

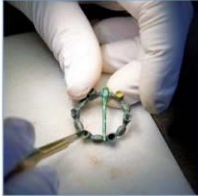
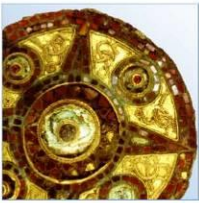
Land off New Road, Clifton Bedfordshire

Archaeological Geophysical Survey

National Grid Reference: TL 16209 38499

AOC Project No: 51818

Date: October 2017



ARCHAEOLOGY

HERITAGE

CONSERVATION

Land off New Road, Clifton
Bedfordshire
Archaeological Geophysical Survey

On Behalf of: WYG Environment Planning Transport Ltd
90 Victoria Street
Bristol
BS1 6DP

National Grid Reference (NGR): TL 16209 38499

AOC Project No: 51818

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Date of survey: 3rd – 4th October 2017

This document has been prepared in accordance with AOC standard operating procedures.

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Non-Technical Summary

AOC Archaeology Group was commissioned by WYG Environment Planning Transport Ltd (hereafter WYG) to undertake an archaeological geophysical survey (gradiometer) to investigate the potential for buried archaeological remains on land off New Road, Clifton (centred at TL 16209 38499). A total of 7 hectares were surveyed and the results of the survey have identified the following.

The results of the survey identified no definitive archaeological anomalies within the survey area.

However a number of discrete archaeological trends have been recorded, of which one would appear to form a possible enclosure. This enclosure is comparable to others located on other archaeological sites and it is highly likely to be archaeological in origin.

Across the site a number discrete linear trends were also identified but due to their poorer strength and patterning only a tentative interpretation could be formed as to their origin. Many of these would appear to be archaeological, associated with the possible enclosure already discussed.

Also located in the survey area are a number of discrete pit like anomalies which again could be archaeological in origin.

Throughout the dataset several anomalies of an unclear origin have been recorded. These appear magnetically weak and although a geological or agricultural origin is likely in most cases, an archaeological origin cannot be dismissed.

Three former field boundaries have been located and confirmed through historical mapping.

A number of agricultural trends, most likely related to conventional ploughing regimes and possible agricultural headlands have also been identified.

Large areas of geological variations representing a possible palaeochannel have also been identified.

1 Introduction

- 1.1 AOC Archaeology Group was commissioned by WYG to undertake an archaeological geophysical survey at land off New Road, Clifton as part of a wider scheme of archaeological assessment in advance of the proposed development of the site.
- 1.2 The survey was carried out to provide information on the extent and significance of potential buried archaeological remains within the proposed development site.

2 Site Location and Description

- 2.1 The proposed development site is located to the west of New Road, south of the village of Clifton, Bedfordshire, centred at TL 16209 38499 (see Figure 1).
- 2.2 The survey area covers approximately 7 hectares (ha) across a single harrowed arable field, bounded to the north and south by houses, to the east by New Road and to the west by further arable land. The survey area is situated on level ground with a slight slope from approximately 55m aOD (above Ordnance Datum) in the west to approximately 48m aOD in the east.
- 2.3 The bedrock recorded geology within most of the survey area consists of the Gault Formation – Mudstone, with a small section of the Woburn Sands Formation – Sandstone, in the most easterly part of site (BGS 2017). These are overlain by superficial deposits of the Lowestoft Formation – Diamicton (BGS 2017).
- 2.4 These are overlain by slightly acidic loamy and clayey soils with impeded drainage (Soilscapes 2017).
- 2.5 Gradiometer survey is suggested to provide an average response to this type of geology, results can vary depending on the formation of these types of geology (David *et al.* 2008, 15).

3 Archaeological Background

- 3.1 The archaeological background below is drawn from an archaeological appraisal of the site, undertaken in 2017 (WYG 2017).
- 3.2 The Central Bedfordshire and Luton Historic Environment Record holds details for 99 monument records within the search area, including entries for cropmarks and Portable Antiquities Scheme findspots. In addition, a related roster of 9 archaeological event records are detailed for the assessment area.
- 3.3 No undesignated heritage assets are recorded within the bounds of the study area. Three monument entries are recorded on land immediately to the north of the study area, on land presently being developed for residential housing. During a prior programme of trial trenching, undated trenches were encountered in association with an abraded potsherd of tentatively Iron Age date (HER 19954). It should be noted that a post-medieval ditch and pit were encountered a short distance to the north of these features that may represent a continuation of post-medieval activity identified to the south (HER 19955). A programme of geophysical survey was also undertaken north of the current study area. This identified anomalies suggestive of ridge and furrow, a conclusion supported by extensive open field systems apparent on mid-18th century historic mapping for the area.

Prehistoric

- 3.4 There are no recorded remains of prehistoric date within the proposed development area itself.
- 3.5 One of several Bronze Age inhumations encountered during the excavation of barrows east of Clifton village in the mid-19th century was accompanied by an Early Bronze Age beaker vessel (HER 394).

To the north of the village, the cropmarks of several ring ditches are visible (HER 1664). These may represent the ploughed-out remnants of Bronze Age round barrows.

- 3.6 As mentioned above, one of several ditches excavated recently, immediately to the north of the study area, was tentatively dated to the Iron Age period, on account of an abraded sherd of pottery (HER 19954).
- 3.7 A number of cropmarks indicative of enclosures have been identified on land immediately east of the village (HER 15095 & 15096) alongside further curvilinear and linear anomalies, as well as reports of ploughed out earthworks (HER 4490 & 1888). Late 19th century mapping also indicates earthworks formerly located to the north of the village (HER2523).

Roman / Romano British

- 3.8 There is no clear evidence for Romano-British activity within the study area.
- 3.9 The Viatores group identified two possible Roman roads running through the assessment area in the 1960s, connecting Woburn and Dunton, and Ickleford and Bedford, respectively (HER 5342 & 10480). These interpretations are speculative at best and should not be treated with any great weight.

Early Medieval / Medieval

- 3.10 There are no known medieval remains within the study area.
- 3.11 The only evidence for early medieval activity in the study area comes from the former place name for the study area itself. This was formerly part of an open field system called How/Hoo Field, a potential development from the Old Norse descriptive place name *haugr* or its Old English version *hlāw*. Whichever the element, it translates as 'mound', suggesting either the presence of an early medieval earthwork, or else an early medieval focus on a prehistoric earthwork. Noting this, the strongest association of the Hoo/How name remains with Hoo Farm and Hoo Hill, to the south of the study area.
- 3.12 There are two moated sites within the assessment area, one associated with Clifton Manor House to the north-west of the village (HER 3575) and the other associated with Hoo Farm to the south of the study area (HER 3428). While post-medieval mapping provides copious evidence for a regime of open field farming around the village, the only physical evidence for this comes from ridge and furrow anomalies identified during geophysical survey immediately north of the study area (HER 19956).

