Appendix: Cultural Heritage

Annex 1: Archaeological Desk-Based Assessment
Annex 2: Geophysical Survey Report 2022
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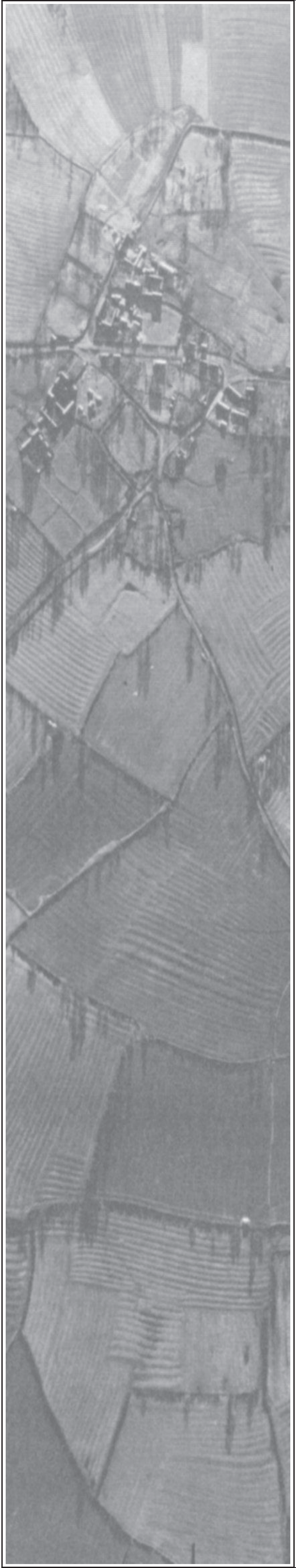
Archaeological Surveys
Specialist Geophysical Surveyors



Culham Battery Storage Site
Culham
Oxfordshire
Phase 2

MAGNETOMETER SURVEY REPORT

for

Oxford Archaeology

Kerry Donaldson & David Sabin

March 2023

Ref. no. J950

ARCHAEOLOGICAL SURVEYS LTD

Culham Battery Storage Site
Culham
Oxfordshire
Phase 2

MAGNETOMETER SURVEY REPORT

for

Oxford Archaeology

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

Survey date – 7th February 2023
Ordnance Survey Grid Reference – **SU 53180 96360**

REGISTERED ORGANISATION CIfA

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SUMMARY

A geophysical survey was carried out by Archaeological Surveys Ltd over 2.1ha of land ahead of construction of a proposed battery storage facility at Culham in Oxfordshire. A series of parallel linear anomalies extend through the site, although it is not possible to determine if they relate to cut, ditch-like features or if they are associated with agricultural activity or drainage. Some appear to have been truncated by later activity, which could indicate that they are earlier features. Other weak anomalies have also been located, but they lack a coherent morphology and cannot be confidently interpreted. The south eastern part of the site contains magnetic debris associated with modern spoil dumping, and similar responses relate to an unmetalled track in the western part of the site.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Oxford Archaeology to undertake a magnetometer survey of an area of land outlined for a new battery storage facility to the north of Culham Science Centre in Oxfordshire. The survey is being undertaken as Phase 2 of a wider scheme, with Phase 1 geophysical survey carried out on land to the west by Magnitude Surveys (2022). The site has been previously subject to geophysical survey for a different scheme (Headland Archaeology, 2016), and the current survey is being carried out in order to understand the archaeological potential of the site prior to construction of the battery storage facility.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2023) and issued to Steven Weaver, Planning Archaeologist for Oxfordshire County Council and archaeological adviser to South Oxfordshire District Council, prior to commencing the survey.

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 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 Standards, guidance and recommendations for the use of this report

1.3.1 Archaeological Surveys Ltd is a Registered Organisation with the Chartered Institute for Archaeologists (CIfA) and both company directors are Members of the Chartered Institute for Archaeologists (MCIfA) and have therefore been assessed for their technical competence and ethical suitability and abide by the CIfA Codes of Conduct. The survey and report follow the recommendations set out by: 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, updated 2020) Standard and Guidance for Archaeological Geophysical Survey.

