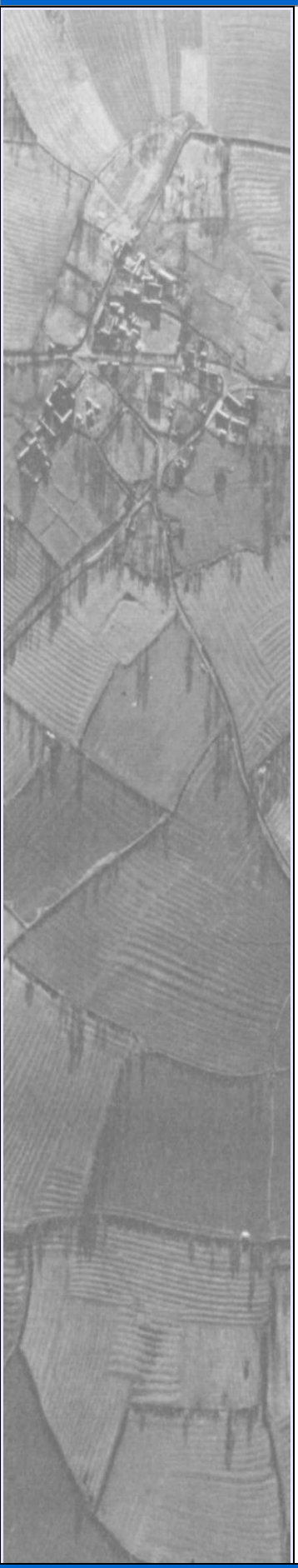

Catsbrain Farm (Site B)
Kingsdown
Swindon

MAGNETOMETER SURVEY REPORT

for

Castlewood Commercial Properties Ltd

Kerry Donaldson & David Sabin

April 2015

Ref. no. 604

ARCHAEOLOGICAL SURVEYS LTD

Catsbrain Farm (Site B)
Kingsdown
Swindon

Magnetometer Survey Report

for

Castlewood Commercial Properties Ltd

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

Survey date – 31st March 2015
Ordnance Survey Grid Reference – **SU 17642 88857**

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SUMMARY

A detailed magnetometer was carried out within a 2ha parcel of land at Catsbrain Farm, Swindon at the request of Castlewood Commercial Properties Ltd. The survey is additional to one carried out previously on land immediately to the east and has been referred to as Site B to differentiate it. The results of the current survey indicate that the site has been subject to intensive field drainage, with several series of land drains evident. A number of positive linear anomalies do not appear to conform to any coherent pattern, and while some may also relate to land drainage, the responses do appear as possible cut, ditch-like features. The site also contains evidence for ridge and furrow and more modern cultivation. A linear zone of magnetic debris has also been located in the western part of the survey area, and this may relate to dumped magnetically thermoremnant material, possibly associated with the dismantled Swindon and Highworth Branch Line that bounds the western edge of the site.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Foundations Archaeology, on behalf of Castlewood Commercial Properties Ltd, to undertake a magnetometer survey of an area of land at Catsbrain Farm, Kingsdown, Swindon. The site has been outlined for a proposed development of a Retirement Care Village consisting of 60 Assisted Living Apartments and a 60 bed Nursing and Dementia Care Centre. The survey forms part of an archaeological assessment of the site.

1.1.2 The site lies immediately west of an area of land previously subject to geophysical survey (Archaeological Surveys, 2015). The current survey area is referred to as Site B, in order to distinguish it from the previous survey area to the east.

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;* and 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 Catsbrain Farm, near Kingsdown, within the parish of Stratton St Margaret, Swindon. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 17642 88857, see Figures 01 and 02.

1.3.2 The geophysical survey covers approximately 1.5ha within a 2ha land parcel which had been recently cleared of vegetation prior to the survey. However the margins of the site contained dense vegetation and were waterlogged, with tall vegetation and building remains within the interior of the site, and a bund of soil a the southern edge which restricted survey. The survey area is bounded to the south by the B4141 Kingsdown Road, the dismantled Swindon and Highworth Branch of the Great Western Railway to the west, and the access route to a care home to the east, with the care home situated to the north.

Plate 1: Survey area looking east

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data although some small zones were unsurveyable due to saplings and boggy ground. Weather conditions during the survey were fine.