4 Aims

- 4.1 The aim of the geophysical survey was to identify any potential archaeological anomalies that would enhance the current understanding of the archaeological resource within the proposed survey area.
- 4.2 Specifically the aims of the gradiometer survey were;
- To locate, record and characterise any surviving sub-surface archaeological remains within the survey area
 - To help determine the next stage of works as per the client's instruction
 - To provide an assessment of the potential significance of any identified archaeological remains in a local, regional and (if relevant) national context
 - To produce a comprehensive site archive and report.

5 Methodology

- 5.1 All geophysical survey work was carried out in accordance with recommended good practice specified in guideline documents published by English Heritage – now Historic England (David *et al.* 2008) and the Chartered Institute for Archaeologists *Standard and Guidance for archaeological geophysical survey* (2014).
- 5.2 Parameters were selected that were suitable for the prospective aims of the survey and in accordance with recommended professional good practice (David *et al.* 2008, 8).
- 5.3 The gradiometer survey was carried out using Bartington Grad601-2 fluxgate gradiometers (see Appendices 2 and 3). Data was collected on an east-west alignment using zig-zag traverses, with a sample interval of 0.25m and a traverse interval of 1m. A total of 89 full or partial 30m by 30m grids were surveyed within the specified area, totalling an area of approximately 7ha.
- 5.4 Attention was taken to avoid metal obstacles present within the survey area during data collection using gradiometers. Gradiometer survey is affected by ‘above-ground noise’ such as metal objects, and avoiding these improves the overall data quality and results obtained.
- 5.5 The gradiometer data were downloaded using Bartington Grad601 PC Software v313 and processed using Geoscan Geoplot v3.0 / v4.0. The details of these processes can be found in Appendices 4 and 5. Data processing, storage and documentation were carried out in accordance with the good practice specifications detailed in the guidelines issued by the Archaeology Data Service (Schmidt and Ernenwein, 2009).
- 5.6 Interpretations of the data were created as layers in AutoCAD LT 2009 / GIS and the technical terminology used to describe the identified features can be found in Appendix 6.

6 Results and Interpretation

- 6.1 The gradiometer survey results have been visualised as greyscale plots, with the minimally processed data plotted at -1nT to 2nT in Figure 3. The processed data is also plotted at -1nT to 2nT and can be seen in Figure 4. An interpretation of the data can be seen in Figure 5 and an individual characterisation of the identified anomalies follows this in Appendix 1.

Archaeology

- 6.2 No responses indicating definitive archaeological remains have been located in the survey area. A number of discrete trends have been recorded which are highly likely to be archaeological in origin.

Discrete linear trends – Archaeology?

- 6.3 Several discrete linear trends have been identified across the dataset which could possibly have an archaeological origin. These trends are described as anomalies of a linear / curvilinear / rectilinear form either composed of an increased or decreased signal compared to magnetic background values. It is highly likely that some of these anomalies belong to archaeological remains, but poor patterning or weaker response values makes interpretation difficult.
- 6.4 The first set of discrete positive linear trends are located in the south-west of the survey area and would appear to form a small sub-circular enclosure (**C1**). The lack of archaeological finds or historical aerial photographs for the area means these anomalies cannot be definitively classed as archaeological. However the shape and size of the feature is comparable to archaeological enclosures located on other sites.
- 6.5 The second set of positive discrete linear trends are located to the east of this enclosure and appear to form a possible outer boundary ditch to the enclosure (**C2** and **C3**). These trends however are

tentative as they are inconsistent in places and appear to have been truncated, possibly by agricultural practises.

- 6.6 Two other positive discrete linear trends are located in the north of the survey area, running in an east-west orientation (**C5**) and a north-east south-west orientation (**C4**). These trends are magnetically weak in places, and they do not form any obvious feature type and appear to be quite isolated and are therefore more tentative than other trends seen in the dataset.
- 6.7 A number of other more discrete trends have been observed in the dataset which are less clear in their form. They are magnetically weaker than the trends already identified and though they are likely to be archaeological in origin, their interpretation is very tentative.
- 6.8 Several of these tentative trends are located in the south of the dataset surrounding enclosure **C1** and the outer boundary ditches **C2** and **C3** (**C6 - C9**). These trends are likely to be archaeological and associated with the enclosures that they are adjacent to. The reason for their weaker magnetic response could be that the material forming these ditches is less enhanced or that truncation from modern ploughing has meant that a large proportion of the anomaly has been eroded.
- 6.9 A weak tentative linear trend adjoins the south of anomaly **C4** and is likely to form a continuation of this feature (**C10**). As with the above it is likely that this trend is less magnetically enhanced or that it has been truncated by agricultural activities.

Discrete Archaeology – Pit

- 6.10 Several discrete pit like anomalies have been recorded in the survey data. These anomalies are composed of an increase in magnetic values with a patterning on the XY trace plot that is suggestive of buried remains, such as the infill of a pit, but are isolated in their location and association with other features in the area or are not clearly enough defined in the XY trace plot.
- 6.11 Two discrete pit like features are located in the centre of the enclosure feature **C1** and are most likely to be associated with the enclosure and therefore be of an archaeological origin (**C11** and **C12**). However the XY trace plots of these pit features is not conclusive enough to say they are definitively archaeological pits.
- 6.12 Two further possible discrete pits are located north-east of enclosure **C1** and would appear to be isolated from any other archaeological anomalies (**C13**). The isolation of these pit like anomalies means that an archaeological origin is more tentative. It is possible that these are related to more natural origins.
- 6.13 A small cluster of three discrete pit like anomalies are located in the central part of the survey area (**C14**). These would appear to be located within a possible geological anomaly making the interpretation more tentative, suggesting that the origin is less likely to be archaeological. However an archaeological origin is still a possibility.

Trends / Areas of Disturbance – Unclear Origins

- 6.14 A number of linear and curvilinear trends and areas of disturbance can be seen across the dataset and it is difficult to interpret their origins. These anomalies are classed as trends of a linear / curvilinear form which are composed of either strong, weak or different change in magnetic values or a combination of all. Coupled with poor patterning, these anomalies are difficult to interpret and it is unclear whether they have an archaeological origin. Areas of disturbance are also difficult to interpret and it is unclear whether they have an archaeological origin or are related to geology or agricultural practises.
- 6.15 The first of these are found in the north of the dataset and though they may be agricultural or geological, an archaeological origin cannot be ruled out (**C15**, **C16** & **C18**). **C15** and **C16** are positive linear trends running north-south and north-west to south-east and could represent agricultural

trends or former boundaries, though historical mapping does not support this suggestion. The linear trends forming **C18** are suggestive of ploughing trends, running north-west to south-east, however they are weak and tentative.