1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.

1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.

1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.

1.4 Site location, description and survey conditions

1.4.1 The site is located to the north of Thame Lane and the Culham Science Centre, Culham, South Oxfordshire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 53180 96360, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 2.1ha within the southern part of a larger grassland field. There is a slight slope down towards the south with the southern edge of the field mapped at 65m AODN. The northern half of the field, immediately north of the surveyed area, appears to have been levelled as there is evidence of a terrace at the field boundaries. The north western extent of the survey is limited by the steep bank of a large mound and rough vegetation, an unmetalled track runs from the mound to the perimeter road of former RNAS Culham (HMS Hornbill) which passes immediately to the south of the survey area. The western limit of the survey lies several metres to the west of the unmetalled track in the adjacent field.

Plate 1: Northern part of the survey area looking north east

Plate 2: Southern part of survey area looking south east

1.4.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Numerous modern ferrous objects were observed within the vicinity of the mound at the north western corner of the survey area and, along with the track, were considered likely sources of magnetic debris. Weather conditions during the survey were mainly fine and cold with dense fog at times.

1.5 Site history and archaeological potential

1.5.1 The site has been previously subject to geophysical survey for a different scheme covering c242ha in the wider vicinity (Headland Archaeology, 2016). The results show the presence of magnetic debris and disturbance from services as well as a linear feature within the site. As part of this different scheme the land immediately to the west and south west was surveyed by Headland Archaeology and subsequently also by Magnitude Surveys (2022) for Phase 1 of the Culham Battery Storage Site scheme. The surveys revealed a number of archaeological features including linear ditches, trackways and rectilinear enclosures situated 150m to the south west of the site (MOX27324).

1.5.2 Immediately to the north east of the survey area aerial photographs indicate the presence of cropmarks relating to a small square enclosure ditch possibly surrounded by a larger outer ditch (Historic England 24857_001 and 24857_003 flown 08/07/2006). In the wider vicinity, two Roman pots dating to the 3rd and 4th centuries were located during the cutting of the railway, 350m to the west (MOX8393).

1.5.3 The northern limit of the site is the southern boundary of Nuneham Park (MOX8652), a landscaped park and pleasure grounds established c1755 by 1st Earl Harcourt. A mound at the north western corner of the surveyed area appears to have been the location of a building, known as Abingdon Lodge, forming the formal southern gateway to the park. A photograph taken in 1970 shows a neoclassical building with arch and pediment shortly before its demolition (*HMS Hornbill* located at www.aeolian-hall.myzen.co.uk/index.htm).

1.5.4 Immediately south of the site lies Thame Lane, a former perimeter road to Royal Naval Air Station (RNAS) Culham (HMS Hornbill). The site operated as a RNAS from 1944 to 1953 when it became an Admiralty storage facility, in 1960 the United Kingdom Atomic Energy Authority took over the site for nuclear and atomic research, it is now known as the Culham Science Centre. An aerial photograph of the site (Historic England raf_58_8107_f21_0121 flown 14/06/1967) shows a number of presumably former military buildings to the north of Thame Lane, with two small structures in the southern part of the survey area and several structures on the mound next to the neoclassical gatehouse referred to in 1.5.3.

1.5.5 The previous geophysical surveys indicate that there are archaeological features within 150m of the site with aerial photographs indicating cropmarks of archaeological potential immediately north east of the survey area. However, the previous geophysical survey carried out within the site located anomalies that are likely to relate to modern, natural and agricultural features (Headland Archaeology, 2016).

1.6 Geology and soils

1.6.1 The underlying solid geology across the site is sandstone from the Lower

Greensand Group (BGS, 2022).

1.6.2 The overlying soil across the survey area is from the Frilford association (554a) and is an argillic brown sand. It consists of a deep, well drained, sandy and coarse loamy soil (Soil Survey of England and Wales, 1983).