1.4 Site history and archaeological potential

1.4.1 An archaeological desk-based assessment has been carried out for the site by Foundations Archaeology (2014). It outlines that prehistoric activity dating

to the Palaeolithic, Mesolithic, Neolithic and Bronze Age periods has been recorded at Kingsdown cemetery 400m to the north. Late Neolithic and Bronze Age flint waste was also recovered on the site of Kingsdown Lodge, 120m to the north west. Evaluation of the Triangle site to the south of the survey area revealed a number of ditches, pits and postholes dating to the Early and Middle Iron Age period. Further features recorded during subsequent excavation included an enclosure complex and a round house dating to the Late Bronze Age or Early Iron Age. Evidence for Roman activity was also recorded at all of these sites, including two crouched burials at the Triangle site.

1.4.2 A geophysical survey recently undertaken by Archaeological Survey (2015) within land immediately to the east located evidence for possible quarrying and other potential cut features. A large number of land drains and other agricultural anomalies also crossed the site.

1.5 Geology and soils

1.5.1 The underlying geology is sandstone from the Hazelbury Bryan Formation and the Kingston Formation (undifferentiated) with alluvium overlying the majority of the survey area (BGS, 2015).

1.5.2 The overlying soil across the site is from the Evesham association and is a typical calcareous pelosol. It consists of a slowly permeable, calcareous, clayey soil (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry carried out over similar geology and soil has produced good results. The site is, therefore, considered suitable 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 spaced 0.5m apart with readings recorded at 20 Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. The system is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Data are collected along a series of parallel survey transects wherever possible. 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.

2.2.3 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).

2.3 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. Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display using TerraSurveyor.

2.3.2 The data are collected between limits of ±10000nT and clipped for display. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track. A zero median traverse function is required in order to remove fixed offset values present within the sensors which do not undergo a zeroing procedure in the field. The approach ensures that the gradiometer sensors are very accurately aligned and fixed to the vertical magnetic field and are not influenced by localised magnetic fields or disturbed by vibration. 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 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 any processes, such as clipping, carried out on the data.

2.3.4 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.

2.3.5 The raster images are combined with base mapping using ProgeCAD Professional 2014, creating DWG 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.

2.3.6 An abstraction and interpretation is offered 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.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 the survey area.

2.3.7 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 approximately 1.5ha within a single land parcel.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative linear anomalies of an uncertain origin, linear anomalies associated with land management, linear anomalies of an agricultural origin, areas of magnetic debris and strong discrete dipolar anomalies relating to ferrous objects. Anomalies located within the survey area have been numbered and are described in 3.4 below.

3.2 Statement of data quality

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

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, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics within the survey area.

Report sub-heading CAD layer names and plot colour	**Description and origin of anomalies**
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG NEG LINEAR UNCERTAIN	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. 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 AS-ABST MAG LAND DRAIN	Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies.
Anomalies with an agricultural origin AS-ABST MAG AGRICULTURAL AS-ABST MAG RIDGE AND FURROW	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing.
Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is 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, or hearths 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.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 417642 188857, see Figures 03 & 04.

Anomalies with an uncertain origin

(1) - Located towards the eastern edge of the survey area are possibly three parallel positive linear anomalies. They are oriented generally north north east to south south west, with some indication that two may extend towards the south east at the southern end. While it may be possible for these anomalies to relate to land drainage, they do not conform to any of the general patterns within the field that indicate other land drainage systems. It is possible that they relate to cut, ditch-like features.

(2) - A positive linear anomaly extends across the centre of the survey area. It is not clear if it crosses or is crossed by the series of land drains (8), but it is possible that it relates to a cut, ditch-like feature.

(3) - Located at the western edge of the survey area are a number of positive linear anomalies. Although they lack of a coherent pattern, it is possible that these are associated with land drainage.

(4) - Situated in the south western corner of the survey area are a number of positive and negative linear anomalies. Some of these form a grid pattern, others extend diagonally across. It is possible that there is an association with land drainage, with some oriented similar to anomalies (6).

(5) - A number of short, positive and negative linear anomalies are located in the northern part of the survey area.