- 6.16 A further set of trends of an unclear origin have been recorded in the north of the survey area (**C17**). These trends are positive and curvilinear / linear in form and possibly form a small enclosure feature that could be archaeological. However as the anomaly is located close to both geological anomalies and agricultural ploughing trends, it could actually have been formed by a combination of both rather than being of an archaeological origin.
- 6.17 Three sets of parallel linear trends of an unclear origin are located in the centre and south of the dataset (**C19 - C21**). They do not form any sort of pattern and are isolated in their location. These anomalies could have archaeological origins, however an agricultural origin relating to conventional ploughing is equally if not more likely.
- 6.18 A further linear trend is located close to the northern boundary of the survey area running in an east-west direction (**C22**). Even though it is located close to discrete features **C4** and **C5** and could be related, it is likely to be related to agricultural ploughing trends located close by or even represent an agricultural headland running parallel to the northern boundary.

Linear Trend - Agricultural (Conventional ploughing)

- 6.19 Agricultural trends are described as a series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. The regular patterning is likely to denote the presence of ploughing, however isolated trends can occasionally be observed that follow the orientation of ploughing trends seen elsewhere in the area. Anomalies seen adjacent to field edges are representative of headlands caused by ploughing.
- 6.20 The first set of conventional ploughing trends are visible running east-west parallel to one another in the northern and eastern part of the survey area (**C23**).
- 6.21 The second set by contrast appear to run north-south through the survey area and are located predominantly in the southern half of the survey area (**C24**).
- 6.22 The clear difference in ploughing trends between the north and south of the dataset lend weight to anomaly **C16** representing a former field boundary.

Linear Trend (Old Field boundary)

- 6.23 Within the survey area three former field boundaries have been recorded (**C25 - C27**). These responses typically consist of isolated negative / positive linear anomalies. The signal for this kind of anomaly appears to be inconsistent, but the patterning and positioning suggests such anomalies belong to those associated with former field division systems. Historic mapping for the area has confirmed that these trends represent former field boundaries (old-maps, 2017).
- 6.24 The clearest trend runs roughly east-west across the centre of the survey area and would originally have split the field in half (**C25**).
- 6.25 The second trend adjoins this central boundary in the west at a 'dog leg' and consists of a parallel inconsistent trend running north-east to south-west (**C26**).
- 6.26 A third field boundary runs north-east to south-west along the western survey boundary (**C27**) further west of **C26**, appearing to join the central possible boundary **C25**.

Non-archaeology

Geology / Natural

- 6.27 Geology is normally described as being an area of disturbance that is composed of irregular significant increases or decreases in magnetic values compared with background readings and is likely to indicate natural variations in soil composition or geology.
- 6.28 Two areas of geology, possibly representing a historical palaeochannel, are observed running north-south through the whole survey area (**C28** and **C29**). Although the anomalies are fractured in places and become periodically weaker, it is likely that they are adjoined and form one continuous geological variation through the dataset.

Disturbed Area (Modern disturbance?)

- 6.29 Anomalies of this type are described as areas of disturbance that are likely to be caused by modern activity and are characterised by significant increases or decreases in magnetic values compared with background readings within the dataset.
- 6.30 Two areas of modern disturbance have been located within the dataset which relate to pylons present in the field, which although were avoided during the survey, still impacted the data (**C30**).
- 6.31 Further to these, a number of areas of modern magnetic disturbance can be seen along the survey area boundaries relating to modern fencing or detritus (**C31**).

Isolated Dipolar Anomalies / Ferrous (iron spikes)

- 6.32 Anomalies of this type are characterised as a response normally caused by ferrous materials on the ground surface or within the top soil, which cause a 'spike' representing a rapid variation in the magnetic response. These are generally not assessed to be archaeological when surveying on rural sites and generally represent modern material often re-deposited during manuring.

7 Conclusion

- 7.1 The gradiometer survey has not identified any anomalies or features of a definitive archaeological nature. However a number of discrete archaeological trends have been recorded, of which one would appear to represent a possible enclosure. This enclosure is comparable to others located on other archaeological sites and it is highly likely to be archaeological in origin.
- 7.2 A possible further enclosure has been identified to the east of this which could be a boundary feature, which is also likely to be archaeological in origin, even though the anomaly is slightly more fractured and tentative.
- 7.3 Across the site a number discrete linear trends were also identified but due to their poorer strength and patterning only a tentative interpretation could be formed as to their origin. Many of these would appear to also be of an archaeological nature, relating to the possible enclosure.
- 7.4 A number of discrete pit like anomalies were identified in the dataset which could be archaeological in origin, however interpretation is tentative as they could be geological in origin.
- 7.5 Throughout the dataset, several responses of an unclear origin have been recorded. These appear to be magnetically weak and although a geological or agricultural origin is likely in most cases; an archaeological origin cannot be dismissed.
- 7.6 A number of agricultural trends, most likely related to conventional ploughing regimes and possible agricultural headlands have also been identified. Three former field boundaries have also been identified and their locations confirmed through historical mapping.
- 7.7 A long swathe of geological variations has been observed, representing a possible palaeochannel.

- 7.8 Several areas of magnetic disturbance of a likely modern date were also detected including two which are directly related to pylons situated in the centre of the survey area.

8 Statement of Indemnity

- 8.1 Although the results and interpretation detailed in this report have been produced as accurately as possible, it should be noted that the conclusions offered are a subjective assessment of collected data sets.
- 8.2 The success of a geophysical survey in identifying archaeological remains can be heavily influenced by several factors, including geology, seasonality, field conditions and the properties of the features being detected. Therefore the geophysical interpretation may only reveal certain archaeological features and not produce a complete plan of all of the archaeological remains within a survey area.