1.6.3 Magnetometry survey carried out across similar soils has produced good results. 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 (also known as thermoremanence) are factors associated with the formation of localised magnetic fields.

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 positive magnetic anomalies that can be mapped by magnetic prospection. In addition, where soil is displaced by material of comparatively low magnetic susceptibility, such as many types of sedimentary rock, anomalies of negative value may occur which could be indicative of structural remains.

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). Additional details are set out in 2.2 below and within Appendix A.

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 20Hz. 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 measurement range of ±8000nT, although the recorded range is ±3000nT, and resolution is approximately 0.1nT. They are linked to a Leica GS10 RTK GNSS with data recorded by SENSYS MonMX software on a rugged notebook 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 manifests 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 the 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 ±3000nT and clipped for display at ±50nT with high and low values highlighted in red and blue and also at ±3nT in order to see low magnitude responses. 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 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. The data have been clipped for display at ±3nT. Data treated to additional processing have 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. 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. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.

2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2021, creating DWG (2018) 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 GNSS, 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 the survey area.

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 approximately 2.1ha.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, linear anomalies of an agricultural origin, 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. Anomalies located within each survey area have been numbered and are described in 3.4 below.

3.2 Data quality and factors affecting the interpretation or formation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. Zones of magnetic disturbance and debris have the potential to obscure weak magnetic anomalies, particularly in the eastern part of the site and where the unmetalled track crosses the western side of the site.

3.2.2 The soils appear to support useful magnetic contrast as attested by the location of several positive linear anomalies probably relating to former cut features.

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 general 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 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	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 with an agricultural origin	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. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
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 centred on OS NGR 453180 196360, see Figs 03 – 06.

Anomalies with an uncertain origin

(1) – The survey area contains a number of positive and negative linear anomalies located approximately 21m apart. They are generally parallel with the northern and southern field boundaries and could relate to agricultural activity or land drainage. However, a number of them do appear to have been truncated by later activity and their morphology could indicate an association with an earlier series of cut features.

(2) – The north western part of the site contains a number of weakly positive linear, curvilinear and sinuous anomalies. They lack a coherent morphology and it is possible that they are associated with ground disturbance or natural features.

(3) – A number of weakly positive linear and curvilinear responses are located at the western edge of the site. It is not possible to determine their origin.

(4) – The site contains a small number of positive and negative curvilinear anomalies. They are poorly defined and of uncertain origin.

(5) – A negative linear anomaly extends through the western part of the site. It is parallel with agricultural anomalies (9) and other agricultural anomalies (10) extend

towards it but it is not clear if it relates to a former land boundary or if it is associated with a buried service.

(6) – Positive linear anomalies join to form an arrow-shaped feature in the northern part of the site. They appear to join a drain or pipe (7) and may be associated with drainage.

Anomalies associated with land management

(7) – A weak, multiple dipolar linear anomaly extends from anomaly (6) towards the north western corner of the site. A former gatehouse to Nuneham estate, known as Abingdon Lodge, as well as a number of wartime buildings were situated on the higher ground to the north west, and it is possible that the anomaly relates to a drain from a building.

(8) – Linear zones of magnetic debris and magnetic enhancement in the south western corner of the site relate to the existing and former tracks

Anomalies with an agricultural origin

(9 & 10) – Parallel linear anomalies relating to agricultural activity. Anomalies (9) are parallel with negative linear anomaly (5), while anomalies (10) are at a different orientation, but extend towards anomaly (5).

Anomalies associated with magnetic debris

(11) – A large area of magnetic debris is evident in the south eastern corner of the site. This corresponds to a rectangular area visible on aerial photographs from 2009 and which relates to an area used for dumping spoil. The magnetic response indicates that there are ferrous objects within the spread.

(12) – Strongly magnetic debris in the western part of the site is associated with material used to consolidate a number of tracks.

(13) – Strong, discrete dipolar anomalies are a response to ferrous and other magnetically thermoremnant objects, such as brick/tile, within the topsoil.

