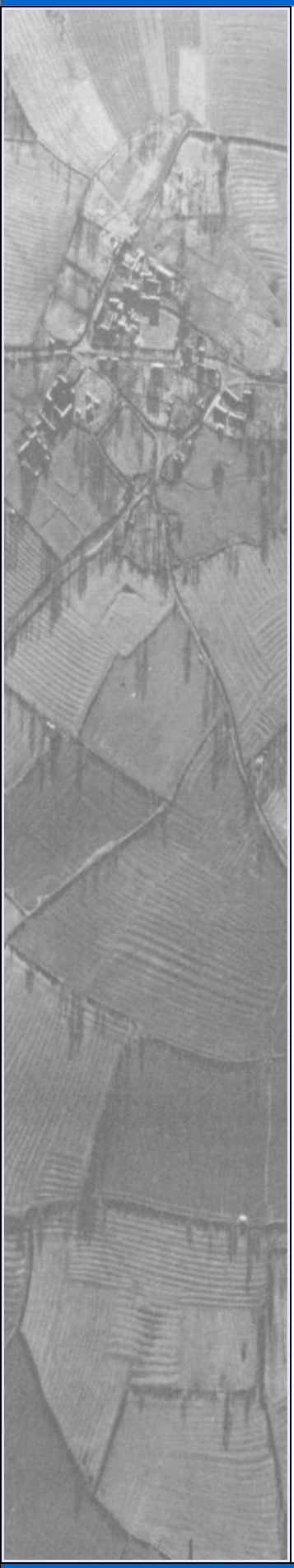

Building ONE
Science Museum Group
Wroughton

MAGNETOMETER SURVEY REPORT

for

Science Museum Group

Kerry Donaldson & David Sabin

January 2018

Ref. no. J736

ARCHAEOLOGICAL SURVEYS LTD

Building ONE
Science Museum Group
Wroughton

Magnetometer Survey Report

for

Science Museum Group

Fieldwork by David Sabin BSc (Hons) MCIfA
Report by Kerry Donaldson BSc (Hons)
Report checked by David Sabin
Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey dates – 13th to 15th & 18th to 20th December 2017
Ordnance Survey Grid Reference – **SU 13815 78900**

Archaeological Surveys Ltd
1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD
Tel: 01249 814231 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

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SUMMARY

Detailed magnetometry was carried out by Archaeological Surveys Ltd, on behalf of the Science Museum Group, within two survey areas at the former Wroughton airfield. Part of the site has been outlined for the development of a new storage facility to be known as Building ONE, and a wider survey was undertaken to put anomalies within context. The results reveal a number of positive linear, curvilinear and discrete anomalies within the application boundary that relate to ditches and pits associated with an Iron Age settlement formerly identified during an earlier evaluation by Oxford Archaeology. Further anomalies within the western part of Area 2 are also likely to be associated with these Iron Age features. Elsewhere, the majority of the site has been subject to widespread ground make-up or consolidation with magnetically contaminated material which may have obscured weaker anomalies. Magnetic debris is also associated with the demolished 19th century Rectory Cottages and Wroughton Down/Rectory Farm, both formerly located within Area 2 and demolished prior to construction of the wartime airfield.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by the Science Museum Group (SMG) to undertake a magnetometer survey of an area of land at the former Wroughton airfield in Wiltshire. The site has been outlined for a proposed development of a new storage facility, to be known as Building ONE, which aims to house 80% of the SMG collections.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2017) and approved by Melanie Pomeroy-Kellinger, County Archaeologist for Wiltshire Council Archaeology Service.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation;* European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology;* Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3 Site location, description and survey conditions

1.3.1 The site is located at SMG Wroughton within the former RAF Wroughton airfield. The northern part of the site (Area 1) is centred on Ordnance Survey National Grid Reference (OS NGR) SU 13910 79080 and the southern (Area 2) on SU 13625 78770, see Figs 01 and 02.

1.3.2 The application area and the location of Building ONE are outlined in Fig 02 with this part of the site likely to be affected by groundworks, with associated parking and other infrastructure to be located near to the building. The remaining parts of the survey areas outside of the application boundary will not be subject to development and are being surveyed in order to gain a better understanding of any anomalies located and put them in context. The application boundary and Building ONE footprint have also been shown within Figs 03 to 06 in order to define those anomalies that lie within and those outside of the application boundary.

1.3.3 The geophysical survey covers approximately 24ha within two areas of grassland divided by a former airfield runway. The runways are used for storage and contain sources of magnetic disturbance. Area 1 is generally flat with short grass cover except for the north eastern end of the area which contained longer grass and some uneven ground. Area 2 slopes up towards the south west and contained sheep grazed pasture at the time of survey. Some inspection chambers were noted in the south western part of the area and some undulating ground along the southern side.

1.3.4 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were variable but mainly cold with wind and occasional sleet and rain.