Anomalies associated with land management

(6) - A series of positive linear anomalies, form a series of parallel and orthogonal linear anomalies that appear to relate to land drainage.

(7) - Two positive linear anomalies may relate to land drains. They are in the position of a field boundary, formerly mapped in the early 20th century, although they do not appear to continue across the whole field.

(8) - A series of parallel linear anomalies, oriented north west to south east and located in the northern central part of the survey area appear to relate to a series of land drains.

Anomalies with an agricultural origin

(9) - A series of parallel linear anomalies are located in the eastern part of the

survey area and relate to former ridge and furrow cultivation.

(10) - A number of parallel linear anomalies, oriented east north east to west south west can be seen in the southern part of the survey area.

Anomalies associated with magnetic debris

(10) - Widespread magnetic debris can be seen in the north western part of the survey area. A former structure is indicate on mapping in the northern part of the field and the western edge is adjacent to the dismantled Swindon and Highworth Branch Line, it is possible that the material is associated.

(11) - Strong, discrete, dipolar anomalies are associated with ferrous and other magnetically thermoremnant objects within the topsoil.

4 CONCLUSION

4.1.1 The results of the detailed magnetometer survey indicate that the site contains a large number of linear anomalies, many of which relate to different series of land drains. It is possible that some of these anomalies indicate land divisions associated with different forms of cultivation. The site also contains a number of positive linear anomalies that do not generally conform to any pattern of land drainage, and some may have been truncated by land drains, but this is not clear.

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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 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 ±20nT and ±10nT 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 and modern agricultural features.

Appendix C – survey and data information

COMPOSITE
Path: C:\Business\Jobs\J604 Catsbrain Farm 2\Data\Mag\comps\
Filename: J604-mag.xcp
Description: Imported as Composite from: J604-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 417557.95890717, 188945.746862857 m
Southeast corner: 417724.15890717, 188772.946862857 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 594600

Dimensions
Composite Size (readings): 1108 x 1152
Survey Size (meters): 166 m x 173 m

X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 2.56
Mean: 0.13
Median: 0.01
Composite Area: 2.8719 ha
Surveyed Area: 1.3126 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0

Processes: 1
1 Base Layer

GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -10.00 to 10.00 nT
5 Clip from -5.00 to 5.00 nT

Appendix D – digital archive

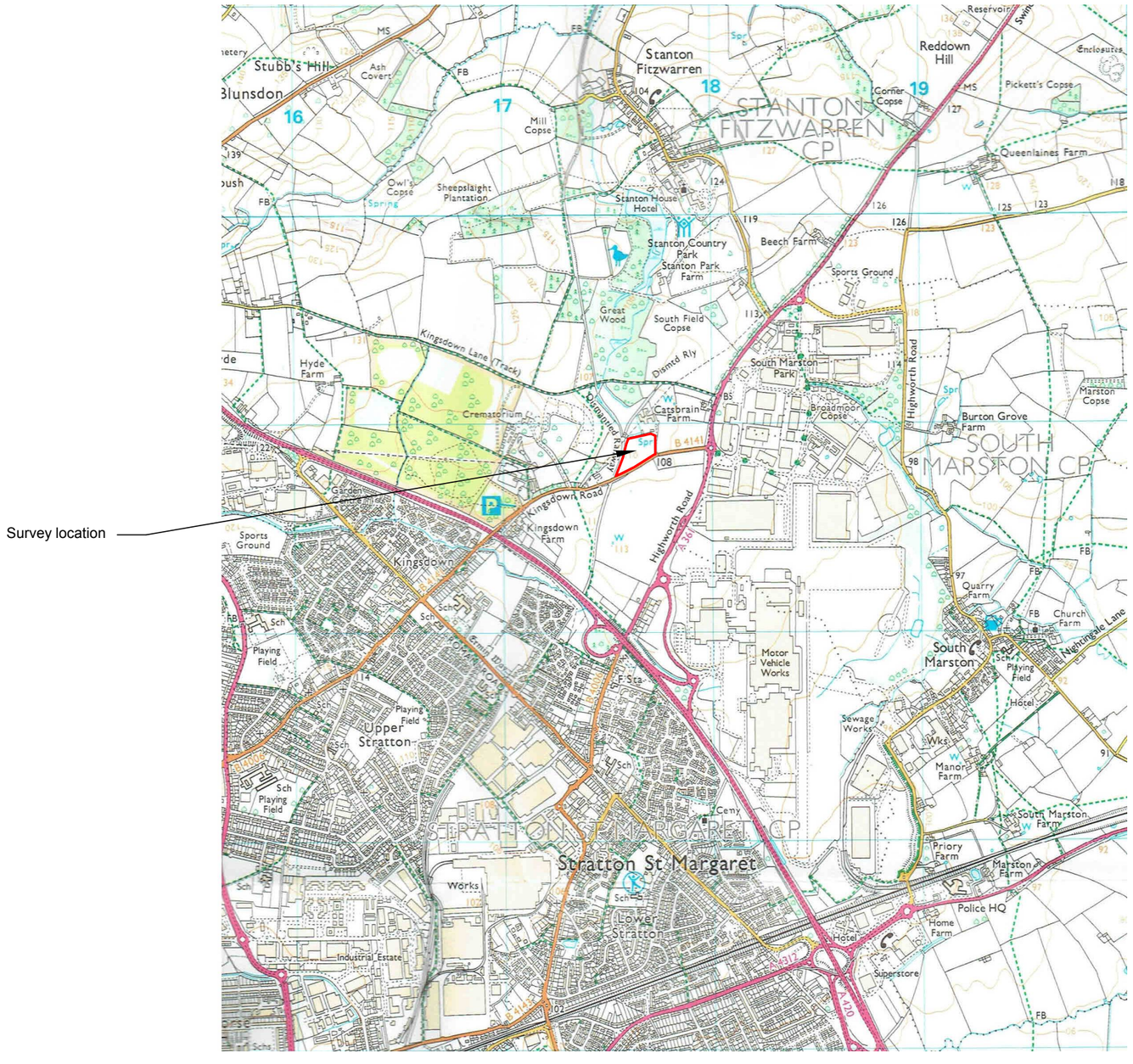
Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