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Plate 1. Survey area looking west



Plate 2. Survey area looking north-west



Plate 3. Survey area looking north



Plate 4. Survey area looking east

LAND OFF NEW ROAD, CLIFTON, BEDFORDSHIRE
ARCHAEOLOGICAL GEOPHYSICAL SURVEY
(AOC PROJECT NO. 51818)



Figure

1

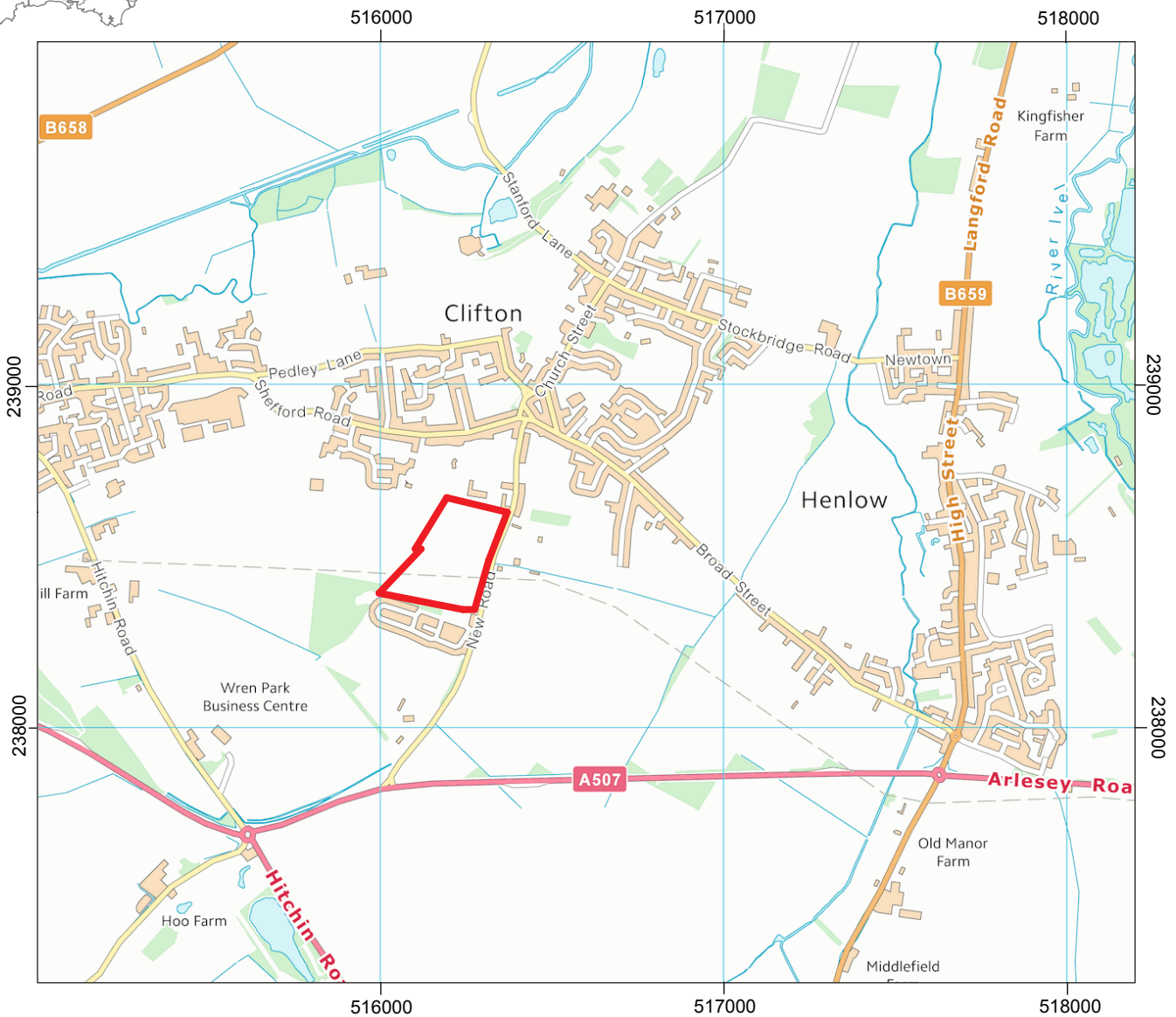


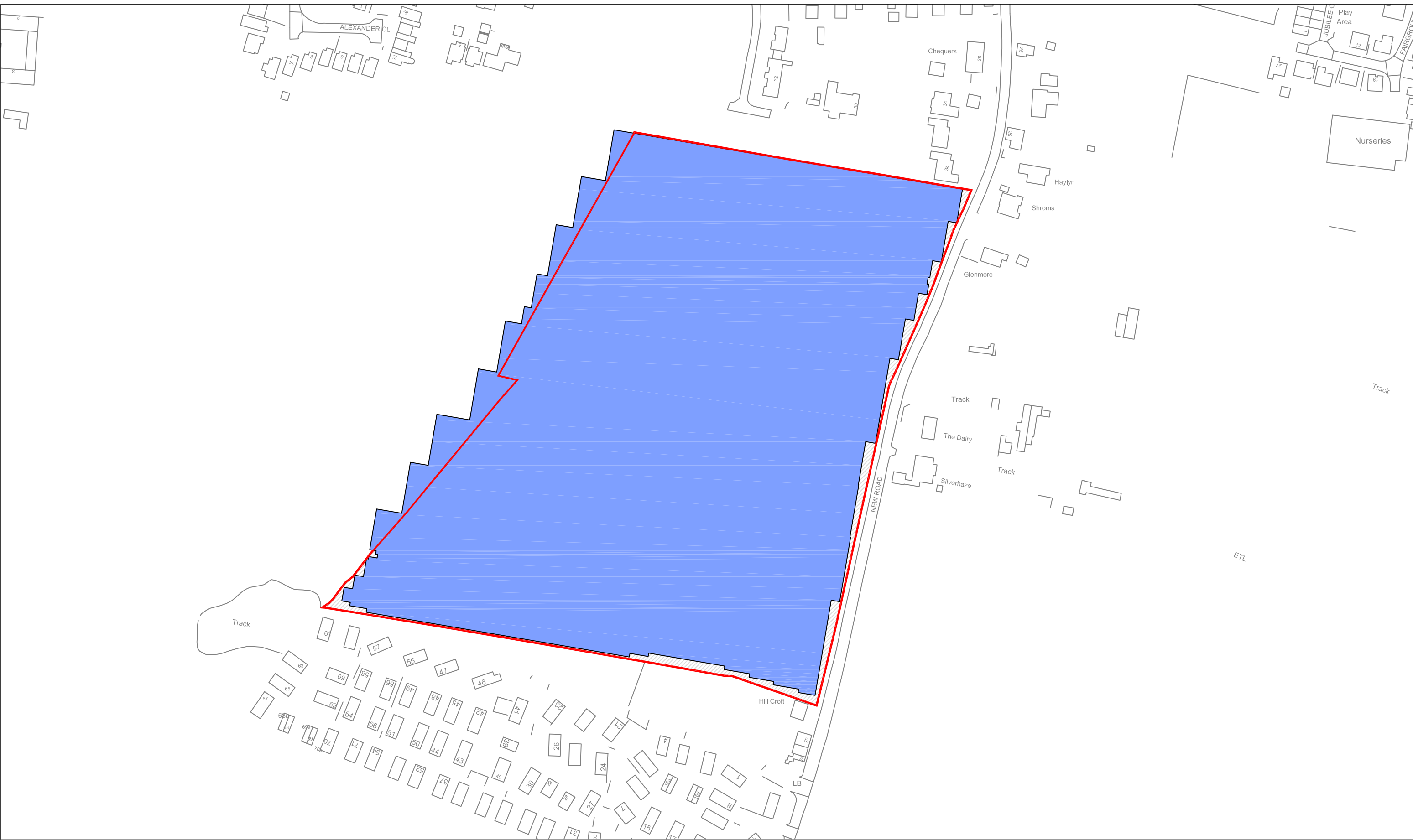
Site location



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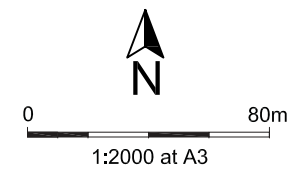