1.4 Site history and archaeological potential

1.4.1 A desk-based Heritage Assessment has been produced for the site (Cotswold Archaeology, 2017). It outlines that previous archaeological evaluation directly within the survey area in 2006 recorded an early Iron Age settlement, extending for 1200m, with a number of post-built circular structures, post-holes, ditches and pits, within and immediately north and north east of the site (Oxford Archaeology, 2006). A possible Iron Age/Romano-British field system was also recorded and other features that could relate to medieval to modern agricultural practices and land division. There was also evidence for modern landscaping associated with the construction of the former airfield. A geophysical survey carried out prior to construction of the solar farm immediately to the south did not locate archaeological features, but widespread magnetic debris and disturbance from the airfield construction and demolition of Wroughton Down/Rectory Farm may have masked underlying

weaker anomalies (ASWYAS, 2013).

1.4.2 Mapping from the 19th century indicates that the survey areas contained several land boundaries with the location of Rectory Cottages and Wroughton Down/Rectory Farm within the eastern part of Area 2. These were cleared for the construction of the airfield in 1939/40 as part of RAF Wroughton which housed No.15 Maintenance Unit and had a primary role as an Aircraft Storage Unit Site for storage of reserve aircraft during the war. The hangars in the northern part of the site have been used for storage by the Science Museum since the 1980s.

1.4.3 The site has potential to contain remains dating from the prehistoric and Roman periods and also early medieval to modern agricultural features, including the demolished remains of Rectory Cottages and a farm known as Wroughton Down in 1886 and Rectory Farm from 1899 onwards. However, the construction of the airfield, which included levelling and landscaping, may have truncated earlier features and magnetic debris and disturbance is also likely to be associated both with the airfield construction and demolition of 19th century buildings.

1.5 Geology and soils

1.5.1 The underlying solid geology across the site is from the Zig Zag Chalk Formation (Lower Chalk) (BGS, 2017).

1.5.2 The overlying soil across the survey area is from the Upton 2 association and is a grey rendzina. It consists of a shallow, well drained, calcareous, silt soil over argillaceous rock (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry survey carried out across similar soils has produced variable results as there can be poor magnetic contrast between the fill of cut features and the material into which they are cut. However, where there is long term occupation or industrial activity within a site the fills can become sufficiently magnetically enhanced for magnetic anomalies to be located. The underlying geology and soils are, therefore, considered acceptable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is

increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20 Hz. The cart is pushed at walking speed and not towed. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a range of recording data between ±0.1nT and ±10,000nT. They are linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this is manifest as

drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 The minimally processed data are collected between limits of ±10000nT and clipped for display at ±20nT (Fig 03). The data have also been clipped for display with readings over +10nT highlighted in red, and those below -10nT highlighted in blue (Fig 04). In order to see much weaker anomalies the data have also been clipped at ±3nT (Figs 05, 07,09, 11 & 13). Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 Additional data processing has been carried out for Area 2 in the form of high pass filtering. This effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies, cultivation or rapid temperature change. Data treated to additional processing has been compared to unprocessed data to ensure that no significant anomalies have been removed.

2.3.5 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on processing.

2.3.6 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the Sensys MXPDA, minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection.

2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2016, creating DWG (2010) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

2.3.8 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. Appendix E sets out CAD layer names with colour and graphic content for each interpretation category, see 3.3.

2.3.9 A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.

2.3.10 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of two survey areas covering approximately 24ha.

3.1.2 Magnetic anomalies located can be generally classified as positive linear and discrete positive responses of archaeological potential, positive anomalies of an uncertain origin, anomalies associated with land management, areas of magnetic debris and disturbance, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines.

3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 below with subsequent discussion in Section 4.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.

3.2.2 The site contains some localised magnetic disturbance caused by modern steel objects stored immediately adjacent to the survey areas and associated with services and demolished buildings within the areas. With the exception of the zone relating to demolished buildings, it is unlikely that the disturbance has obscured weak anomalies of archaeological potential.

3.2.3 Both survey areas contain widespread, dense magnetic debris of moderately high magnitude. Although not completely obscuring the presence of other anomalies, it is likely to be highly detrimental to the location of weak anomalies of archaeological potential. Given the nature of the soils, contrast between the magnetic susceptibility of the fill of former cut features and the surrounding natural is often poor, and this may further inhibit the location of archaeology within the magnetic 'noise' caused by the debris.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or

	as parallel linear anomalies. The multiple dipolar response indicates ceramic land drains.
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, hearths and nail spreads from former wooden structures or rooves and may, therefore, be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around these features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Area centred on OS NGR 413910 179080, see Figs 03 – 10.

Anomalies of archaeological potential within application boundary

(1) - A fragmented positive linear anomaly extends across the north western part of Area 1. It appears to have been truncated by former field boundary (8) and also part of the land drain series (9) beyond the application area, but it is also truncated elsewhere. It appears to relate to a linear boundary or trackway ditch, likely to be associated with the Iron Age settlement previously identified through evaluation in 2006.

(2) - A group of positive linear and discrete responses to the south of anomaly (1). An evaluation trench to the east in 2006 identified further cut features relating to the Iron Age settlement and these anomalies are likely to be associated.

