, as well as a large number of irregularly shaped features more characteristic of tree bowls. The pottery from both areas dated overwhelmingly from the middle to late Iron Age period, with a small amount dating from the early to mid Iron Age and Romano-British periods. Other remains included a series of broadly parallel ditches containing pottery of possible Roman date. These appeared to be on a similar alignment to Roman Watling Street located approximately 300m to the north-west. The relative lack of artefacts and their character suggested the ditches were associated with agricultural activity (Albion Archaeology 2008).
- 1.1.5 Based upon the results of the trial trenching in Area 10, Phase 1 the Milton Keynes Archaeological Officer requested a programme of open area excavation prior to development commencing. The mitigation work comprises three open area

excavations totally 3ha targeted on possible Iron Age and Romano-British remains uncovered by the trial trenching. This is currently being undertaken by North Pennines Archaeology Ltd.

- 1.1.5 A trial trench evaluation is also presently being undertaken by North Pennines Archaeology Ltd of Area 10, Phase 2, which has revealed a number of undated archaeological features in the form of pits, gullies and ditches, which are likely to be of Iron Age or earlier date. As a result two areas of geophysical survey have been agreed with the Milton Keynes Archaeological Officer (which were not covered by the 2007 programme of geophysical survey), in order to clarify the extent and complexity of the archaeological features identified (centred on Ordnance Survey grid reference SP 8129 3745).
- 1.1.6 The current land use is a mix of arable and pasture. The underlying solid geology comprises Oxford Clay and Kellaways Beds (BGS 2001). The overlying soils for the majority of the site are slowly permeable calcareous soils, known as Hanslope soils which are chalky till (SSEW 1980). The soils in the south east of the site and around Calverton Lane roundabout are known as Wickham 3 soils which are drift over cretaceous clay and sandstone, these consist of slowly permeable seasonally waterlogged fine loamy over clayey soils and coarse loamy over clayey soils.

## **2. METHODOLOGY**

### **2.1 Scope of the work**

- 2.1.1 Two areas of archaeological intensity have been identified during the ongoing trial trench evaluation of the Milton Keynes Western Expansion Area 10, Phase 2. The objective of the geophysical survey is to determine the presence/absence, nature and extent of any further potential archaeological features within the selected areas, in order to clarify the results of the trial trench evaluation. The results of the project will be used to inform the need for further evaluation work and/or mitigation measures, should potential significant archaeological remains be identified during the project.
- 2.1.2 Geophysical survey is to be undertaken over two areas (Area 1 & Area 2) comprising 4.45ha in total. Area 1 measures 1.8ha, and is situated on the western boundary of the site covering the area of Trenches 95-103. Area 2 measures 2.65 has and is situated immediately to the east of Whitehouse Farm, covering portions of two fields and the areas of Trenches 35-47 (Figure 1).
- 2.1.3 Geomagnetic survey is considered to be the most appropriate geophysical technique, given the non-igneous environment, and the expected presence of archaeological features at depths of no more than 1.5m. This technique has proved to be successful in the previous geophysical surveys at the site (Stratascan 2007).
- 2.1.4 The geophysical survey and reporting will be conducted in accordance with English Heritage guidelines (English Heritage 2008), and in accordance with the draft standard and guidance of the Institute for Archaeologists (IfA 2010).

### **2.2 Geomagnetic survey**

- 2.2.1 This technique involves the use of hand-held gradiometers, which measure variations in the vertical component of the earth's magnetic field. These variations can be due to the presence of sub-surface archaeological features. Geomagnetic measurements will be determined using a Bartington Grad601-2 dual gradiometer system, with twin sensors set 1m apart.
- 2.2.2 A 30m grid will be established in each field, and tied-in to known Ordnance Survey points using a Trimble 3605DR Geodimeter total station with datalogger.
- 2.2.3 The survey will be undertaken using a zig-zag traverse scheme, with data being logged in 30m grid units. A sample interval of 0.25m will be used, with a traverse interval of 1m, providing 3600 sample measurements per grid unit. The data will be downloaded onto a laptop computer for data processing and storage in the field using specialist software.
- 2.2.4 Geophysical survey data will be processed using ArchaeoSurveyor II software, to produce 'grey-scale' images of the raw data. Positive magnetic anomalies will be displayed as dark grey, and negative magnetic anomalies are displayed as light grey. A palette will show the relationship between the grey shades and geomagnetic values in nT for each area.

- 2.2.5 Raw data will be processed in order to further define and highlight the archaeological features detected. The resulting grey-scale images will be combined with site survey data and Ordnance Survey data to produce geophysical survey plans. Colour-coded geophysical interpretation diagrams will be provided, showing the locations and extent of positive, negative, dipolar, and diffuse magnetic anomalies.
- 2.2.6 Archaeological interpretation diagrams will also be provided, which will be based on the interpretation of the geophysical survey results, in light of the archaeological and historical background of the site.
- 2.2.7 Trace plots of the unprocessed geophysical data will also be provided if required.

## 2.3 Report

- 2.3.1 A detailed report will be provided, and will include the following:
- A location plan showing the location of the study area, related to the national grid, and an eight figure Ordnance Survey grid reference
  - The dates on which the project was undertaken
  - A concise, non-technical summary of the results
  - A summary of the historical and archaeological background of the site
  - A description of the methodology employed, work undertaken and results obtained
  - Digital photographs where appropriate
  - A description of any geophysical anomalies detected within the study area
  - Greyscale plans at an appropriate scale showing the location and extent of any geophysical anomalies
  - Interpretation of the geophysical survey results in light of the archaeological and historical background of the site
  - Geophysical and archaeological interpretation diagrams
  - Trace plots of the unprocessed geophysical data as appropriate
  - A copy of the Written Scheme of Investigation
  - The associated OASIS reference

## 2.4 Archive and Publication

- 2.4.1 Copies of the final report will be sent to Wardell Armstrong LLP. A digital copy of the report (in pdf format) will also be provided.
- 2.4.2 The data archive for the project will be prepared in accordance with the recommendations of the Archaeology Data Service (ADS 2001). The project will also be registered with the **Online Access to the Index of archaeological investigations (OASIS)**, and the **OASIS** project identifier will be included in the report.

### **3 HEALTH AND SAFETY**

- 3.1 Full consideration will be given to health and safety issues during all fieldwork. North Pennines Archaeology Ltd. Health and Safety Statement conform to the provisions of the Standing Conference of Archaeological Unit Managers (SCAUM) Health and Safety Manual.
- 3.2 A full risk assessment will be undertaken to assess all real and potential hazards prior to the commencement of fieldwork. A valid first aid certificate will be held by at least one member of staff.