Location of survey area

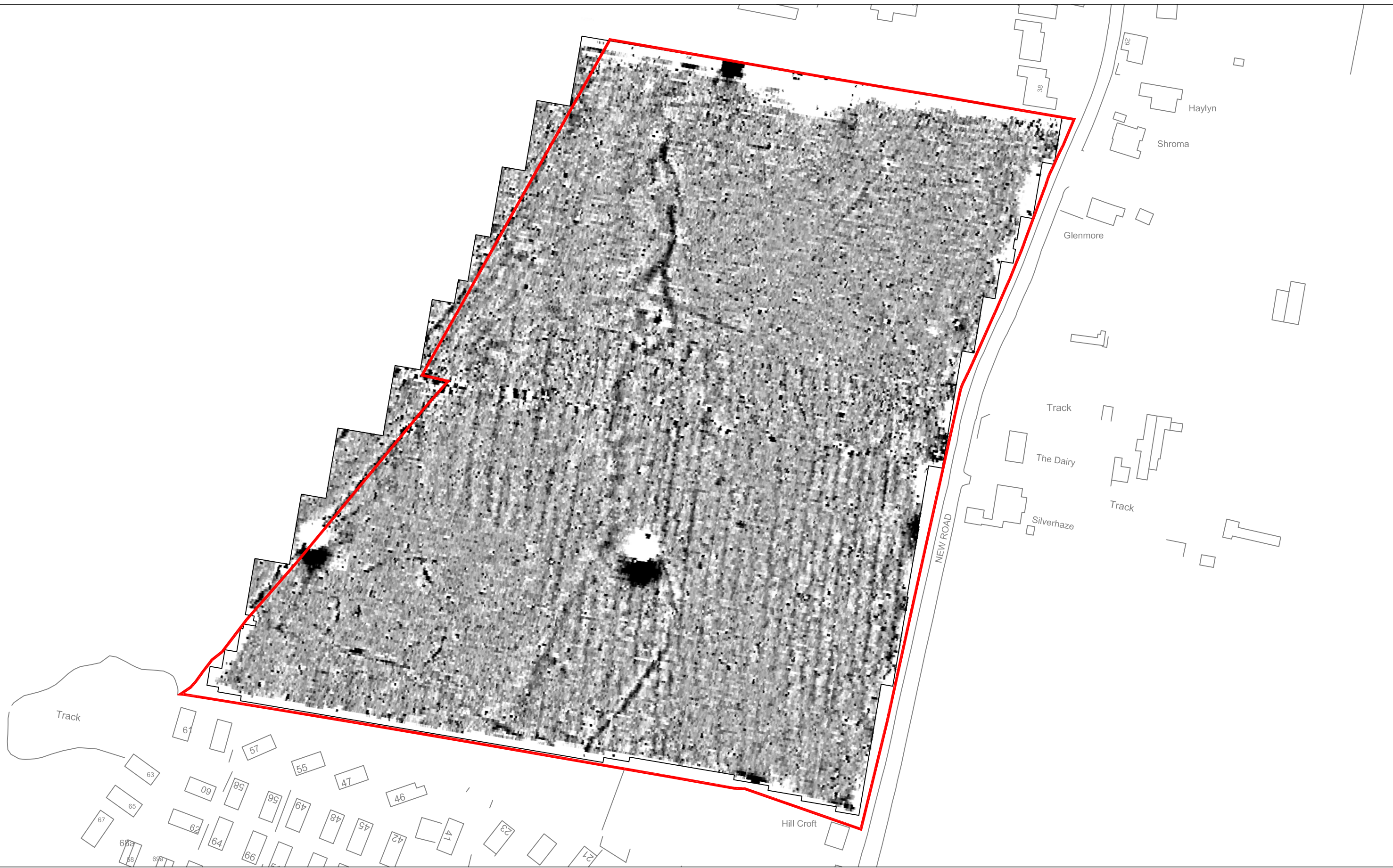
Figure 2

- Areas Surveyed
- Areas Not Surveyed
- Red Line Boundary



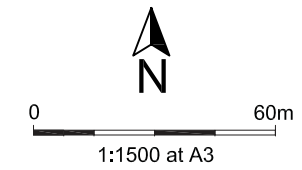
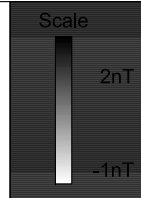
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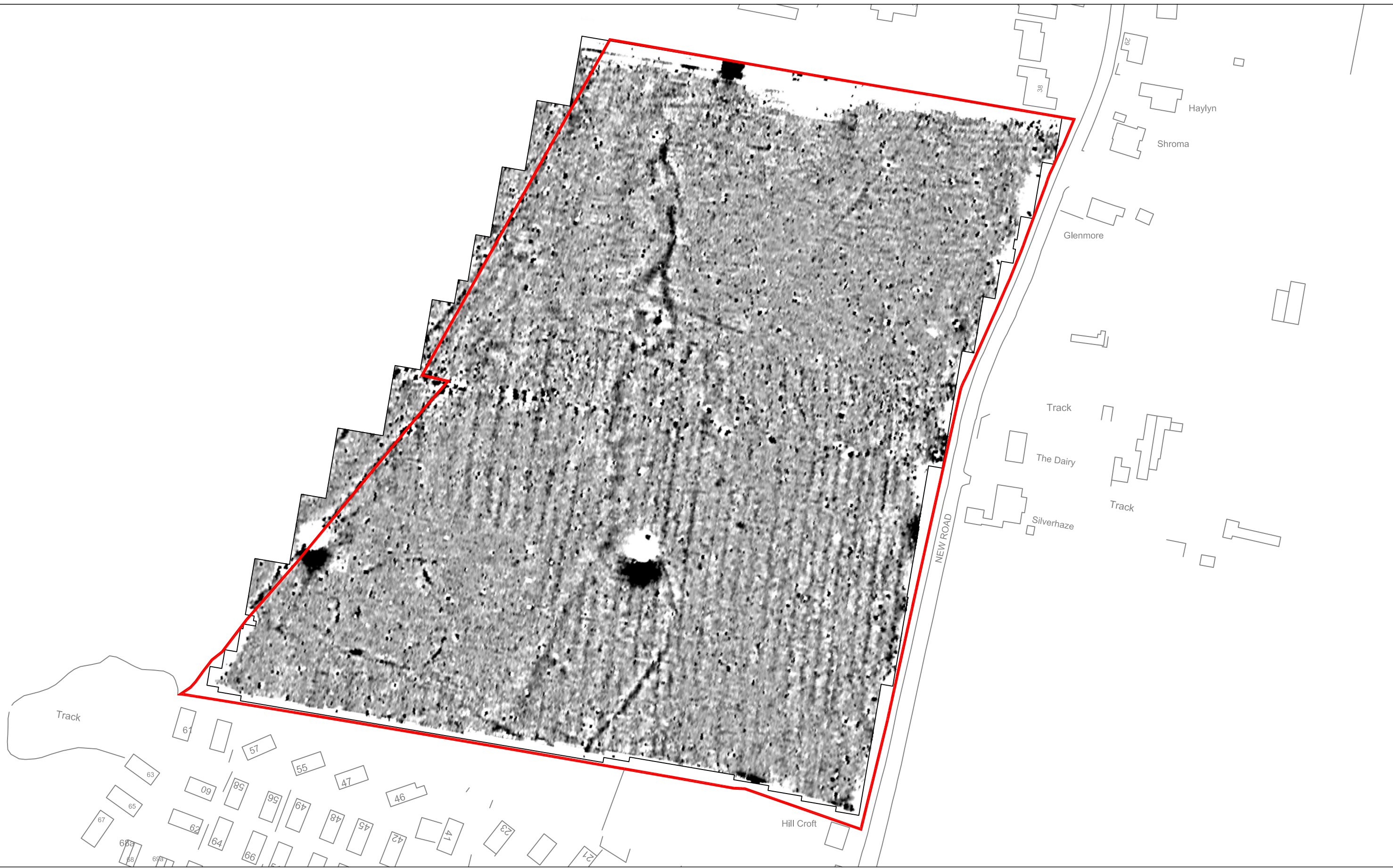