(3) - Positive linear and discrete anomalies to the north and south of anomaly (1) are likely to relate to further cut features.

Anomalies with an uncertain origin within application boundary

(4) - A number of weakly positive linear anomalies have been located in the southern and western part of the survey. However, their proximity to the widespread magnetic debris (10) has obscured them and a lack of coherent morphology means it is not possible to determine if they are associated with the magnetic debris or if they relate to cut features.

Anomalies with an uncertain origin outside of application boundary

(5) - A number of discrete positive responses are located in the northern part of the survey area close to land drain (9). Due to their location and orientation it is not

possible to determine if they directly relate to the land drain or if they relate to further cut features.

(6) - In the north eastern part of the survey area are a number of short, positive linear anomalies that appear as a series of parallel features. Their origin is uncertain.

(7) - A number of positive linear and discrete responses are located in the northern and central parts of the survey area, although many are obscured by the widespread magnetic debris. It is, however, possible that they may relate to further cut features with archaeological potential.

Anomalies associated with land management

(8) – A weakly positive linear anomaly has truncated earlier features (1) and (2) and relates to part of a field boundary, formerly mapped in the late 19th and early 20th centuries.

(9) - Positive linear anomalies relating to land drainage in a herringbone formation.

Anomalies associated with magnetic debris

(10) - Widespread magnetic debris associated with ground make-up during construction of the wartime airfield. This has obscured weaker anomalies.

(11) - Strong, discrete, dipolar anomalies are a response to ferrous and other magnetically thermoremnant objects and material within the topsoil.

Anomalies with a modern origin

(12) - Magnetic disturbance along the western and eastern edges is a response to stored steel supports.

(13 & 14) - Strong, multiple dipolar, linear anomalies relate to buried services or pipes. Anomaly (13) extends across the north eastern part of the survey area, anomaly (14) extends a short way into the survey area in the south western part of the site.

3.5 List of anomalies - Area 2

Area centred on OS NGR 413625 178770, see Figs 03 – 06 & 11 – 14.

Anomalies of archaeological potential

(15) - A positive linear anomaly is located just to the west of the main zone of magnetic debris (21), with other linear anomalies also located just to the west and

to the south. Previous archaeological evaluation in 2006 indicated a continuation of the Iron Age settlement identified in Area 1 further north east and these are likely to be associated.

Anomalies with an uncertain origin

(16) - Positive linear anomalies lie within a narrow zone that does not contain widespread magnetic debris. It is, however, not possible to determine if these relate to cut features.

(17) - Very weakly positive linear anomalies are located in the western part of the survey area away from the main concentrations of magnetic debris (21). Their weak (<1nT) response and lack of coherent morphology prevents confident interpretation, but further cut features with archaeological potential is possible.

Anomalies associated with magnetic debris

(18 & 19) - Zones of strongly magnetic debris are defined by former boundaries associated with the 19th century Wroughton Down/Rectory Farm in the southern part of the site and relate to demolition and infill material.

(20) - Magnetic debris in the northern part of the site is associated with the demolished Rectory Cottages.

(21) - The majority of the eastern part of the survey area contains widespread magnetic debris. This relates to spreads of material used for ground make-up during construction of the wartime airfield. This may have obscured weaker anomalies.

(22) - Two rows of strong, discrete, dipolar anomalies are situated close to the south eastern edge of the survey area. They are parallel with the runway immediately to the south and could relate to airfield infrastructure. However, they are also parallel with and in the position of the former Wroughton Down/Rectory Farm and an association with the former farm is also possible.

Anomalies with a modern origin

(23 & 24) - Strong, multiple dipolar, linear anomalies relate to services or pipes/cables. Anomaly (23) extends across the western corner of the survey area and anomaly (24) extends partially into the survey area from the southern edge.

4 DISCUSSION

4.1.1 Within the application boundary in Area 1, the geophysical survey located a fragmented positive linear anomaly (1) that appears to relate to an Iron Age ditch, previously identified through archaeological evaluation (Oxford Archaeology, 2006). To the south of this are a group of positive linear, curvilinear and discrete responses (2) that are likely to relate to archaeological features with other linear anomalies in the vicinity also likely to be of archaeological potential. The evaluation also identified archaeological features indicating a continuation of the Iron Age settlement within Area 2 to the south west beyond the application boundary. The magnetometer results have located a small number of positive linear anomalies that also appear to relate to associated features within Area 2.

4.1.2 Much of the site contains widespread magnetic debris, which relates to material containing ferrous and other magnetically thermoremnant material that has been used for ground make-up during construction of the wartime airfield. All of the anomalies with archaeological potential can only be identified as they lie within zones that do not contain widespread magnetic debris.

5 CONCLUSION

5.1.1 The results of the detailed magnetometer survey indicated the presence of a fragmented linear ditch within the application area, with several other linear and discrete anomalies located nearby within Area 1. Previous archaeological evaluation identified a linear ditch and other associated features relating to an Iron Age settlement extending into Area 1 and also Area 2 to the south west.