A printed copy of the report and a PDF copy will be supplied to the Wiltshire Historic Environment Record. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

Geophysical data - path: J604 Catsbrain Farm 2\Data				
Path and Filename	**Software**	**Description**	**Date**	**Creator**
catsbrain2\MX\ .prm .dgb .disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA.	31/03/15	D.J.Sabin
catsbrain2\MX\J604-mag.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 1 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	31/03/15	D.J.Sabin
Mag\comps\J604-mag.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	31/03/15	D.J.Sabin
Mag\comps\J604-mag-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±5nT).	31/03/15	D.J.Sabin
Graphic data - path: J604 Catsbrain Farm 2\Data				
Mag\graphics\ J604-mag-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	31/03/15	K.T.Donaldson
Area1\graphics\ J604-mag-proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	31/03/15	K.T.Donaldson
CAD data - path: J604 Catsbrain Farm 2 CAD				
J604 version 1.dwg	ProgeCAD 2014	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.	31/03/15	K.T.Donaldson
Text data - path: J604 Catsbrain Farm 2\Documentation				
J604 report.odt	OpenOffice.org 3.0.1 Writer	Report text as an Open Office document.	31/03/15	K.T.Donaldson

Appendix E – copyright and intellectual property



Survey location

Archaeological Surveys Ltd

Geophysical Survey
Catsbrain Farm (Site B)
Kingsdown
Swindon

Map of survey area

● Survey location

Site centred on OS NGR
SU 17642 88857

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Catsbrain Farm (Site B)
Kingsdown
Swindon

