

## **Appendix 5:**

Geophysical survey results

[Report: Archaeological Surveys Ltd / Development Archaeological Surveys Ltd].



# **Land at Westergate Aldingbourne West Sussex**

## **MAGNETOMETER SURVEY REPORT**

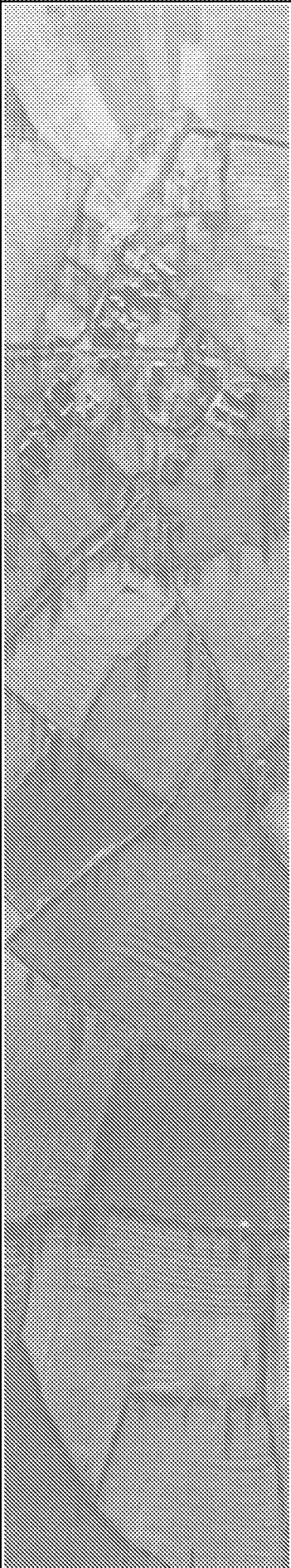
for

## **Development Archaeology Services Ltd**

Kerry Donaldson & David Sabin

June 2023

Ref. no. J967



ARCHAEOLOGICAL SURVEYS LTD

**Land at Westergate  
Aldingbourne  
West Sussex**

**MAGNETOMETER SURVEY REPORT**

for

**Development Archaeology Services Ltd**

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Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

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Ordnance Survey Grid Reference – **SU 94165 04710**



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It is a Registered Organisation with the Chartered Institute for Archaeologists.

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## SUMMARY

A geophysical survey, comprising detailed magnetometry, was carried out within the surveyable parts of a larger site at Westergate in West Sussex. The results indicate the presence of a group of anomalies in the centre of the site that include a possible rectilinear feature, although their origin is uncertain. Two small zones of magnetic enhancement could relate to burning that has been disturbed by later agricultural activity, but it is not possible to determine if the burning is modern or of some antiquity. A small number of weakly positive linear and discrete responses have also been located in the southern part of the site, but again these lack a clearly defined morphology. Other anomalies relate to widespread ferrous objects within the topsoil, natural features and buried services.

## 1 INTRODUCTION

### *1.1 Survey background*

- 1.1.1 Archaeological Surveys Ltd was commissioned by Development Archaeology Services Ltd to undertake a magnetometer survey of an area of land at Westergate in West Sussex. The site has been outlined for a proposed residential development and the survey forms part of an archaeological assessment.
- 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 the client prior to commencing the fieldwork.

### *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 at Westergate within the parish of Aldingbourne in West Sussex. The parish boundary with Eastergate forms the eastern boundary of the site and the railway line between Brighton and Chichester forms the southern boundary. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 94165 04710, see Figs 01 and 02.
- 1.4.2 The geophysical survey covers approximately 10ha within an 18.6ha site. The western and northern parts of the site were under trees or contained overgrown vegetation and could not be surveyed. Five survey areas were covered; Area 1 is an arable field in the southern part of the site that contained a low immature wheat crop and Areas 2 to 5 were recently mown grassland.
- 1.4.3 The site tends to slope down gently towards the east where it is bounded by a small stream known as Eastergate Rife. The land near the south western corner is a little over 10m AODN falling to just below 5m AODN close to the stream at the eastern boundary. Field boundaries are mainly hedgerows with

mature trees and overgrown field margins in the grass areas. Most of the fields were in almost constant use by dog walkers during the course of the survey.

- 1.4.4 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. A small number of steel covered inspection chambers were avoided within Areas 2, 4 and 5. A narrow section of land could not be surveyed along the eastern side of Area 1 due to deep ruts and very disturbed ground. Weather conditions during the survey were fine.