Anomalies with a modern origin

(14) – A buried service extends along the south eastern edge and then into the north eastern part of the site. Another service extends from it at right angles into the centre of the site. The anomalies indicate a response to buried water pipes.

(15) – A linear series of discrete responses extends along the southern part of the site. The response is indicative of a buried cable.

4 CONCLUSION

4.1.1 A series of positive and negative linear anomalies extend across the site. They are generally parallel with the northern and southern field boundaries and could be related to agricultural activity or land drainage. Several appear to be truncated by later anomalies and an association with former cut features is possible. Other anomalies could be associated with drainage and possibly ground make-up or natural features. A zone of dumping in the south eastern corner of the site has resulted in widespread magnetic debris, as has material used within track consolidation in the west.

5 REFERENCES

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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 magnetic 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. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

High Pass Filter

Removes low frequency anomalies within the data that are not considered to be archaeologically significant and may be natural in origin. A window passes over the data, the mean of all the data within the window is subtracted from the centre value. The size of the window is adjusted as is the weighting which may be uniform or Gaussian. The process is used to improve the visibility of anomalies of interest.

Zero Median/Mean Traverse

The median (or mean) of data from 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 offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Filename: J950-mag.xcp
Description: Imported as Composite from: J950-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):
Northwest corner: 453062.19, 196439.98 m
Southeast corner: 453261.39, 196270.48 m
Direction of 1st Traverse: 90 deg
Collection Method: Parallel
Sensors: 1
Dummy Value: 32702

Dimensions
Survey Size (meters): 199 m x 170 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 580904, Recorded: 580909

Stats
Max: 3.32
Min: -3.30
Std Dev: 1.81
Mean: 0.02
Median: 0.04
Composite Area: 3.3764 ha
Surveyed Area: 2.1813 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.37.0

GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (UTM to OSGB36).
3 DeStripe Median Traverse:
4 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. The archive includes the raw and processed geophysical data, greyscale images, CAD, PDF figures and report text. In addition, digital data created during the survey will be archived with the Archaeology Data Service (ADS).

A draft copy will be supplied to the Oxfordshire county archaeological officer for comment and the agreed final copy supplied in PDF format to the Oxfordshire Historic Environment Record. 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	J950-mag-**[area number/name]**.asc J950-mag-**[area number/name]**.xcp J950-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J950-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J950-**[version number]**.dwg	CAD file in 2018 dwg format
Report	J950 report.odt	Report text in LibreOffice odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below 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 an uncertain origin		
AS-ABST MAG POS LINEAR UNCERTAIN	255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG NEG LINEAR UNCERTAIN	Blue 0,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN	255,127,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS UNCERTAIN	255,127,0	Polygon (cross hatched ANSI37)
Anomalies relating to land management		
AS-ABST MAG PATH/ROAD/TRACK	0, 153,153	Line, polyline or polygon (solid or partly cross hatched ANSI38)
AS-ABST MAG LAND DRAIN	Cyan 0,255,255	Line or polyline
Anomalies with an agricultural origin		
AS-ABST MAG AGRICULTURAL	Green 0,255,0	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