### **4 THE COMPANY**

- 4.1 North Pennines Archaeology Limited (NPA) and North Pennines Survey CIC (NPS) are wholly owned companies of North Pennines Heritage Trust (Registered Charity No. 700701). The businesses are not for private profit companies and all surpluses are covenanted to charity.
- 4.2 North Pennines Archaeology and North Pennines Survey have undertaken numerous similar projects, throughout Northern England, the Midlands, and Norfolk. Geophysical Surveys have been undertaken for a wide range of clients, including major developers and consultants such as PFK Planning, United Utilities, WA Developments, NPS Consultants, and Ian Farmer Associates.
- 4.2 The work will be undertaken under the direction of Martin Railton, BA (Hons), MA, MIFA, NPS Project Manager. Martin Railton is a qualified archaeological surveyor with extensive experience of geophysical survey. He has completed numerous similar projects, both for the present companies, and his previous employer, Archaeological Services Durham University. He will be assisted by a small team of professional trained NPA staff to undertake the survey work. All staff are experienced archaeologists with significant previous experience of geophysical survey.

### **5 WORK PROGRAMME**

- 5.1 Following approved of this project design, North Pennines Survey would be able to undertake the work. It is expected that the fieldwork will take 2-3 days to complete, commencing on 15<sup>th</sup> June 2011. All work is programmed into the works schedule for the company, and deadlines will be maintained. A draft report at least will be available within one week following completion of the fieldwork.

## 6 REFERENCES

Albion Archaeology (2008) MK West Area 10 Phase 1: Archaeological Trial Trenching

Archaeology Data Service (2001) Geophysical Data in Archaeology: A Guide to Good Practice, Arts and Humanities Data Service

British Geological Survey (2001) Solid Geology Map: UK South Sheet, 4<sup>th</sup> edition

English Heritage (2008) Geophysical survey in Archaeological Field Evaluation, Research and Professional Services Guideline No.1, 2<sup>nd</sup> Edition, London

Institute for Archaeologists (2010) Standard and guidance for archaeological geophysical survey, IfA draft paper, Birmingham

SSEW (1980) Soils of England and Wales: Sheet 1 Northern England, Soil Survey of England and Wales

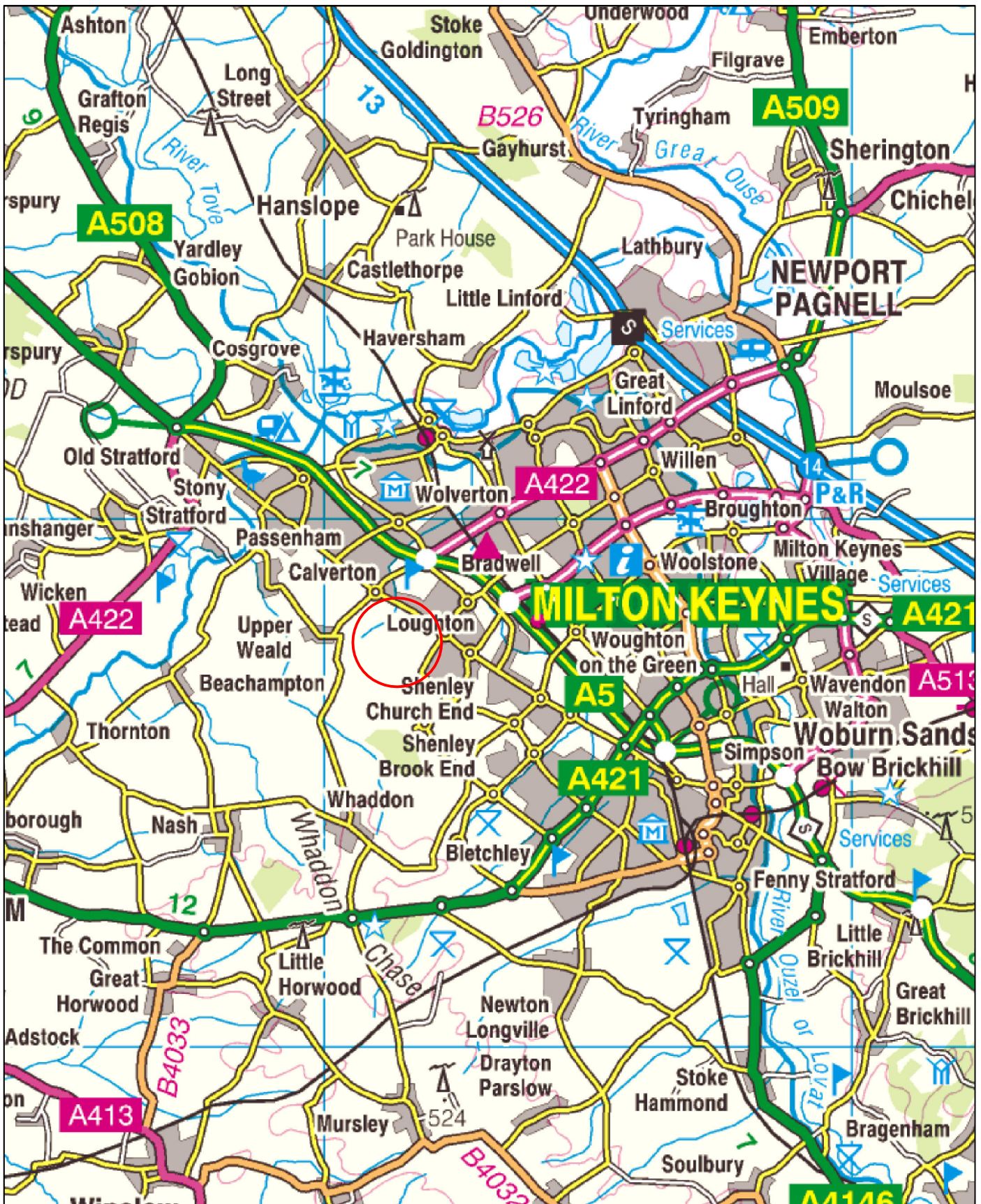
Stratascan (2007) Milton Keynes (Western Expansion) Geophysical Survey Report

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## APPENDIX 2: FIGURES


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North Pennines Survey CIC  
2011

PROJECT: Milton Keynes Western Expansion  
 SCALE: 1:100,000 at A4  
 REPORT No: SP1500/11  
 CLIENT: Wardell Armstrong LLP  
 DRAWN BY: MDR  
 DATE: June 2011  
 FIGURE No: 1