Plate 1: Area 1 looking north



Plate 2: Area 5 looking north

## 1.5 Site history and archaeological potential

- 1.5.1 Archaeological evaluations at the Westergate Community College in 1996 and 1998 located features and finds from the prehistoric, Roman, medieval and post medieval periods 120m to the north (MWS7047-9), while evaluation to the rear of 23-27 Ivy Lane, Westergate also found features dating to the Mesolithic, Bronze Age, Iron Age, Roman and medieval periods, 120m to the north west (EWS1127/MWS9494). The site of a possible Roman building (MWS2364) and sherds of medieval pottery (MWS2365) have been located 400m to the east with a fragment of tegula also recorded during evaluation 275m to the east (MWS6007).

## 1.6 Geology and soils

- 1.6.1 The underlying solid geology across the site is clay, silt and sand from the London Clay Formation with overlying River Terrace Deposits over the majority of Area 1 in the south western part of the site. Raised beach deposits are also present along the eastern edge of Area 1 and a small part of the north western corner of Area 4 in the centre of the site. Alluvial deposits cover the northern part of Area 5 and the southern part of Area 4 in the centre of the site, and head deposits are located in the north western corner of Area 4 and within Areas 2 and 3 in the northern part of the site (BGS, 2022).
- 1.6.2 The overlying soil across the majority of the survey area is from the Park Gate association (841e) and is a typical argillic gley soil. The soil across the northern part of the site within Areas 2 & 3 is from the Hamble 2 association which is a typical argillic brown earth and both soil types consist of a deep,

stoneless, well drained, silty soil (Soil Survey of England and Wales, 1983).

- 1.6.3 Magnetometry survey carried out across similar soils has produced variable results as they are often associated with low magnetic susceptibility resulting in poor magnetic contrast between cut features and the material into which they are cut. However, cut features of archaeological potential may be located where human activity has been sufficiently intensive to alter the magnetic characteristics of the soil, such as an occupation site or where there has been industrial activity. Features associated with less intensive activity, such as land boundaries or short-lived sites may not have sufficient magnetic enhancement to be located through magnetometry.

## 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 thermoremanence (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 thermoremanence 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 thermoremanence.
- 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® MX V3 6 channel cart-based system. The instrument has 6 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 recorded range of  $\pm 3000\text{nT}$ , and resolution is approximately  $0.1\text{nT}$ . 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  $<100\text{s}$ .

## 2.3 *Data processing and presentation*

- 2.3.1 Magnetic data collected by the MAGNETO® MX V3 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  $\pm 3000\text{nT}$  and clipped for display at  $\pm 3\text{nT}$ . 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 within each area 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 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 each 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.

## *2.4 Supplementary measurement of magnetic susceptibility*

- 2.4.1 Magnetic susceptibility is an important factor in the formation of magnetic anomalies located by a magnetometry survey, see 2.1. Accurate measurement of the magnetic susceptibility of soil, subsoil and underlying geology may enhance the results of the magnetometry survey by providing an assessment of magnetic contrast within a site. Where sampling of topsoil only is possible, measurement may assist in understanding whether the soil is likely to be associated with strong, moderate or weak anomalies, which may be a result of low levels of iron minerals, waterlogging, etc. Accurate measurement may also assist in determining industrial activity and the presence of layers or features not visually or texturally apparent on excavation.
- 2.4.2 Supplementary measurement of soil magnetic susceptibility is not considered part of the main objective of the survey and is discussed in section 3.2 below as a factor influencing the formation of anomalies.
- 2.4.3 Measurements are achieved using a Bartington MS2 Magnetic Susceptibility Meter with MS2B sensor. Small soil samples are measured in 10 cubic centimetre plastic pots after accurately weighing, generally each sample is subdivided and at least 3 separate measurements are made in order to provide a mean value, or assess variability due to ferrous contamination and other factors. Measurement can be made at low or high frequency, generally low frequency measurements are made but occasionally high frequency measurements are also recorded as the frequency dependence of a soil may be informative.
- 2.4.4 The measurements are converted to mass specific readings using SI units for bulk density. Archaeological Surveys express the measurements as  $X_{lf}$  or  $X_{hf}$  for low frequency or high frequency magnetic susceptibility respectively with units of  $10^{-8} \text{m}^3 \text{kg}^{-1}$ .