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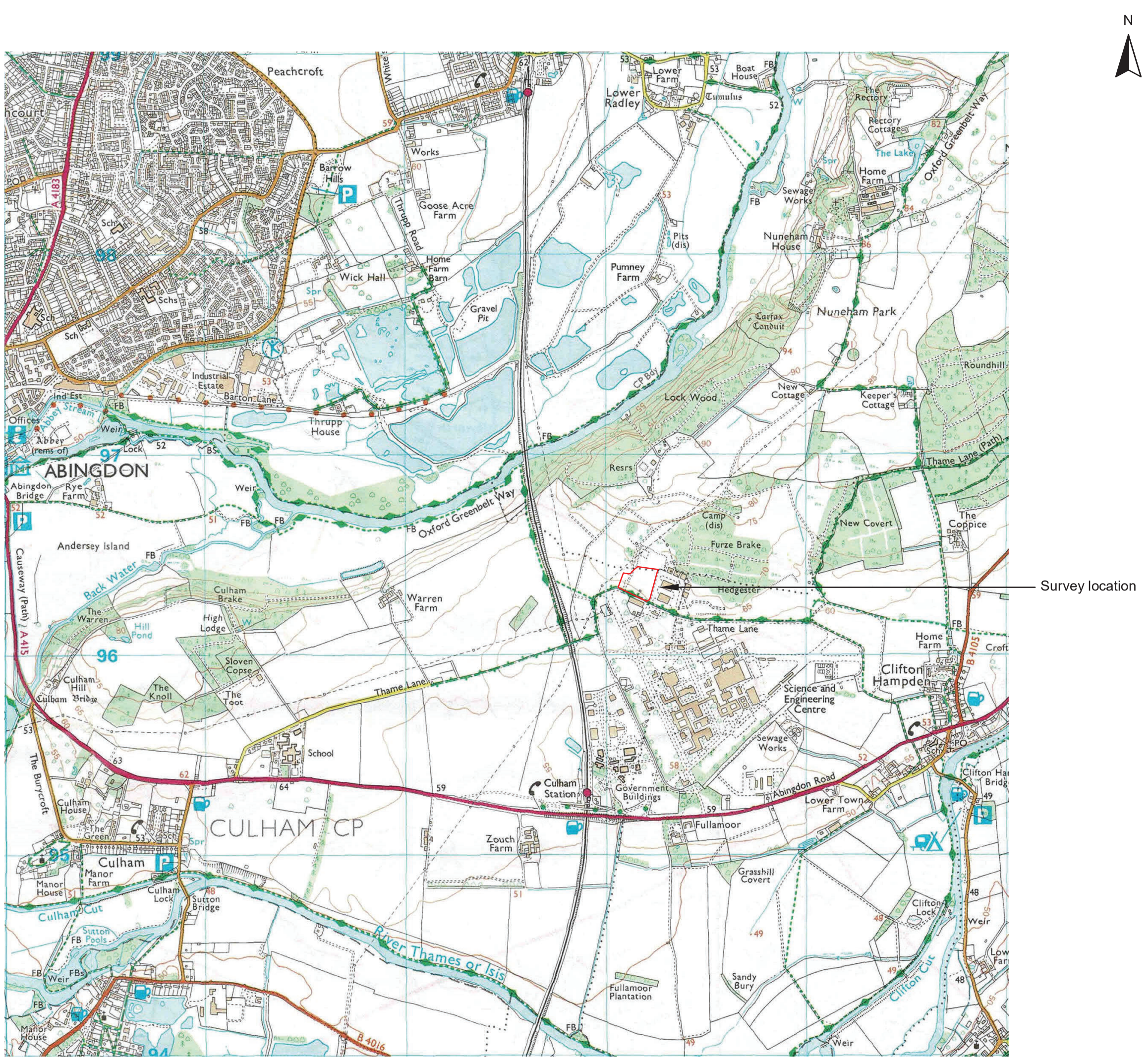
Culham Battery Storage Site
Culham
Oxfordshire
Phase 2