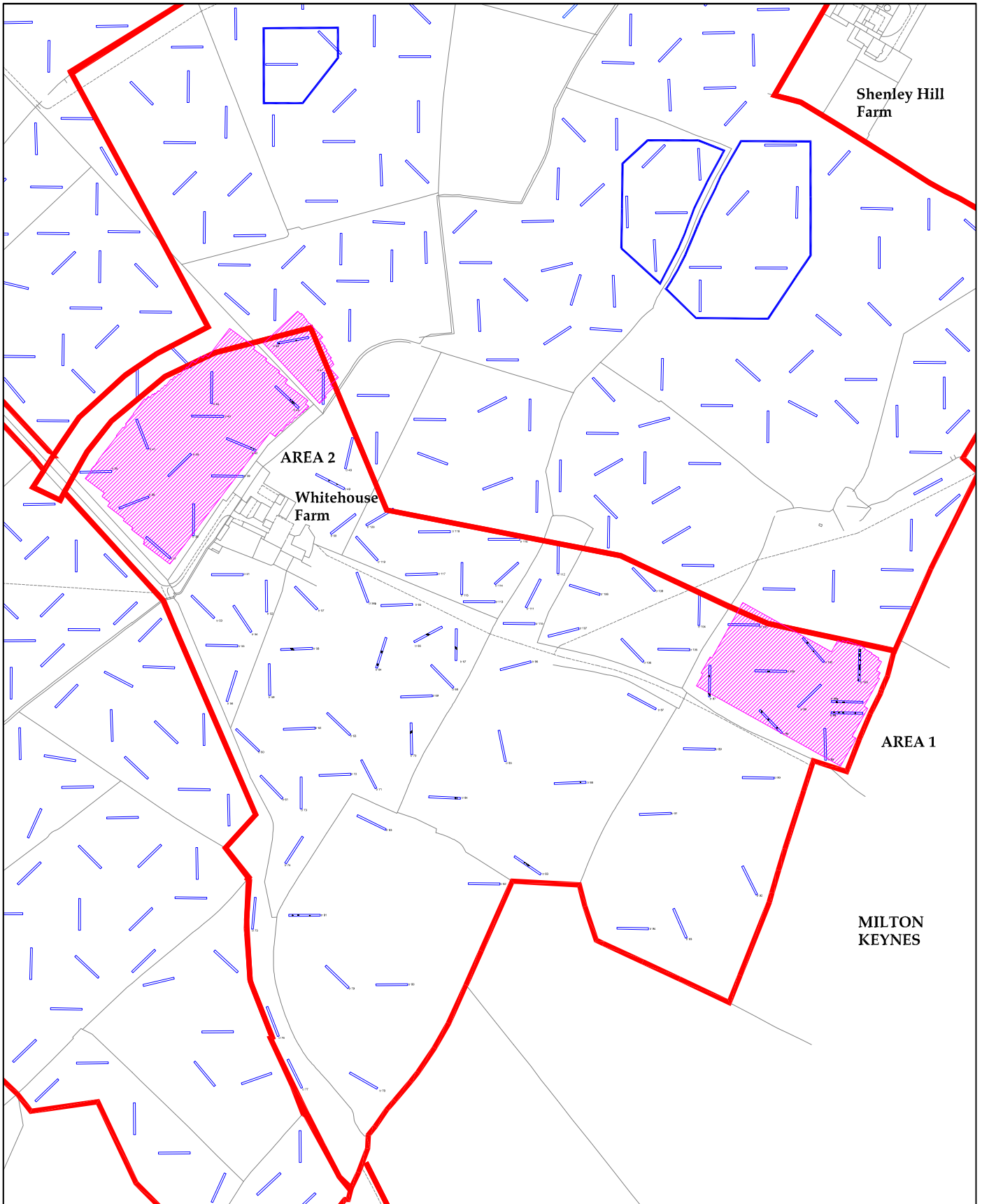
 site location



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Figure 1 : Location map











 <p>North Pennines Survey CIC 2011</p>	<p>PROJECT: Milton Keynes Western Expansion</p> <p>SCALE: 1:5000 at A4</p> <p>REPORT No: SP1500/11</p> <p>CLIENT: Wardell Armstrong LLP</p> <p>DRAWN BY: MDR</p> <p>DATE: June 2011</p> <p>FIGURE No: 2</p>	<ul style="list-style-type: none"> <li> outline of proposed development area</li> <li> geophysical survey area</li> <li> evaluation trench</li> <li> outline of open area excavation</li> </ul>	 <p>Reproduced by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationary Office. © Crown copyright. All rights reserved. Licence number 100014732</p>
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Figure 2 : Location of the geophysical survey areas (Area 1 & Area 2)



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2011  
Milton Keynes Western Expansion

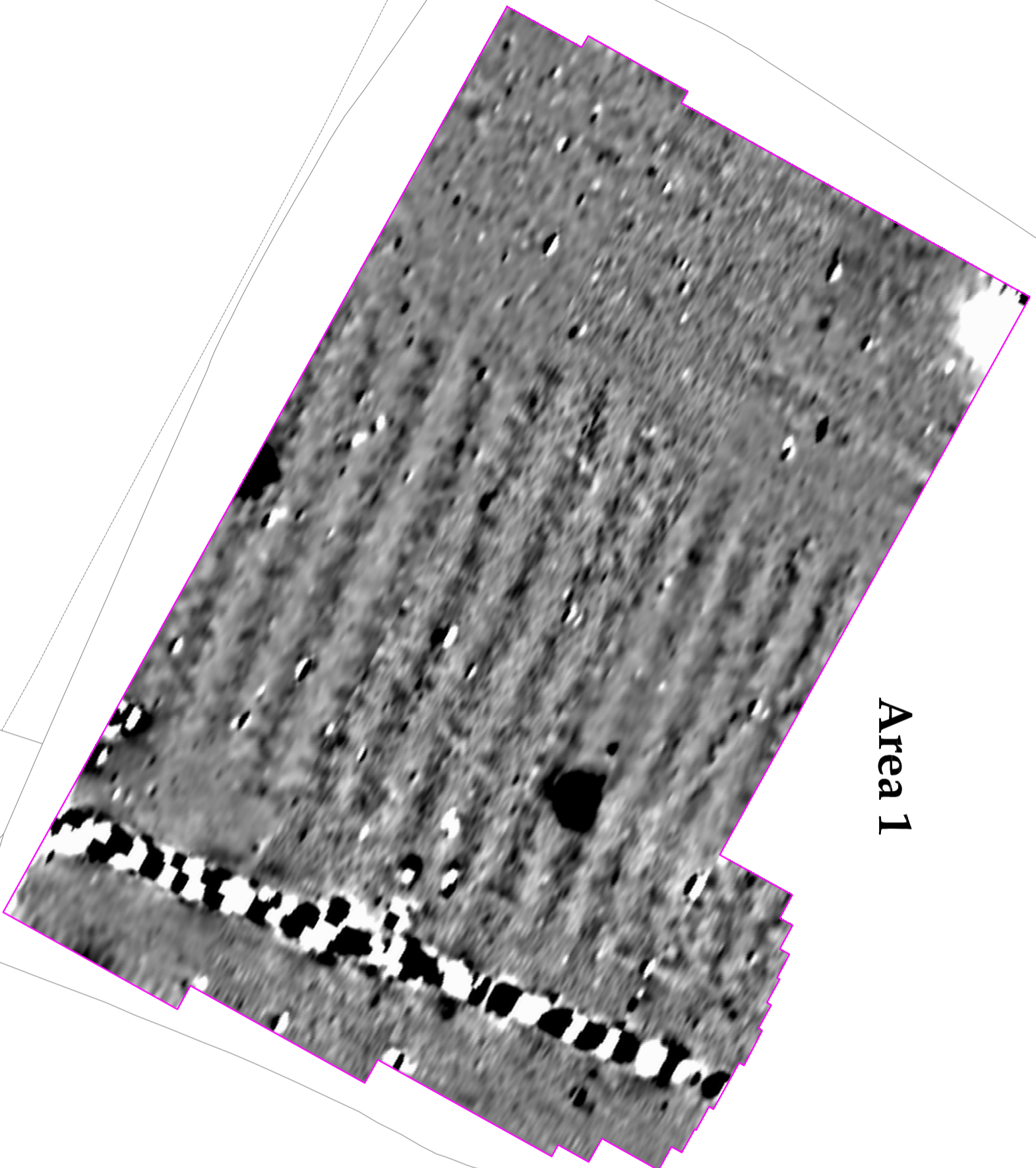
COMMISSIONED BY:

Wardell Armstrong LLP


SCALE: 1:750 at A3

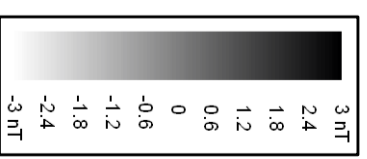
DRAWN BY: MDR

DATE: June 2011



# Area 1

 outline of geophysical survey area



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Figure No: 3

Figure 3 : Geophysical survey of Area 1



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2011  
Milton Keynes Western Expansion


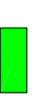


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SCALE: 1:750 at A3

DRAWN BY: MDR

DATE: June 2011

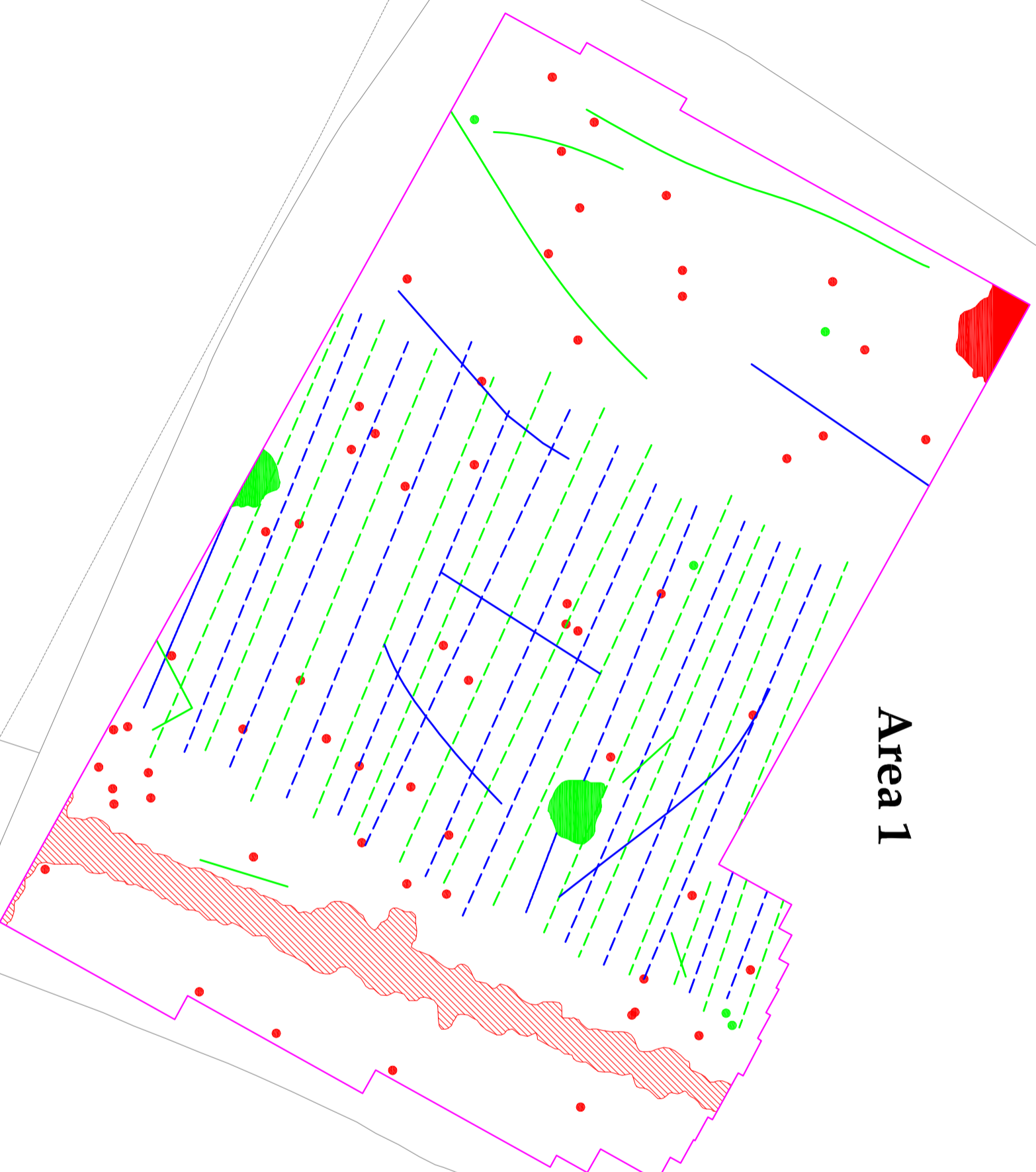
-  outline of geophysical survey area
-  positive magnetic anomaly
-  negative magnetic anomaly
-  dipolar magnetic anomaly



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Figure No: 4



Area 1

Figure 4 : Geophysical interpretation of Area 1



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2011

Milton Keynes Western Expansion








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-  outline of geophysical survey area
-  possible land drain
-  former field boundary
-  direction ridge & furrow
-  service pipe
-  possible soil-filled features
-  uncertain magnetic features