### 3 RESULTS

#### 3.1 *General assessment of survey results*

- 3.1.1 The detailed magnetic survey was carried out over a total of five survey areas covering approximately 10ha.
- 3.1.2 Magnetic anomalies located can be generally classified as positive anomalies of an uncertain origin, anomalies associated with land management, 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.
- 3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 to 3.7 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. High magnitude magnetic disturbance has been caused by several underground services crossing the site and this has produced low level striping in Area 1 and both low level and severe striping in Area 3. The effect has been effectively removed by the use of a high pass filter; both filtered and unfiltered data have been compared and analysed to ensure that no significant anomalies have been altered or removed. High magnitude magnetic anomalies in the immediate vicinity of the services has the potential to obscure weak anomalies.
- 3.2.2 Although a number of anomalies were located by the survey, contrast appears poor which may well relate to the nature of the underlying geology and the soils derived from it. Confident interpretation is often impossible where anomalies are weak and produce no coherent pattern.
- 3.2.3 In order to provide further understanding of the magnetic characteristics of the soil, a single topsoil sample was taken from the southern part of Area 5 and mass specific magnetic susceptibility was measured, see 2.4. The sample produced an average low frequency mass specific magnetic susceptibility ( $X_{lf}$ ) of  $6.5 \times 10^{-8} \text{m}^3 \text{kg}^{-1}$ . The value is low and typical of soils where magnetic anomalies are generally weak. The value is slightly lower than samples obtained from similar geology/soil obtained from other sites in the region.

#### 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Anomalies with an uncertain origin</b>        | The category applies to a range of anomalies where <u>there is not enough evidence to confidently suggest an origin</u> . Anomalies in this category <u>may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered</u> . 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. |
| <b>Anomalies relating to land management</b>     | 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.                                                                                                                                                                                                                                   |
| <b>Anomalies with an agricultural origin</b>     | 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 <u>does not include</u> agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Anomalies associated with magnetic debris</b> | 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 thermoremanent 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 <u>may, therefore, be archaeologically significant</u> . 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.                                                |
| <b>Anomalies with a modern origin</b>            | 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 - south

Area 1 centred on OS NGR 494145 104480, Area 5 centred on OS NGR 494230 104550, see Figs 06 – 08.

#### *Anomalies with an uncertain origin*

(1) – A number of weakly positive anomalies are located within the southern part of Area 1. One has a curvilinear form and one is a discrete feature. There is a general lack of clearly defined morphology, and it is not possible to determine their origin.

(2) – A small number of discrete positive responses are located within the southern part of the site. Some are formed of pairs of responses, others are more isolated. They appear to relate to pit-like features with a magnetic response of 3-8nT, which could indicate an association with anthropogenic activity.

(3) – A curvilinear anomaly and discrete responses are located in the north eastern corner of Area 5. The responses are 3-30nT which may indicate a magnetic enhancement that may be associated with burning.

(4) – A fragmented positive linear anomaly extends across the narrow width of Area 5. It does not appear to continue westwards into Area 1 and may relate to a former boundary or drainage feature within the confines of the existing field boundary layout.

#### *Anomalies associated with land management*

(5 & 6) – Positive linear anomalies with associated magnetic debris relate to formerly mapped field boundaries that extend across the width of Area 5.

#### *Anomalies with a natural origin*

(7) – Zones of magnetically variable responses can be seen predominantly in the eastern part of Area 1 and these generally correspond to the variations in the raised beach deposits and river terrace deposits.

#### *Anomalies associated with magnetic debris*

(8) – The entire site contains widespread and numerous strong, discrete, dipolar anomalies which are a response to ferrous and other magnetically thermoremanent objects within the topsoil.

#### *Anomalies with a modern origin*

(9) – A strong, multiple dipolar linear anomaly indicative of a buried service crosses Area 1 from the north western corner to the southern edge.

### **3.5 List of anomalies - centre**

Area 4 centred on OS NGR 494160 104780, see Figs 09 – 11.

#### *Anomalies with an uncertain origin*

(10) – A group of positive anomalies, including a possible rectilinear feature, are located in the north western part of Area 4. It does not appear to extend northwards into Area 3. It is not clear if the anomalies relate to natural features or cut, ditch-like features with archaeological potential.

(11) – Two patches of magnetic enhancement appear as a series of linear anomalies in the south western part of Area 2. The linear appearance has been caused by disturbed related to later agricultural activity (13) and although the enhancement could relate to burning, it is not clear if it is due to bonfires or much earlier features.

(12) – A weakly positive linear anomaly crosses the centre of Area 4. It may be associated with a former field boundary or possibly agricultural activity.

*Anomalies with an agricultural origin*

(13) – A series of linear anomalies parallel with the western boundary relate to agricultural activity. They have disturbed features associated with anomalies (11).

*Anomalies with a modern origin*

(14) – A strong, multiple dipolar, linear anomaly extends through the south western corner of Area 4 and across the north western corner of Area 5 and relates to a buried service.