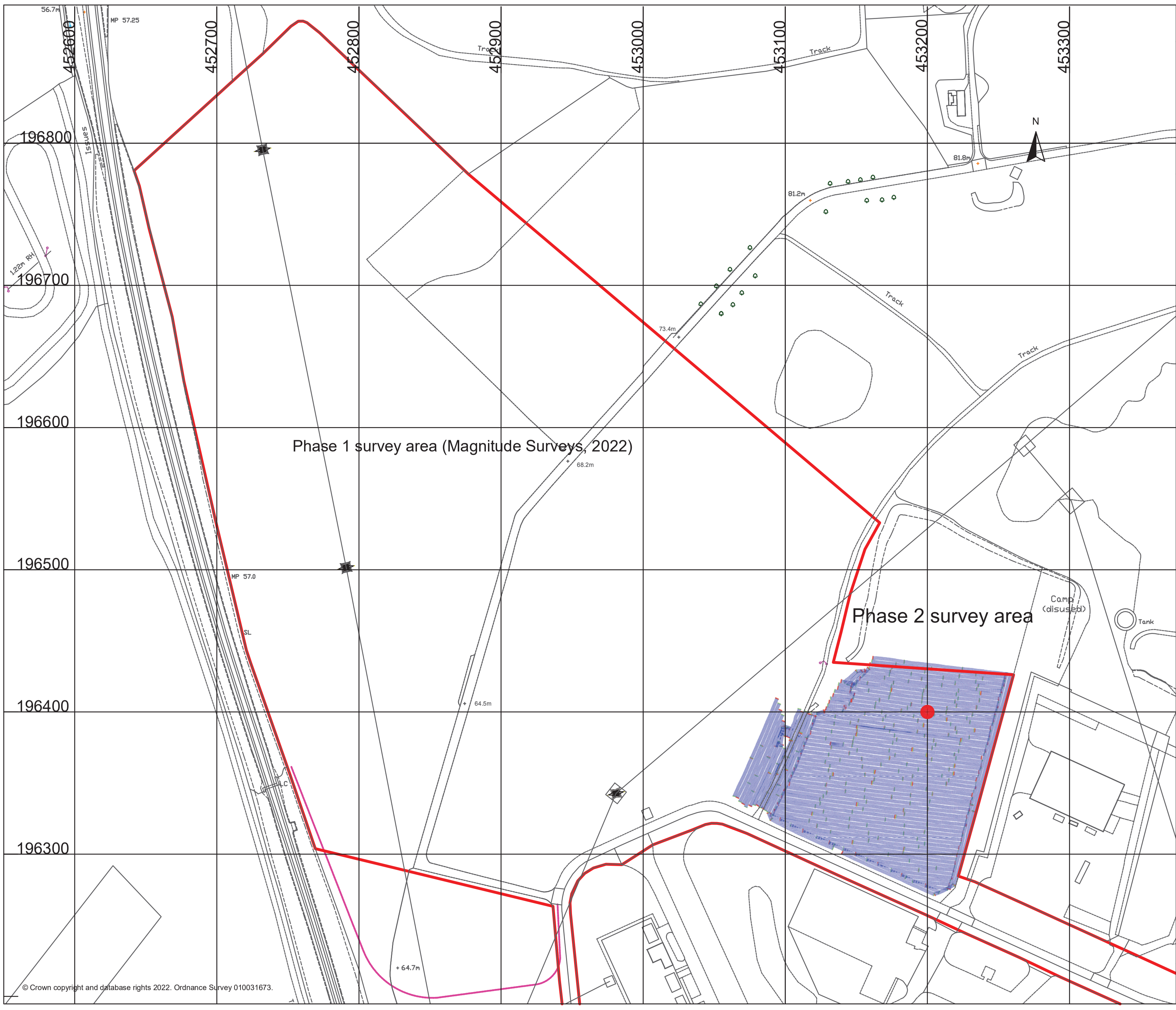
Map of survey area



Site centred on OS NGR
SU 53180 96360

SCALE 1:25 000
0m 500m 1000m
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01



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Culham
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Referencing information