5.1.2 The evaluation also revealed widespread ground make-up and also truncation relating to ground levelling during construction of the wartime airfield. The magnetometry has revealed widespread magnetic debris within the site, likely to be associated with ground make-up or consolidation, with only the north western part of Area 1 and the western part of Area 2 having minimal amounts. Within these magnetically 'quieter' zones the survey has located the weaker anomalies of archaeological potential; this may imply that it has not been possible to identify anomalies of archaeological potential within magnetically 'noisy' zones.

5.1.3 Magnetic debris was also located over the former 19th Rectory Cottages and Wroughton Down/Rectory Farm, demolished prior to construction of the airfield. Other anomalies relating to services and land drainage were also located by the survey.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±5nT and ±3nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero (destripe) Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the baseline value of gradiometer sensors.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks, modern agricultural features and other large magnetic bodies within or adjacent to survey areas.

Low Pass Filtering

A mathematical process used to remove high frequency anomalies relating to uneven ground, vibration, etc.

Appendix C – survey and data information

Area 1 minimally processed data

Filename: J736-mag-Area1-proc.xcp
Description: Imported as Composite from: J736-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 413753.310364496, 179344.288538116 m
Southeast corner: 414185.910364496, 178746.688538116 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 3054600
Dimensions
Composite Size (readings): 2884 x 3984
Survey Size (meters): 433 m x 598 m
Grid Size: 433 m x 598 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 22.10
Min: -22.00
Std Dev: 6.26
Mean: 0.03
Median: 0.04
Composite Area: 25.852 ha
Surveyed Area: 12.508 ha
Name: TerraSurveyor
Version: 3.0.23.0
Processes: 1
1 Base Layer
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00 nT
Stats
Max: 11.05
Min: -11.00
Std Dev: 4.55
Mean: 0.01
Median: 0.03
Composite Area: 25.852 ha
Surveyed Area: 12.508 ha
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -10.00 to 10.00 nT

Stats
Max: 3.32
Min: -3.30
Std Dev: 1.99
Mean: 0.00
Median: 0.01
Composite Area: 25.852 ha
Surveyed Area: 12.508 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 2 minimally processed data

Filename: J736-mag-Area2-proc.xcp
Description: Imported as Composite from: J736-mag-Area2.asc
Northwest corner: 413320.857222173, 179084.187320618 m
Southeast corner: 413810.007222173, 178605.837320618 m
Source GPS Points: 2556500
Dimensions
Composite Size (readings): 3261 x 3189
Survey Size (meters): 489 m x 478 m
Grid Size: 489 m x 478 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 22.10
Min: -22.00
Std Dev: 6.23
Mean: -0.09
Median: 0.02
Composite Area: 23.398 ha
Surveyed Area: 10.681 ha
Processes: 1
1 Base Layer
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -20.00 to 20.00 nT

Area 2 filtered data

Stats
Max: 11.05
Min: -11.00
Std Dev: 4.37
Mean: -0.06
Median: 0.02
Composite Area: 23.398 ha
Surveyed Area: 10.681 ha
Processes: 1
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -20.00 to 20.00 nT
6 Clip from -10.00 to 10.00 nT

Max: 3.32
Min: -3.30
Std Dev: 1.92
Mean: -0.02
Median: 0.00
Composite Area: 23.398 ha
Surveyed Area: 10.681 ha
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -20.00 to 20.00 nT
6 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

A printed copy of the report and a PDF copy will be supplied to the Wiltshire Historic Environment Record. Greyscale images and abstraction layers will also be made available to the HER on request. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

File type	Naming scheme	Description
Data	J736-mag-**[area number/name]**.xcp J736-mag-**[area number/name]**-proc.xcp	Raw data Minimally processed data
Graphics	J736-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J736-version1.dwg	CAD file in 2010 dwg format
Report	J736-report.odt	Report text in Open Office odt format

Table 2: File archive information

Appendix E – CAD layers for abstraction and interpretation plots

Table 3 sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index		Layer content
Anomalies with archaeological potential			
AS-ABST MAG POS DISCRETE ARCHAEOLOGY		Red 255,0,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS ARCHAEOLOGY		Red 255,0,0	Polygon (cross hatched ANSI37)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
Anomalies relating to land management			
AS-ABST MAG BOUNDARY		127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
AS-ABST MAG LAND DRAIN		Cyan 0,255,255	Line or polyline
Anomalies associated with magnetic debris			
AS-ABST MAG DEBRIS		132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR		132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin			
AS-ABST MAG DISTURBANCE		132, 132, 132	Polygon (hatched ANSI31)
AS-ABST MAG SERVICE		132, 132, 132	Line or polyline