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Figure No: 5

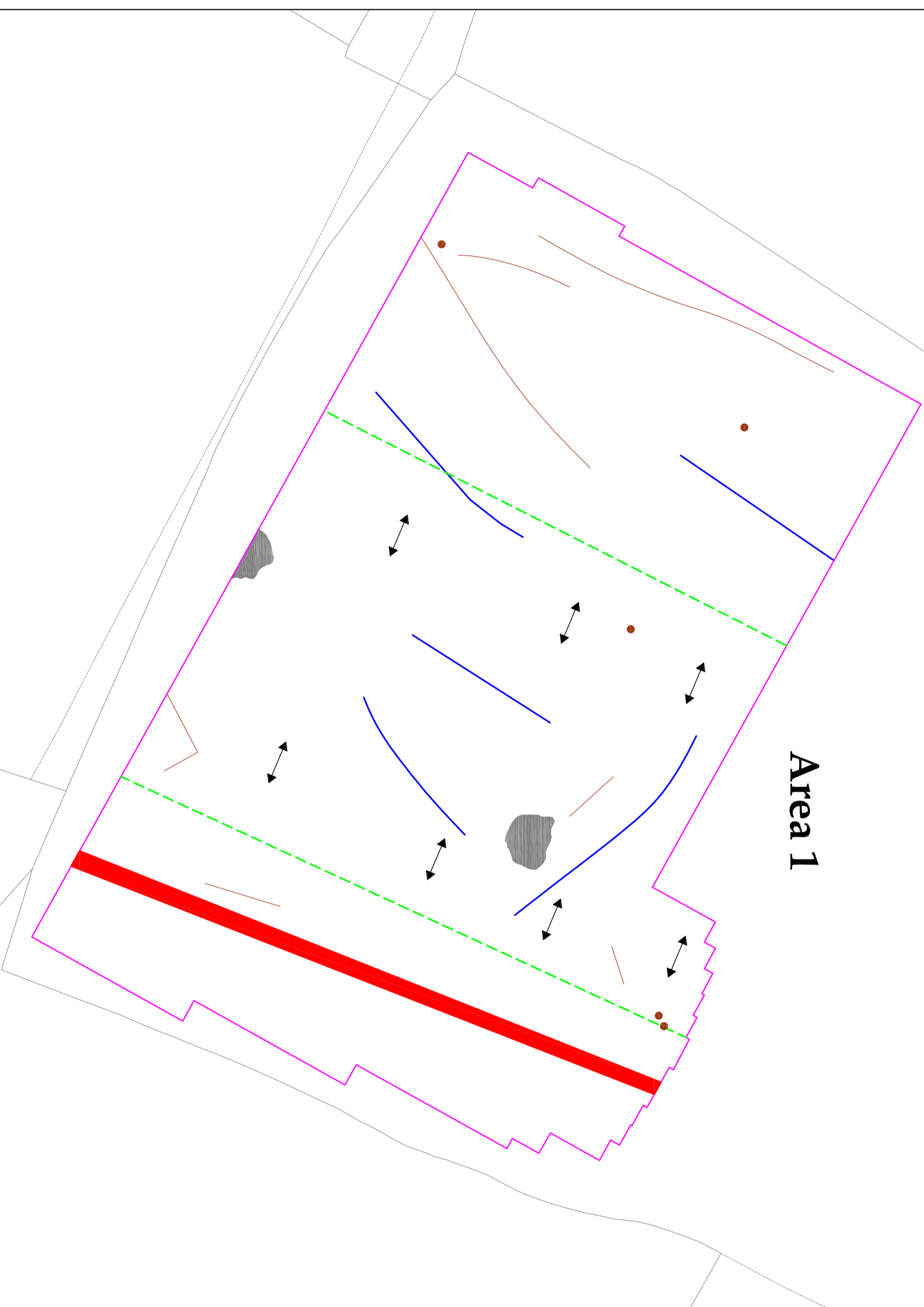
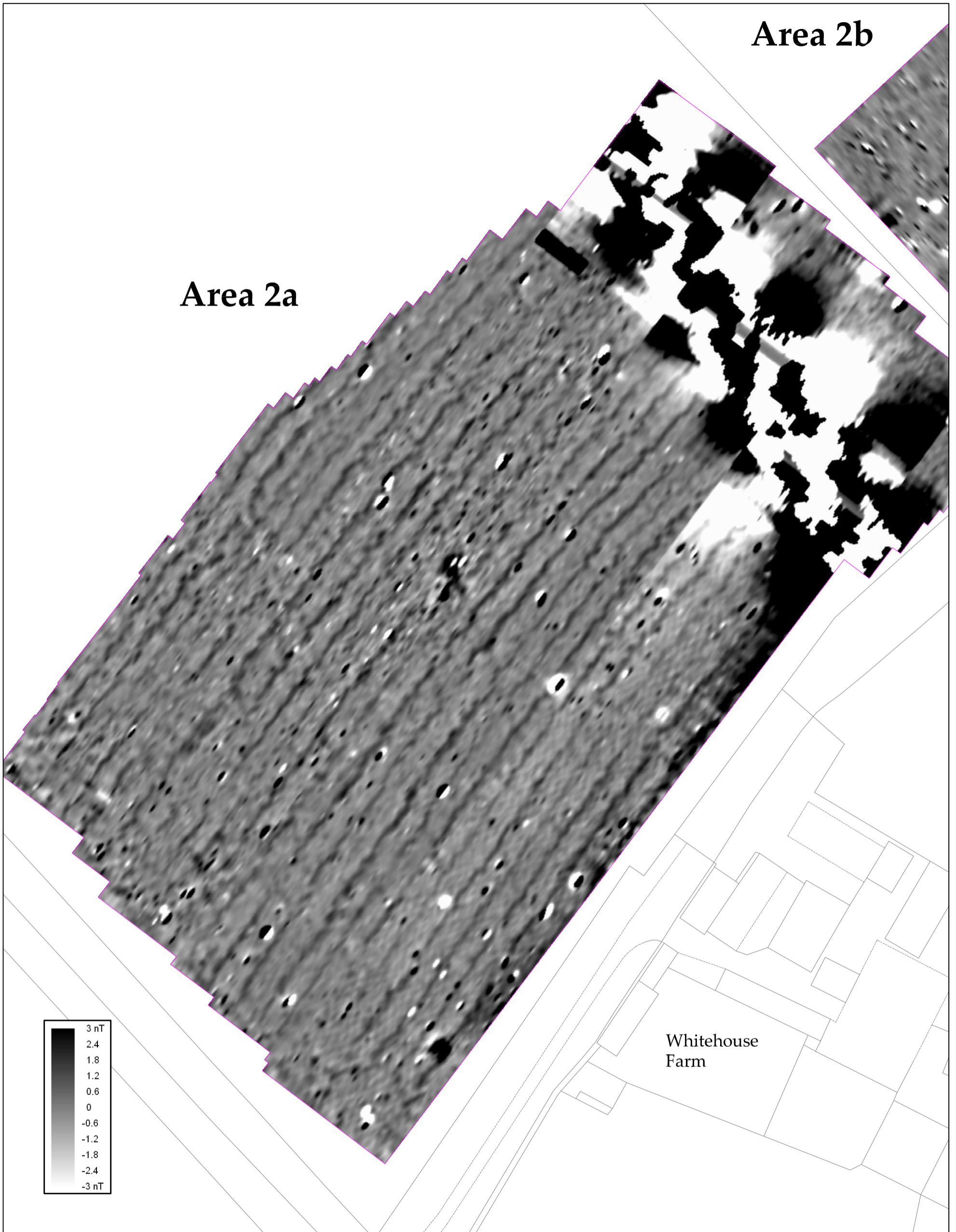