Referencing grid to OSGB36 datum at 100m intervals

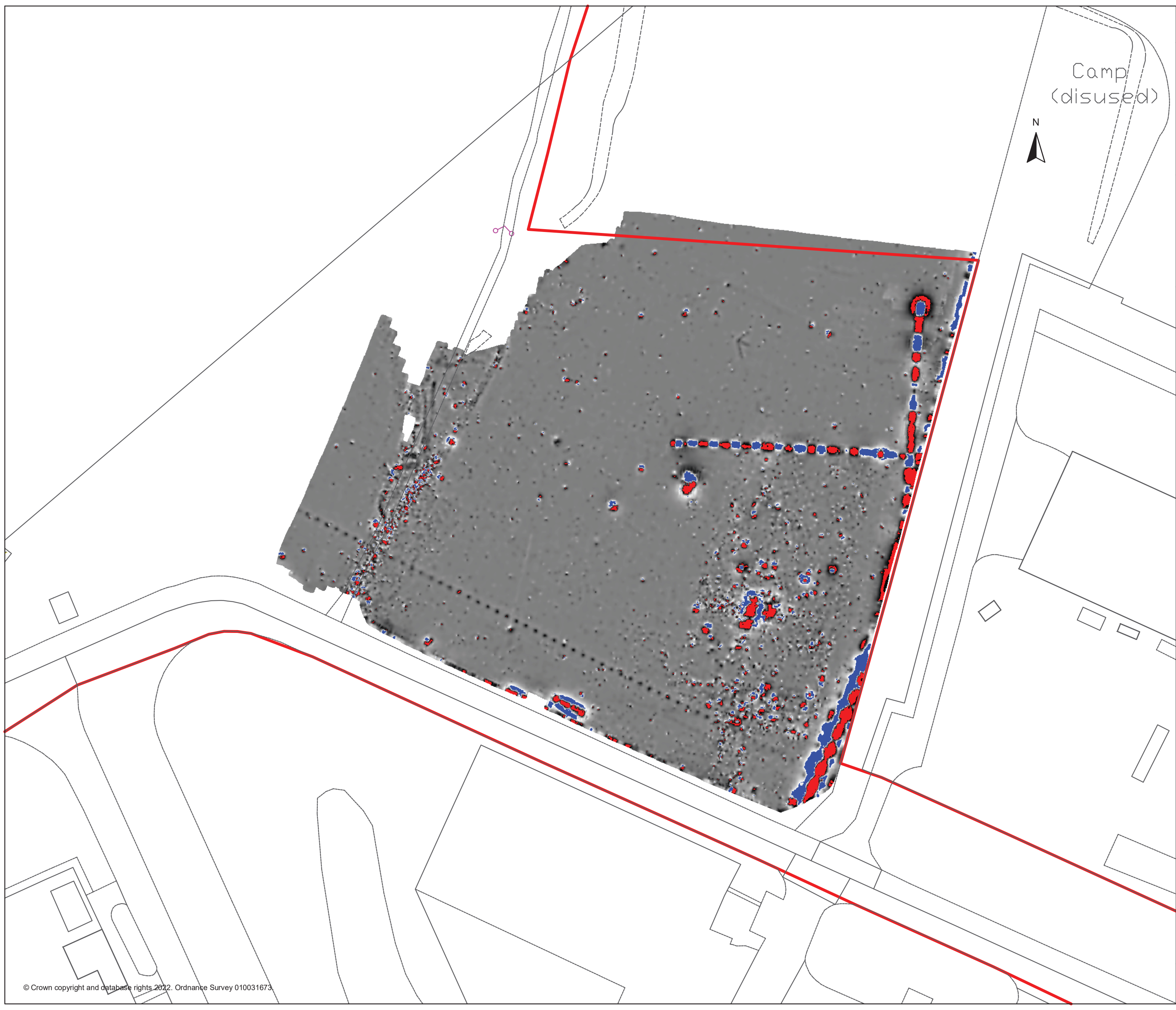
- 453200 196400
- Survey tracks
- Survey track start
- Survey track stop
- Development boundary

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY KTD | CHECKED BY DJS | FIG 02



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Greyscale plot of minimally processed magnetometer data clipped at ±50nT

+50nT
-50nT
-50nT +50nT

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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Greyscale plot of minimally processed magnetometer data clipped at ±3nT