Table 3: CAD layering

Appendix F – copyright and intellectual property

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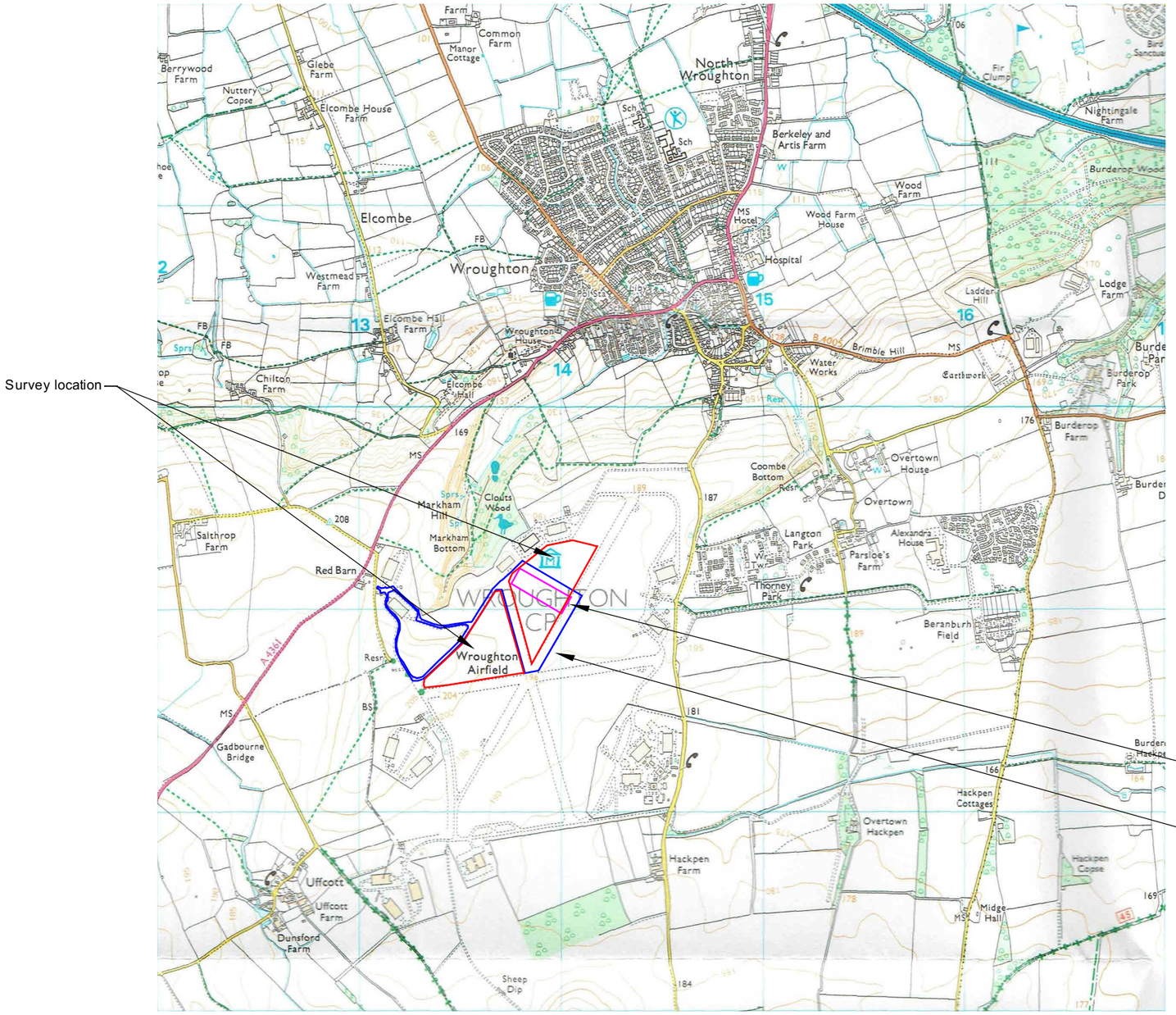
Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Map of survey area



● Survey location

Site centred on OS NGR
SU 13815 78900

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Referencing information

Referencing grid to OSGB36 datum at 100m intervals

Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

413800 179100

Application boundary

Proposed location of Building ONE

SCALE 1:6000

0m 60 120 180 240 300m

SCALE TRUE AT A3

FIG 02

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of minimally processed magnetometer data clipped at ±20nT

+20nT

-20nT Area 1 +20nT

-20nT

-20nT Area 2 +20nT

Science Museum

Area 1

Area 2

Wroughton Airfield
(dis)

N

SCALE 1:3000

0m 30 60 90 120 150m

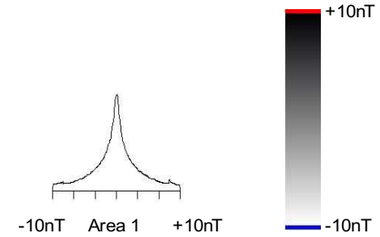
SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of filtered magnetometer data clipped at ±10nT



Science Museum

Area 1

Area 2

Wroughton Airfield
(dis)