Figure 5 : Archaeological interpretation of Area 1

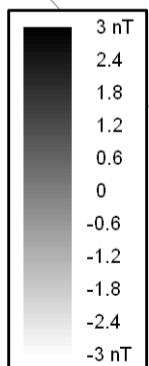





Area 2b

Area 2a

Whitehouse Farm



 outline of geophysical survey area



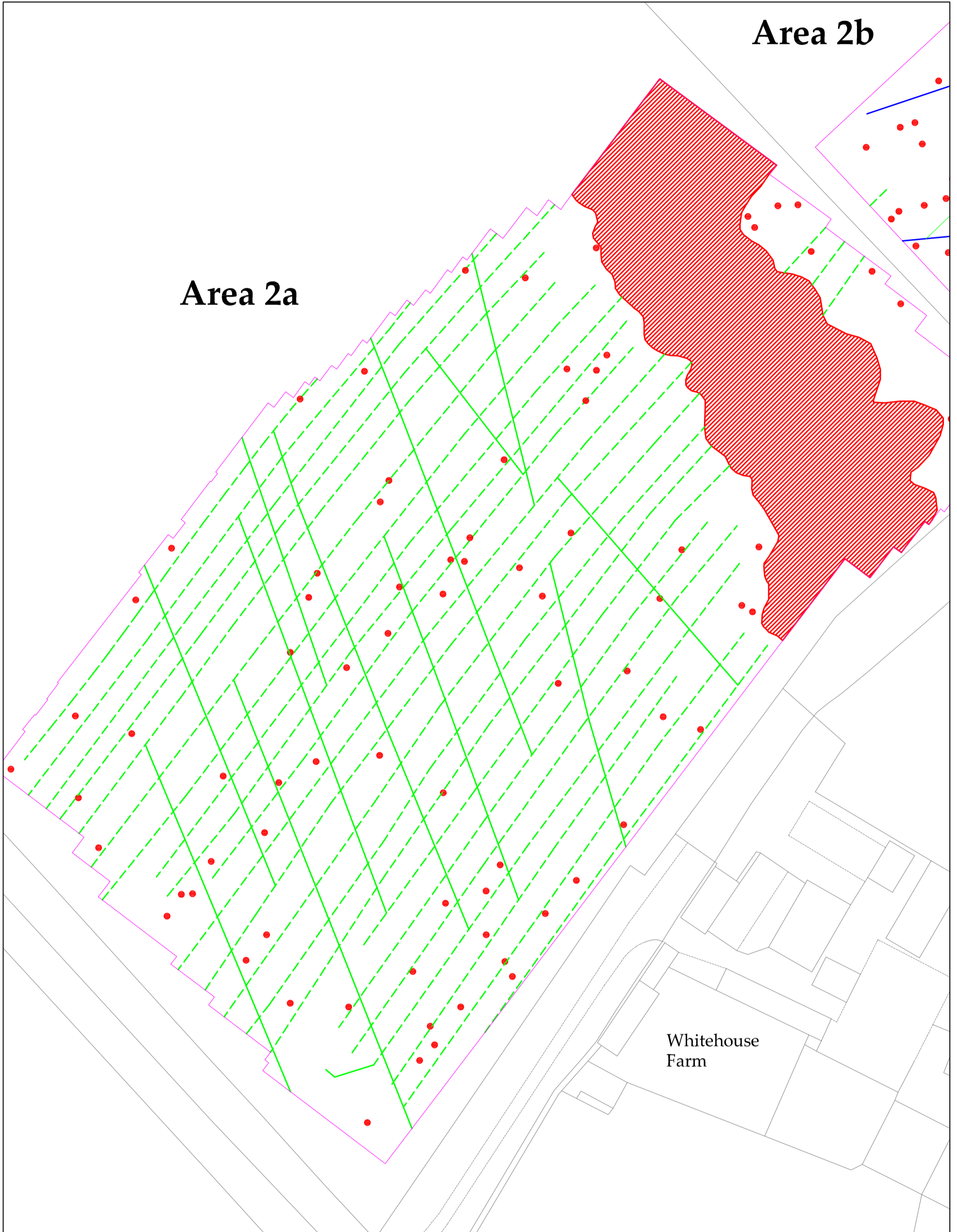
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FIGURE NO: 6

Figure 6 : Geophysical survey of Area 2a



Area 2b





Area 2a

Whitehouse Farm



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 SCALE: 1:750 at A3  
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 DATE: June 2011  
 FIGURE NO: 7

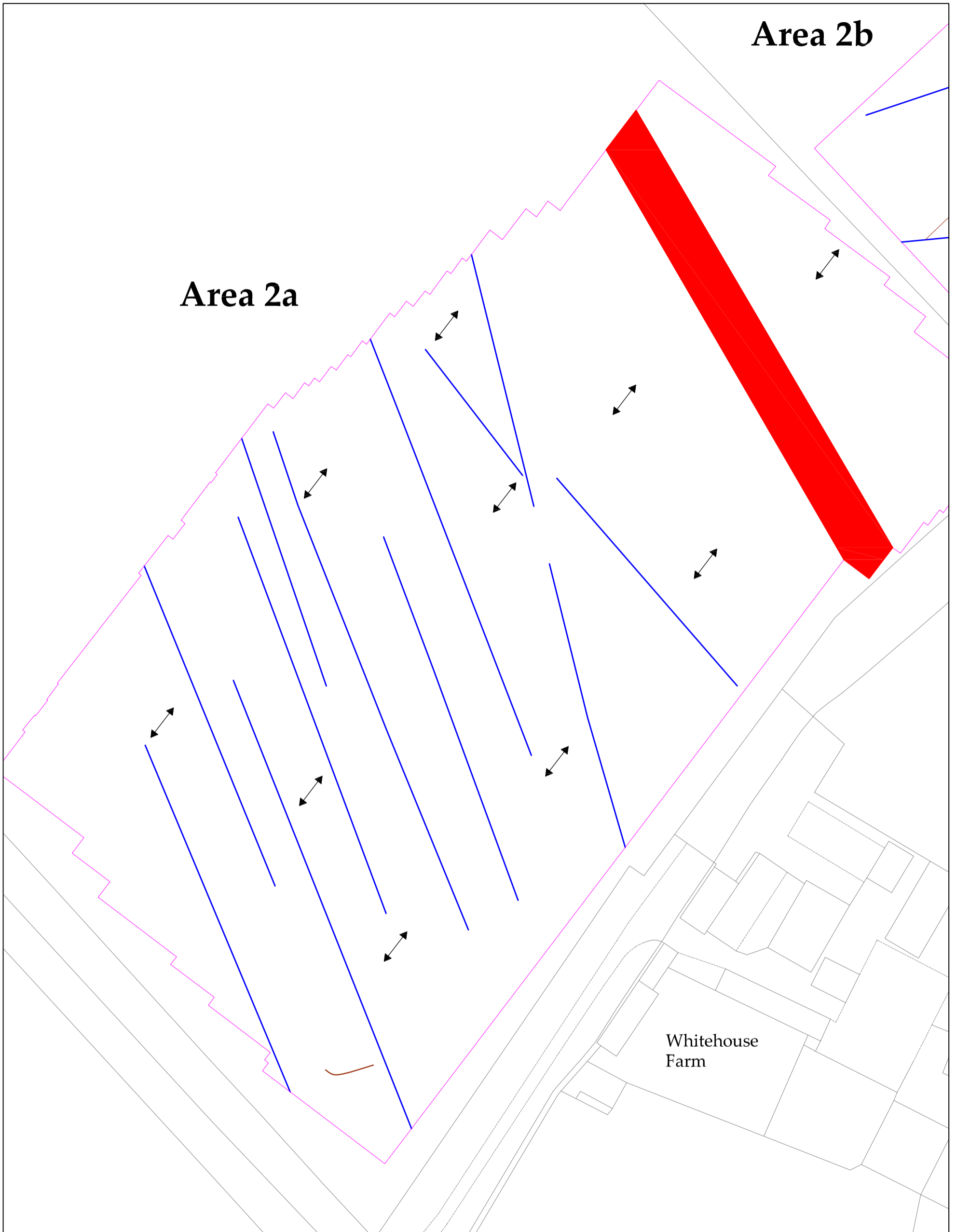
-  outline of geophysical survey area
-  positive magnetic anomaly
-  negative magnetic anomaly
-  dipolar magnetic anomaly