Minimally processed Gradiometer survey results - Greyscale plot

Figure
3



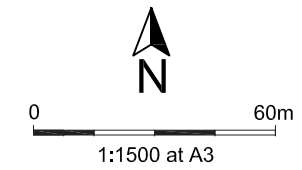
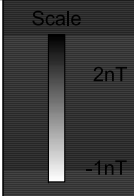
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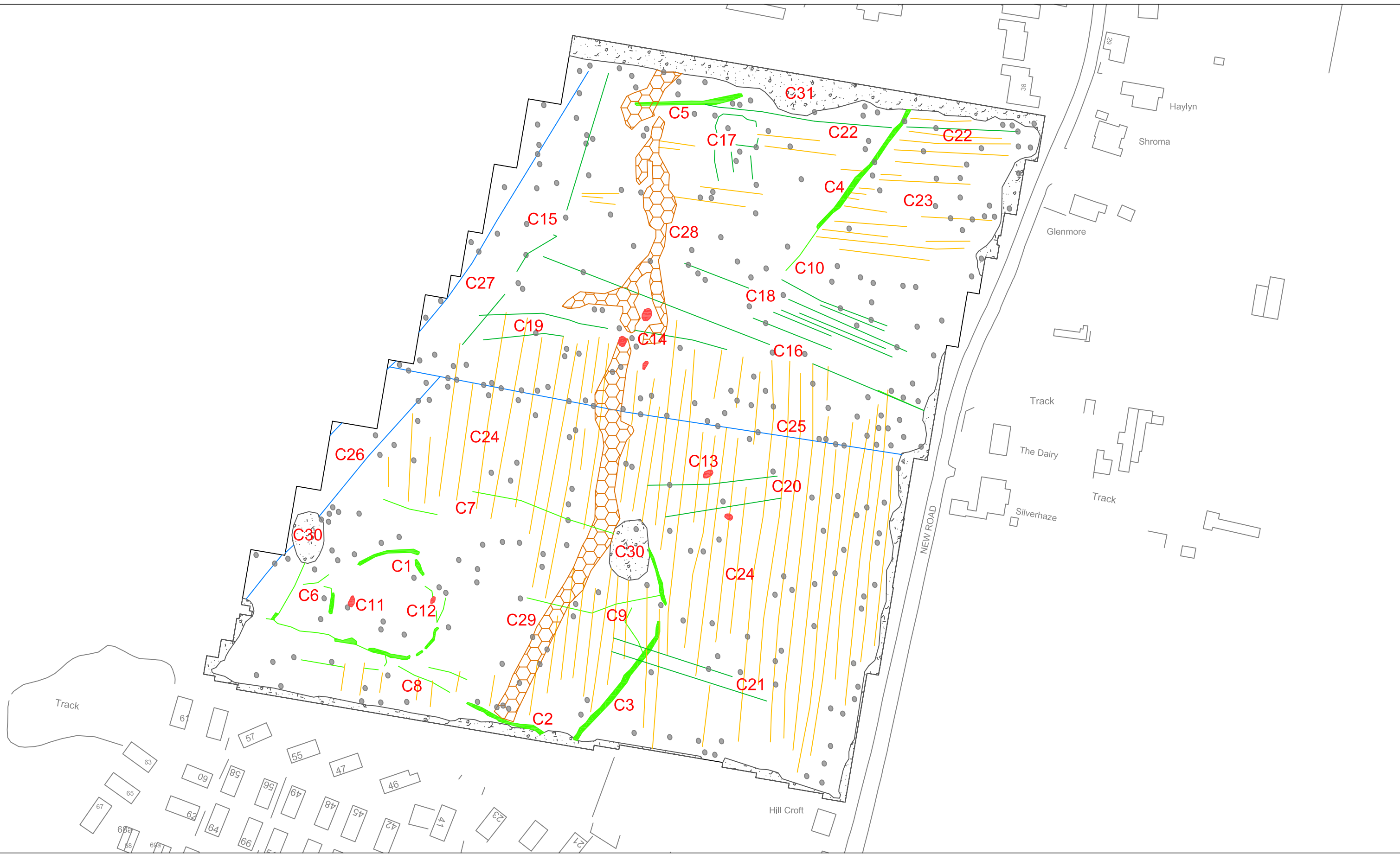
Processed Gradiometer survey results - Greyscale plot