N

SCALE 1:3000

0m 30 60 90 120 150m

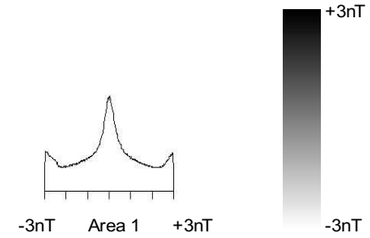
SCALE TRUE AT A3

FIG 04

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of filtered magnetometer data clipped at ±3nT



Science Museum

Area 1

Area 2

Wroughton Airfield
(dis)

N

SCALE 1:3000

0m 30 60 90 120 150m

SCALE TRUE AT A3

FIG 05

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - land drain
- Positive linear anomaly - possible former field boundary
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

Science Museum

Area 1

Area 2

Wroughton Airfield (dis)

Markham Bottom

Track

Drain

Stone

ESS

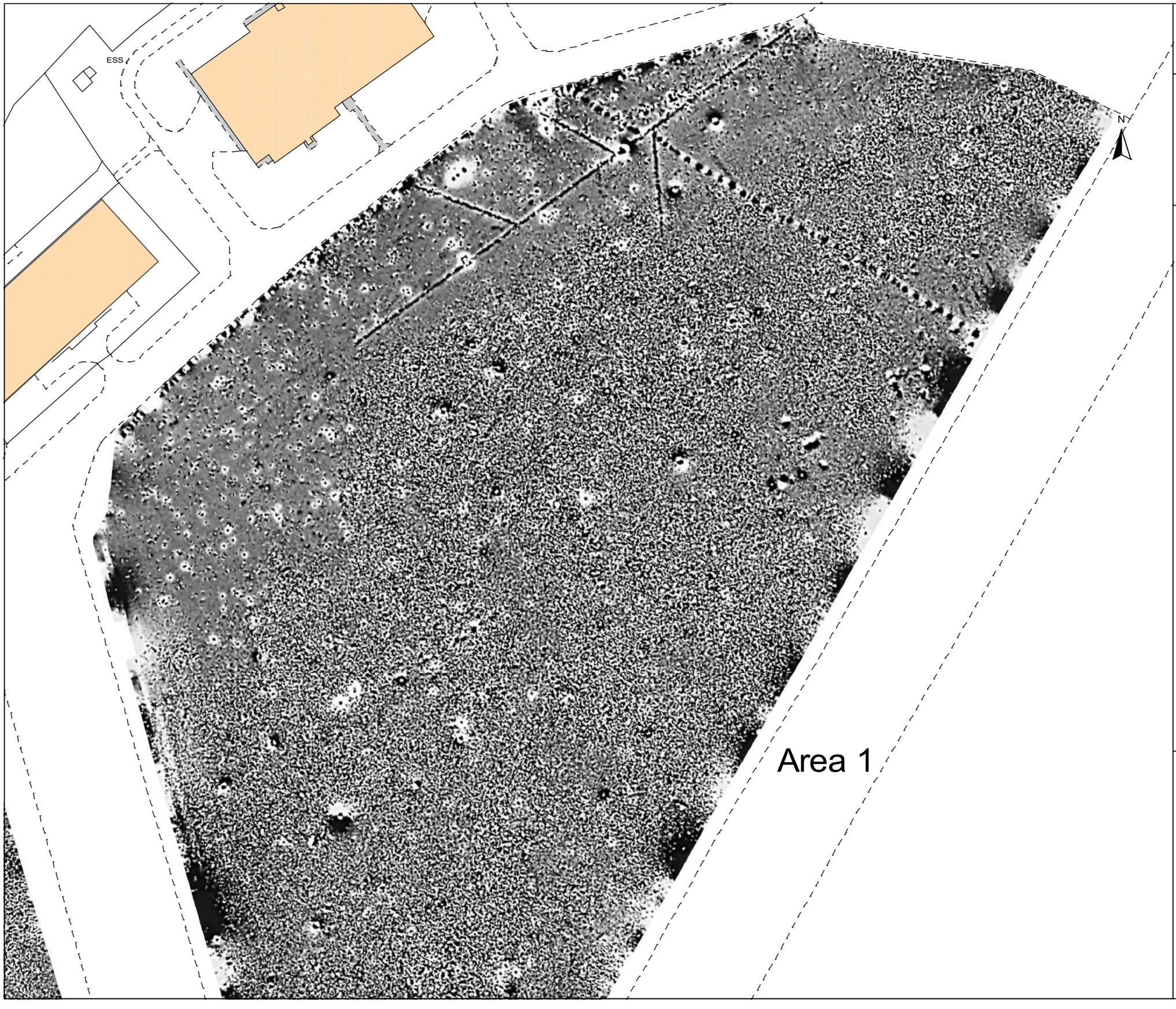
N

SCALE 1:3000

0m 30 60 90 120 150m

SCALE TRUE AT A3

FIG 06



Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of minimally processed magnetometer data - Area 1 north

+3nT

-3nT Area 1 +3nT

-3nT

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 07

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Abstraction and interpretation of magnetic anomalies - Area 1 north

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - land drain
- Positive linear anomaly - possible former field boundary
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