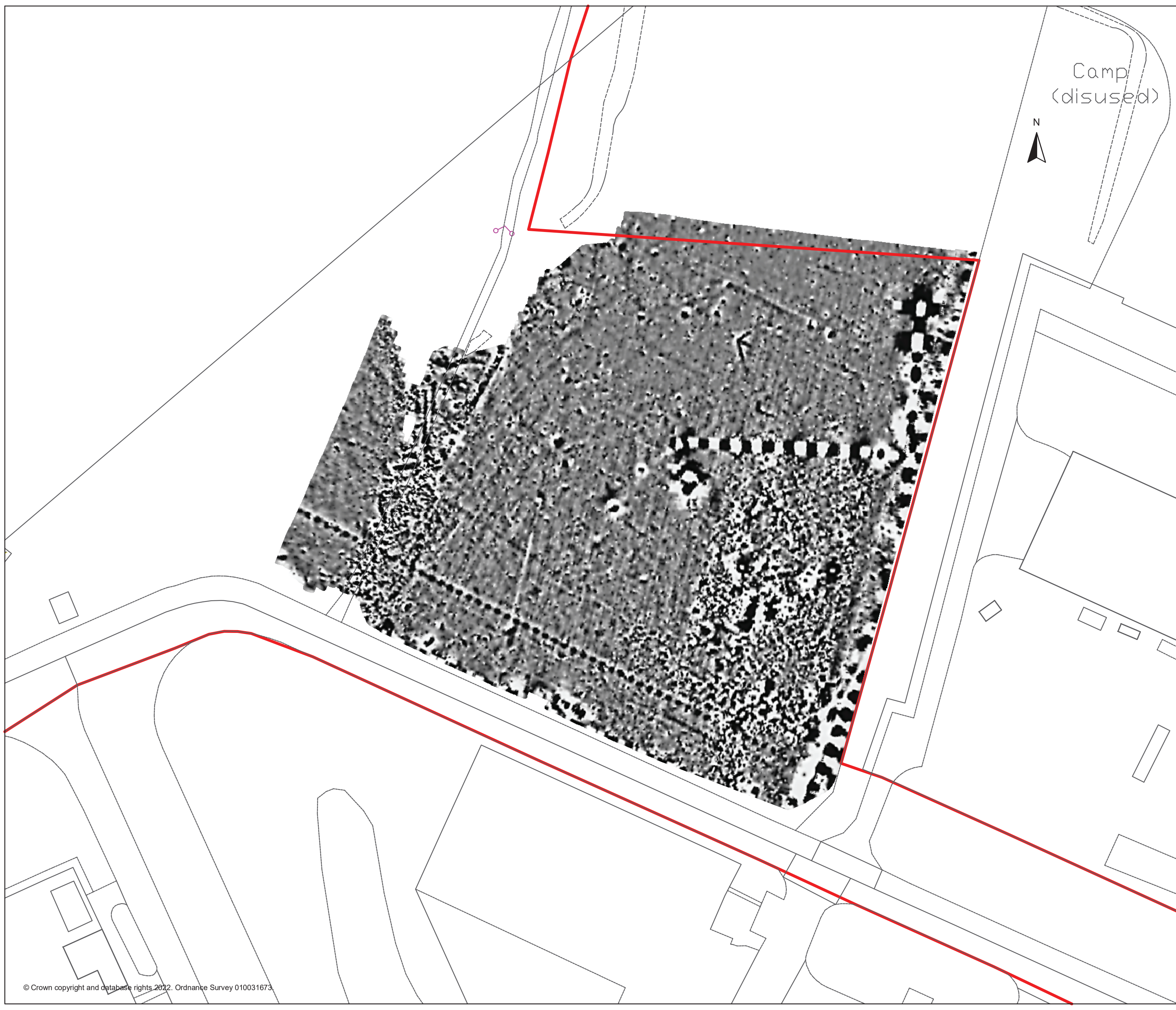
-3nT +3nT
+3nT -3nT

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04



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Greyscale plot of filtered magnetometer data

-3nT +3nT
+3nT -3nT

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 05

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Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Weak multiple dipolar linear anomaly - land drain / drainage pipe
- Linear anomaly - of agricultural origin
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- 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 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 06