Figure 4



Project Title: Land off New Road, Clifton, Bedfordshire		
Project No: 51818		
Drawing Title: Figure 4		
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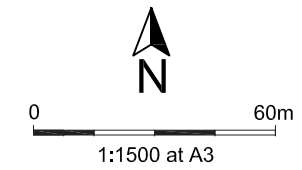




Interpretation of survey results

Figure 5

- Discrete Trend (Archaeology?)
- Old Field Boundary
- Area of Disturbance (Modern)
- Discrete Pit (Archaeology?)
- Linear Trend (Ploughing)
- Ferrous / Iron Spikes
- Trend (Unclear Origin)
- Geology / Natural



Project Title: Land off New Road, Clifton, Bedfordshire		
Project No: 51818		
Drawing Title: Figure 5		
Interpretation of survey results		
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18/10/2017	18/10/2017	18/10/2017



Appendix 1: Characterisation of Identified Anomalies

Gradiometer survey

Site Specific Anomaly Code: **C**

Anomaly	Type of Archaeology
C1	Discrete linear trend Archaeology?
C2	Discrete linear trend Archaeology?
C3	Discrete linear trend Archaeology?
C4	Discrete linear trend Archaeology?
C5	Discrete linear trend Archaeology?
C6	Discrete linear trend
C7	Discrete linear trend
C8	Discrete linear trend
C9	Discrete linear trend
C10	Discrete linear trend
C11	Discrete pit like anomaly
C12	Discrete pit like anomaly
C13	Discrete pit like anomaly
C14	Discrete pit like anomaly
C15	Unclear origin trend
C16	Unclear origin trend
C17	Unclear origin trend
C18	Unclear origin trend
C19	Unclear origin trend
C20	Unclear origin trend
C21	Unclear origin trend
C22	Unclear origin trend
C23	Agricultural conventional ploughing
C24	Agricultural conventional ploughing
C25	Agricultural Old field boundary
C26	Agricultural Old field boundary
C27	Agricultural Old field boundary
C28	Geology?
C29	Geology?
C30	Magnetic Disturbance Pylons
C31	Magnetic Disturbance

Appendix 2: Survey Metadata

Field	Description
Surveying Company	AOC Archaeology
Data collection staff	Alistair Galt, Dan Shiel
Client	WYG Environment Planning Transport
Site name	Land off New Road, Clifton, Bedfordshire
County	Bedfordshire
NGR	TL 16209 38499
Land use/ field condition	Arable - harrowed
Duration	3/10/17 – 4/10/17
Weather	Overcast/Sunny
Survey type	Gradiometer Survey
Instrumentation	Trimble GXOR system Bartington Grad 601-2
Area covered	Approx 7 ha (89 full and partial)
Download software	Grad601 PC Software v313
Processing software	Geoplot v3.0 / v4.0
Visualisation software	AutoCAD LT 2009
Geology	Gault Formation – Mudstone, with a small section of the Woburn Sands Formation – Sandstone, in the most easterly part of site (BGS 2017). These are overlain by superficial deposits of the Lowestoft Formation – Diamicton (BGS 2017).
Soils	Slightly acidic loamy and clayey soils with impeded drainage (Soilscapes 2017).
Scheduled Ancient Monument	No
Known archaeology on site	None
Historical documentation/ mapping on site	None
Report title	Land off New Road, Clifton, Bedfordshire
Project number	51818
Report Author	James Lawton
Report approved by	Graeme Cavers

Appendix 3: Archaeological Prospection Techniques, Instrumentation and Software Utilised

Gradiometer survey

Gradiometer surveys measure small changes in the earth's magnetic field. Archaeological materials and activity can be detected by identifying changes to the magnetic values caused by the presence of weakly magnetised iron oxides in the soil (Aspinall *et al.*, 2008, 23; Sharma, 1997, 105). Human inhabitation often causes alterations to the magnetic properties of the ground (Aspinall *et al.*, 2008, 21). There are two physical transformations that produce a significant contrast between the magnetic properties of archaeological features and the surrounding soil: the enhancement of magnetic susceptibility and thermoremanent magnetization (Aspinall *et al.*, 2008, 21; Heron and Gaffney 1987, 72).

Ditches and pits can be easily detected through gradiometer survey as the top soil is generally suggested to have a greater magnetisation than the subsoil caused by human habitation. Also areas of burning or materials which have been subjected to heat commonly have high magnetic signatures, examples include: hearths, kilns, fired clay and mudbricks (Clark 1996, 65; Lowe and Fogel 2010, 24). It should be noted that negative anomalies can also be useful for characterising archaeological features. If the buried remains are composed of a material with a lower magnetisation compared with the surrounding soil, the surrounding soil will consequently have a greater magnetisation resulting in the feature displaying a negative signature. For example stone materials of a structural nature that are composed of sedimentary rocks are considered non-magnetic and so will appear a negative features within the data set.

Ferrous objects- i.e. iron and its alloys- are strongly magnetic and are typically detected as high-value peaks in gradiometer survey data, though it is not usually possible to determine whether these relate to archaeological or modern objects.

Although gradiometer surveys have been successfully carried out in all areas of the United Kingdom, the effectiveness of the technique is lessened in areas with complex geology, particularly where igneous and metamorphic bedrock is present. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Gradiometer survey instrumentation

AOC Archaeology's gradiometer surveys are carried out using Bartington Grad601-2 magnetic gradiometers. The Grad601-2 is a high-stability fluxgate magnetic gradient sensor, which uses a 1m sensor separation. The detection resolution is from 0.03 nT/m to 0.1nT/m, depending on the sensor parameters selected, making the Grad601-2 an ideal instrument for prospective survey of large areas as well as detailed surveys of known archaeology. The instrument stores the data collected on an on-board data-logger, which is then downloaded as a series of survey grids for processing.

Gradiometer survey software

Following the survey, gradiometer data is downloaded from the instrument using Grad601 PC Software v313. Survey grids are then assembled into composites and enhanced using a range of processing techniques using Geoscan Geoplot v3.0 / v4.0 (see Appendix 4 for a summary of the processes used in Geoplot and Appendix 5 for a list of processes used to create final data plots).