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

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

417600 188900

SCALE 1:1000

0m 10 20 30 40 50m

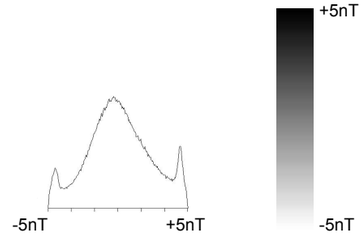
SCALE TRUE AT A3

FIG 02

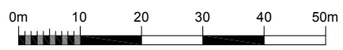
Archaeological Surveys Ltd

Geophysical Survey
Catsbrain Farm (Site B)
Kingsdown
Swindon

Greyscale plot of minimally processed magnetometer data



SCALE 1:1000



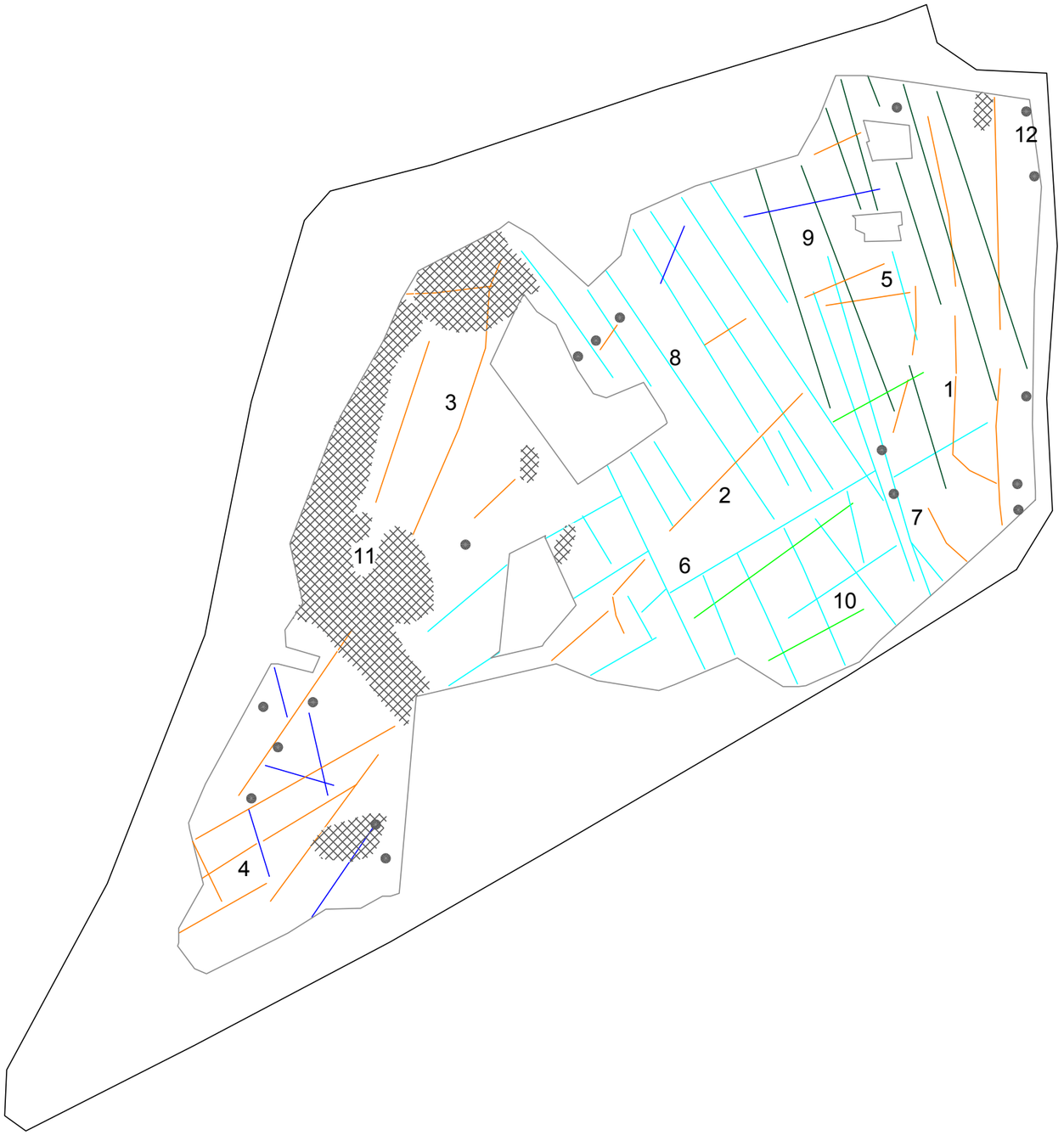
SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Catsbrain Farm (Site B)
Kingsdown
Swindon

Abstraction and interpretation of magnetometer anomalies



- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Linear anomaly - ridge and furrow
- Positive linear anomaly - possible land drain
- Negative linear anomaly - material of low magnetic susceptibility
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 04