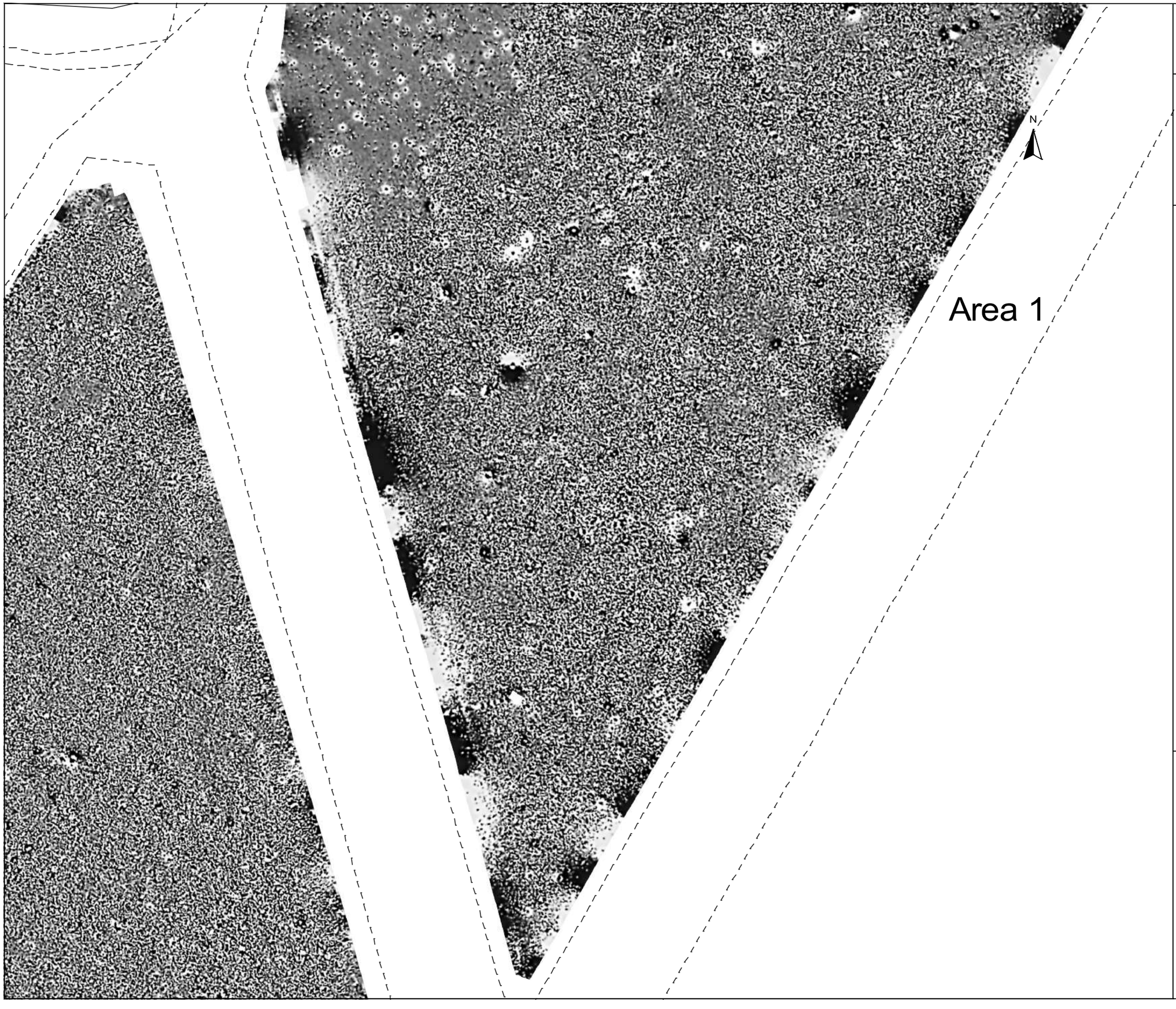
FIG 08

ESS

N

Area 1

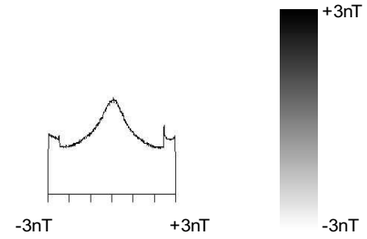
1 2 3 4 5 6 7 8 9 10 11 12 13



Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of minimally processed data - Area 1 south