Appendix 4: Summary of Processes used in Geoplot

Process	Effect
Clip	Limits data values to within a specified range
De-spike	Removes exceptionally high readings in the data that can obscure the visibility of archaeological features. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground. In gradiometer survey, these can be caused by highly magnetic items such as buried ferrous objects.
De-stagger	Corrects a misalignment of data when the survey is conducted in a zig-zag traverse pattern.
Edge Match	Counteracts edge effects in grid composites by subtracting the difference between mean values in the two lines either side of the grid edge.
High pass filter	Removes low-frequency, large scale detail in order to remove background trends in the data, such as variations in geology.
Interpolate	Increases the resolution of a survey by interpolating new values between surveyed data points, creating a smoother overall effect.
Low Pass filter	Uses a Gaussian filter to remove high-frequency, small scale detail, typically for smoothing the data.
Periodic Filter	Used to either remove or reduce the appearance of constant and reoccurring features that distort other anomalies, such as plough lines.
Wallis filter	Applies a locally adaptive contrast enhancement filter.
Zero Mean Grid	Resets the mean value of each grid to zero, in order to counteract grid edge discontinuities in composite assemblies.
Zero Mean Traverse	Resets the mean value of each traverse to zero, in order to address the effect of striping in the data and counteract edge effects.

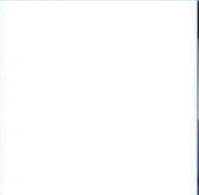
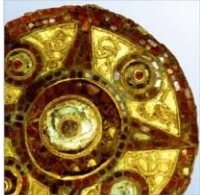
Appendix 5: Survey Processing Steps

Gradiometer survey	
Process	Extent
Zero Mean Traverse	All LMS =on, threshold -5 to 5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Expand –SinX/X x2
Raw Palette Scale	Grey08 Min= -1nT Max= 2nT
Palette Scale	Grey08 Min= -1nT Max= 2nT

Appendix 6: Technical Terminology

Type of Anomaly	Description
Archaeology	
Archaeology - Trend	<p>These are made up of linear / curvilinear / rectilinear anomalies and are either characterised by an increase or decrease in values compared to the magnetic background.</p> <p>This evidence is normally supported by the presence of archaeological remains and is confirmed by other forms of evidence such as HER records and aerial photography.</p>
Archaeology - Area of Disturbance	<p>This is characterised by a general increase and decrease of magnetic responses over a localised area and does not appear as having a linear form. These anomalies do not have the high dipolar response which are manifested in an 'iron spike' anomaly. This anomaly may be supported by the known location of a former building, or other forms of evidence such as HER records and aerial photography.</p>
Archaeology - Pit	<p>An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is suggestive of buried remains, such as the infill of a pit.</p> <p>This evidence is normally supported by the presence of archaeological remains and is confirmed by other forms of evidence such as HER records and aerial photography.</p>
Discrete Archaeology	
Archaeology? – Trend	<p>Anomalies of a linear / curvilinear / rectilinear form either composed of an increased or decreased signal compared to magnetic background values.</p> <p>It is possible these anomalies belong to archaeological remains, but poor patterning or weaker response values makes interpretation difficult.</p> <p>Where historical records are present, the anomalies would appear to be weak or inconclusive.</p>
Archaeology? - Area of Disturbance	<p>Anomalies with an increase or decrease in magnetic values compared with the magnetic background over a localised area. Poor patterning or weak signal changes creates difficulty in defining the origin of the anomaly and so interpretation is only tentative. The anomaly lacks definitive records to confirm its origin as being archaeological.</p> <p>Disturbed areas could indicate the presence of buried rubble relating to fallen structures, or instead denote modern material from either quarrying or agricultural activity. On certain geologies these anomalies could be caused by in-filled natural features.</p>
Archaeology? – Pit	<p>An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is suggestive of buried remains, such as the infill of a pit, but is isolated in its location and association with other features.</p>
Unclear Origin	
Linear Trend	<p>Anomalies of a linear / curvilinear form which are composed of a weak or different change in magnetic values. Coupled with poor patterning, the anomaly is difficult to interpret and it is unclear whether it has an archaeological origin.</p>
Area of Disturbance	<p>An area of magnetic disturbance which consists of a variety of increased and decreased magnetic values compared with background readings, but lacks sufficient patterning or context for a conclusive interpretation. It is likely that these readings are caused by modern disturbances, but interpretation is tentative.</p>

<i>Agricultural</i>	
Linear Trend (Old Field Boundary)	These isolated long linear anomalies, most often represented as a negative magnetic trend, are likely to relate to former field boundaries. The magnetic signal may appear inconsistent but when the positioning is cross referenced with historic mapping, it is confirmed as a former field boundary.
Linear Trend (Old Field Boundary?)	These isolated long linear anomalies, most often represented as a negative magnetic trend, are likely to relate to former field boundaries. The positioning is not supported by historic mapping, but is often confirmed with adjacent ploughing patterns.
Linear Trend (Ridge and Furrow / Rig and Furrow)	A series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. The width between the anomalies is consistent with that of a Ridge and Furrow ploughing regime, which is normally wider than conventional ploughing methods.
Linear Trend (Conventional ploughing)	A series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. The regular patterning is likely to denote the presence of ploughing, however isolated trends can occasionally be observed that follow the orientation of ploughing trends seen elsewhere in the area. Anomalies seen adjacent to field edges are representative of headlands caused by ploughing.
Linear Trend (field drainage)	A series of linear anomalies of an indeterminate date, usually with a regular or herringbone patterning and regular spacing. These are likely to represent agricultural activity such as land drainage.
<i>Non- Archaeology</i>	
Geology / Natural	An area of disturbance that is composed of irregular significant increases or decreases in magnetic values compared with background readings and is likely to indicate natural variations in soil composition or geology.
Linear Trend (possible modern service)	Anomalies of a linear form often composed of contrasting high positive and negative values. Such anomalies usually signify a feature with a high level of magnetisation and are likely to belong to modern activity such as pipe lines or modern services.
Disturbed Area (modern disturbance?)	An area of disturbance that is likely to be caused by modern activity and is characterised by significant increases or decreases in magnetic values compared with background readings.
Isolated Dipolar Anomalies / Ferrous (iron spikes)	A response normally caused by ferrous materials on the ground surface or within the top soil, which causes a 'spike' representing a rapid variation in the magnetic response. These are generally not assessed to be archaeological when surveying on rural sites, and generally represent modern material often re-deposited during manuring.



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