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Figure 7 : Geophysical interpretation of Area 2a





Area 2b






Area 2a

Whitehouse Farm



North Pennines Survey CIC  
2011

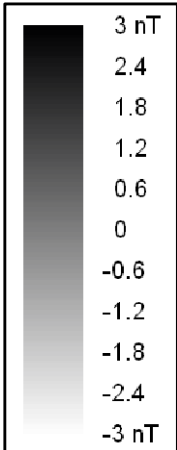
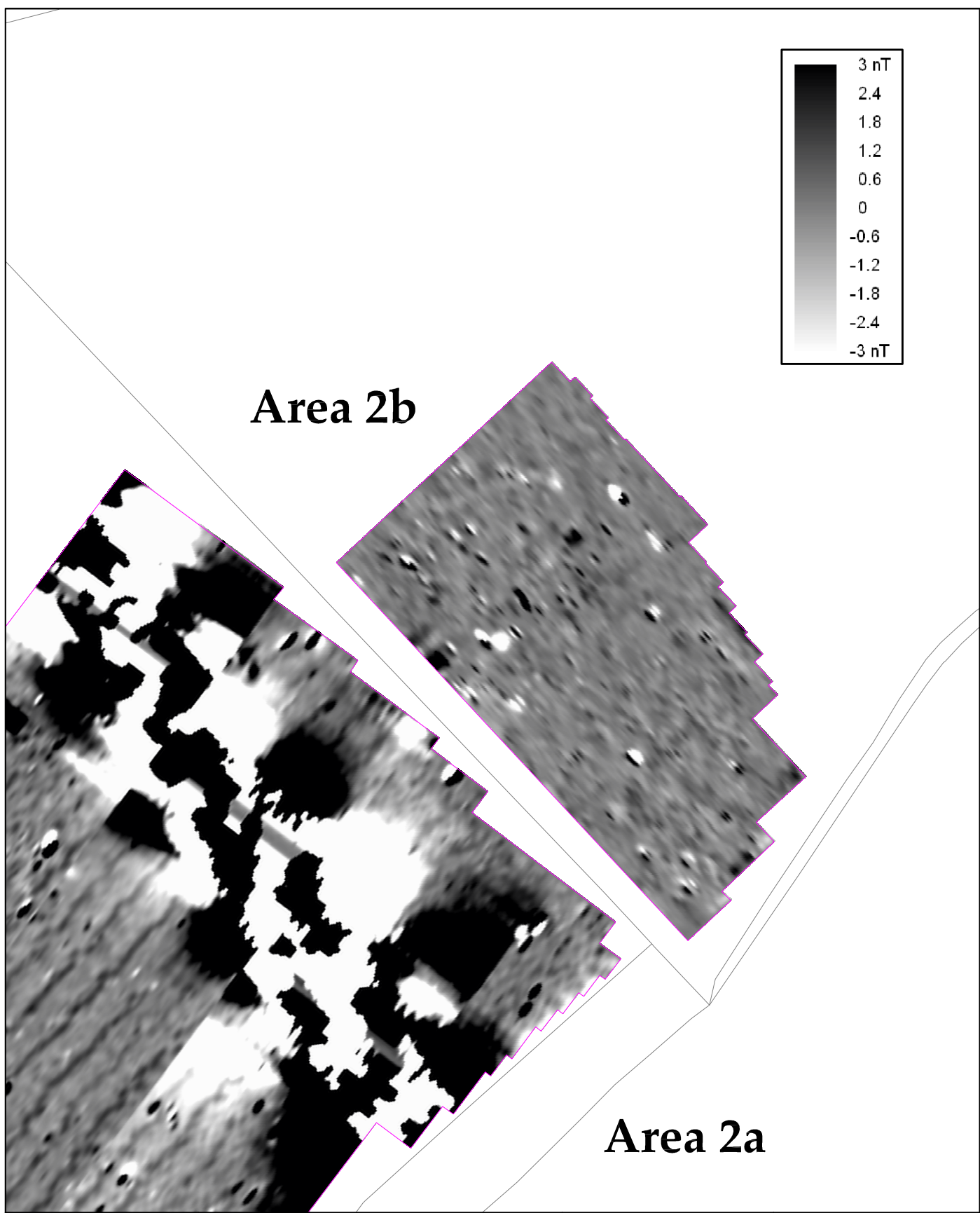
PROJECT: Milton Keynes Western Expansion  
 SCALE: 1:750 at A3  
 REPORT No: SP1500/11  
 CLIENT: Wardell Armstrong LLP  
 DRAWN BY: MDR  
 DATE: June 2011  
 FIGURE NO: 8

-  outline of geophysical survey area
-  possible land drain/furrow
-  ridge & furrow
-  service pipe
-  possible soil-filled feature



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Figure 8 : Archaeological interpretation of Area 2a




**Area 2b**

**Area 2a**



North Pennines Survey CIC  
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 SCALE: 1:500 at A4  
 REPORT No: SP1500/11  
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 DATE: June 2011  
 FIGURE No: 9