SCALE 1:1500

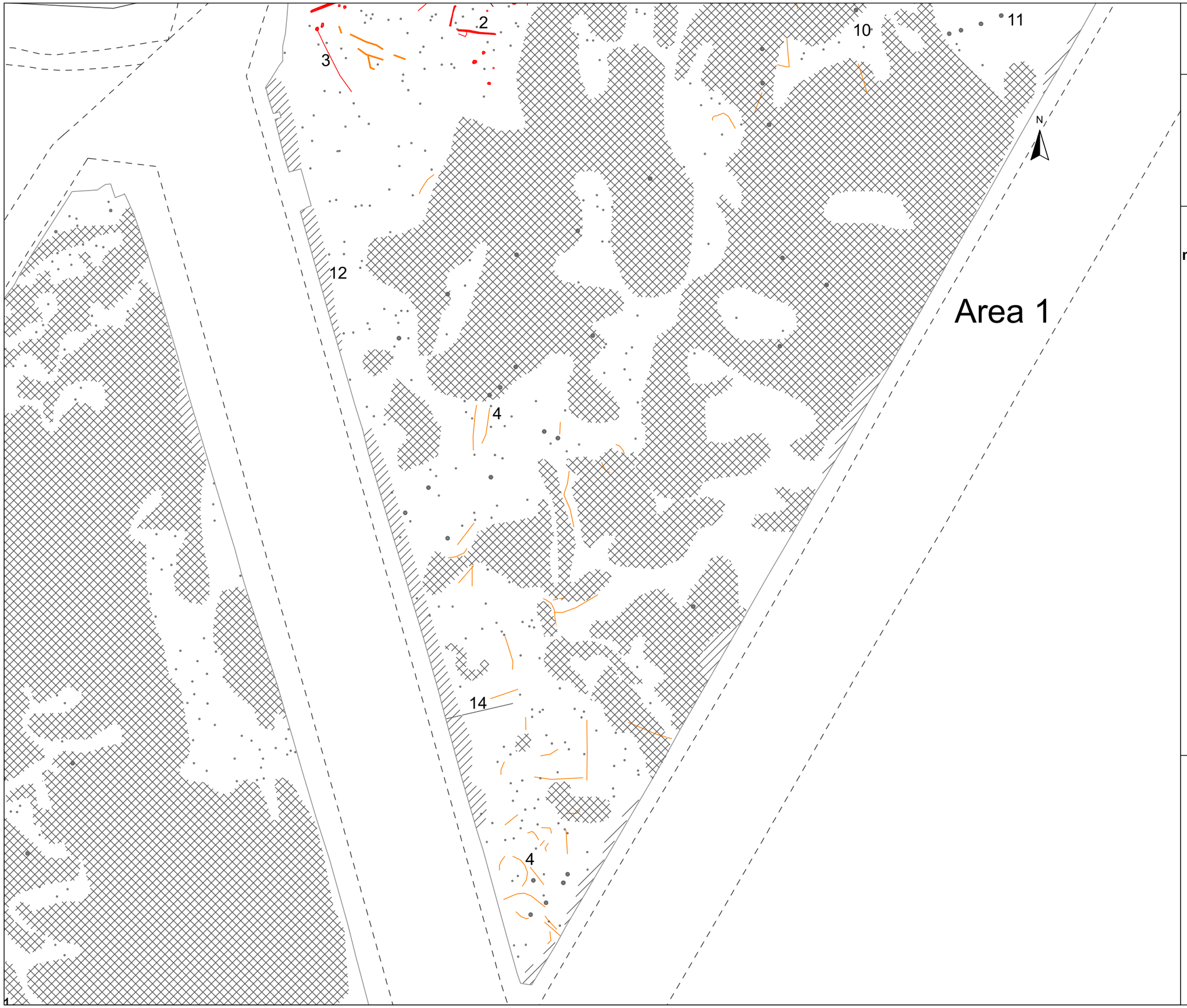
SCALE TRUE AT A3

FIG 09

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Abstraction and interpretation of magnetic anomalies - Area 1 south



- Positive linear anomaly - possible ditch-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 10

Science Museum

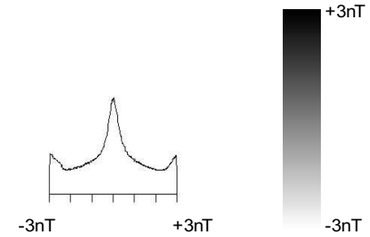
Area 2

N

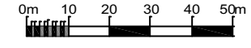
Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of filtered magnetometer data - Area 2 east



SCALE 1:1500



SCALE TRUE AT A3

FIG 11

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Abstraction and interpretation of magnetic anomalies - Area 2 east

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Strong magnetic response - former boundary associated with 19th century farm
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

Area 2

N

12

20

16

15

21

19

17

18

22

24

23

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 12

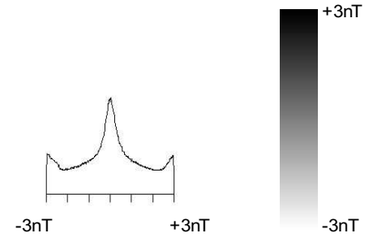
Area 2

N

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Greyscale plot of filtered magnetometer data - Area 2 west



SCALE 1:1500

SCALE TRUE AT A3

FIG 13

Area 2

15

16

17

18

19

20

21

22

23

24

N

Archaeological Surveys Ltd

Geophysical Survey
Building ONE
SMG Wroughton
Swindon

Abstraction and interpretation of magnetic anomalies - Area 2 west

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Strong magnetic response - former boundary associated with 19th century farm
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 14