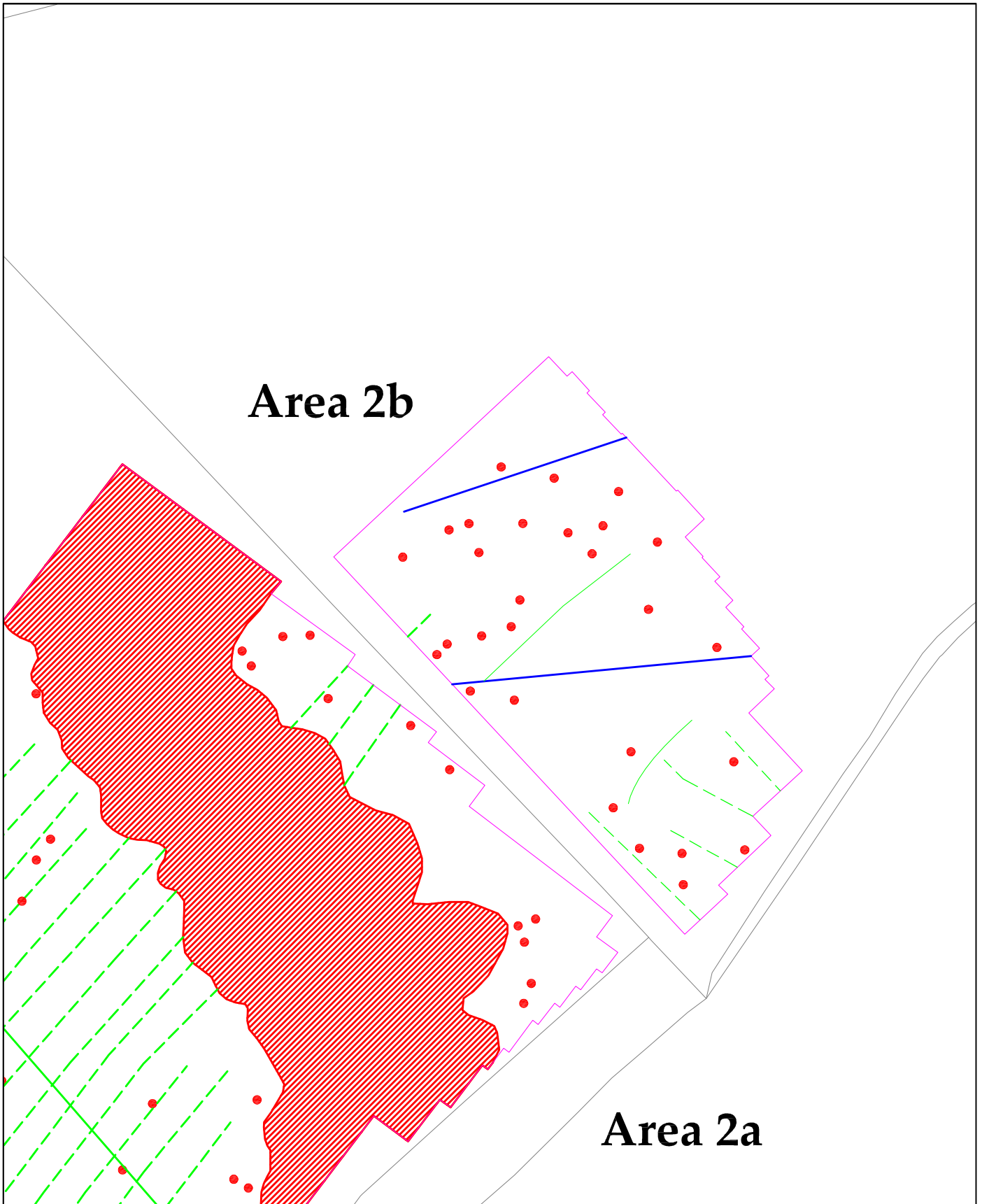
 outline of geophysical survey area



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



Figure 9 : Geophysical survey of Area 2b





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2011

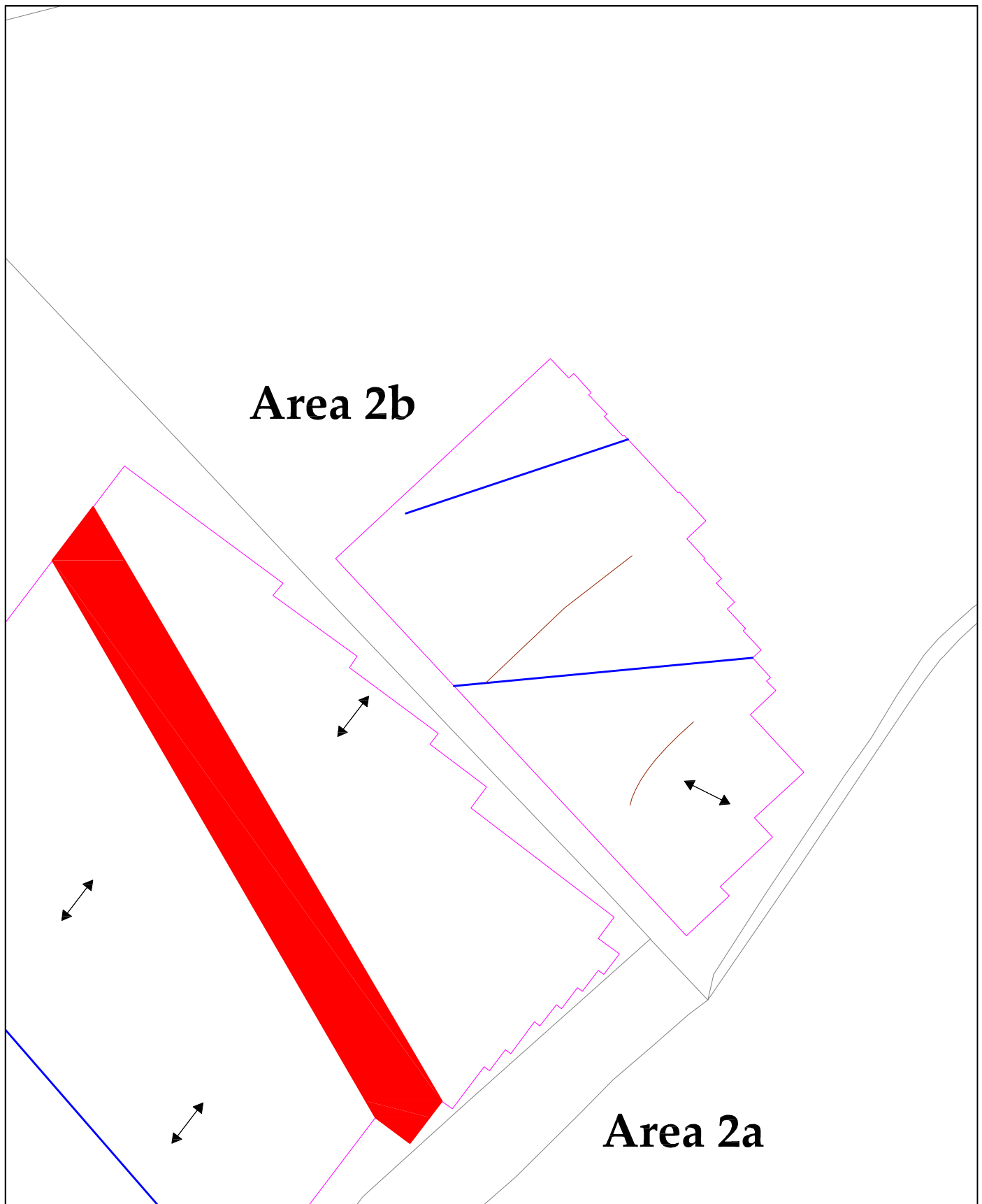
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 SCALE: 1:500 at A4  
 REPORT No: SP1500/11  
 CLIENT: Wardell Armstrong LLP  
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 DATE: June 2011  
 FIGURE No: 10

-  outline of geophysical survey area
-  positive magnetic anomaly
-  negative magnetic anomaly
-  dipolar magnetic anomaly



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Figure 10 : Geophysical interpretation of Area 2b








**Area 2b**

**Area 2a**



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 FIGURE No: 11

-  outline of geophysical survey area
-  land drain
-  ridge & furrow
-  service pipe
-  possible soil-filled features



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Figure 11 : Archaeological interpretation of Area 2b