### 3.6 List of anomalies - north

Area 2 centred on OS NGR 494212 104957, Area 3 centred on OS NGR 494152 105000 see Figs 12 – 14.

*Anomalies with an agricultural origin*

(15) – A series of parallel linear anomalies within Area 3 relate to agricultural activity.

*Anomalies associated with magnetic debris*

(16) – A zone of magnetic debris at the southern end of Area 2 is a response to dumped material.

*Anomalies with a modern origin*

(17) – Strong, multiple dipolar linear anomalies relate to two pipes that cross Area 3.

## 4 CONCLUSION

- 4.1.1 The geophysical survey located a small number of weakly positive responses within the site. These include a possible rectilinear feature within the central part of the site; however, the anomalies generally lack a coherent morphology and cannot be confidently interpreted. The site contains numerous ferrous objects and fragments of magnetic material, such as brick and tile, that have a very widespread distribution. Naturally formed anomalies can be seen in the southern part of the site and a number of buried services have also been located.

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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 thermoremanent 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. Thermoremanent 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. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent 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

### Area 1 minimally processed data

Filename: J967-mag-Area1-proc.xcp  
 Instrument Type: Sensys DLMGPS  
 Units: nT  
 UTM Zone: 30U  
 Survey corner coordinates (X/Y): OSGB36  
 Northwest corner: 494050.29, 104657.20 m  
 Southeast corner: 494291.64, 104344.75 m  
 Collection Method: Randomised  
 Sensors: 5  
 Dummy Value: 32702  
 Dimensions  
 Survey Size (meters): 241 m x 312 m  
 X&Y Interval: 0.15 m  
 Source GPS Points: Active: 1359614, Recorded: 1359620  
 Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.34  
 Mean: -0.17  
 Median: 0.09  
 Composite Area: 7.541 ha  
 Surveyed Area: 4.758 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

### Area 1 filtered data

Filename: J967-mag-Area1-proc-hpf.xcp  
 Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.19  
 Mean: -0.14  
 Median: 0.01

### GPS based Proce5

- 1 Base Layer.
- 2 Unit Conversion Layer (UTM to OSGB36).
- 3 DeStripe Median Traverse:
- 4 High pass Uniform (median) filter: Window dia: 253
- 5 Clip from -3.00 to 3.00 nT

### Area 2 minimally processed data

Filename: J967-mag-Area2-proc.xcp  
 Northwest corner: 494188.08, 105026.77 m  
 Southeast corner: 494226.78, 104889.52 m  
 Dimensions  
 Survey Size (meters): 38.7 m x 137 m  
 X&Y Interval: 0.15 m  
 Source GPS Points: Active: 124893, Recorded: 124899  
 Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.48  
 Mean: -0.08  
 Median: 0.02  
 Composite Area: 0.53116 ha  
 Surveyed Area: 0.3843 ha

### 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

### Area 2 filtered data

Filename: J967-mag-Area2-proc-hpf.xcp  
 Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.43  
 Mean: -0.05  
 Median: 0.00

### GPS based Proce5

- 1 Base Layer.
- 2 Unit Conversion Layer (UTM to OSGB36).
- 3 DeStripe Median Traverse:
- 4 High pass Uniform (median) filter: Window dia: 201
- 5 Clip from -3.00 to 3.00 nT

### Area 3 minimally processed data

Filename: J967-mag-Area3-proc.xcp  
 Northwest corner: 494112.72, 105094.92 m  
 Southeast corner: 494204.37, 104900.67 m  
 Dimensions  
 Survey Size (meters): 91.7 m x 194 m  
 X&Y Interval: 0.15 m  
 Source GPS Points: Active: 357675, Recorded: 357681

Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 2.05  
 Mean: -0.37  
 Median: 0.06  
 Composite Area: 1.7803 ha  
 Surveyed Area: 1.2871 ha

### 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

### Area 3 filtered data

Filename: J967-mag-Area3-proc-hpf.xcp  
 Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.84  
 Mean: -0.35

### GPS based Proce5

- 1 Base Layer.
- 2 Unit Conversion Layer (UTM to OSGB36).
- 3 DeStripe Median Traverse:
- 4 High pass Uniform (median) filter: Window dia: 253
- 5 Clip from -3.00 to 3.00 nT

### Area 4 minimally processed data

Filename: J967-mag-Area4-proc.xcp  
 Northwest corner: 494084.56, 104880.37 m  
 Southeast corner: 494233.81, 104689.57 m  
 Dimensions  
 Survey Size (meters): 149 m x 191 m  
 X&Y Interval: 0.15 m  
 Source GPS Points: Active: 572338, Recorded: 572344

### Stats

Max: 3.32  
 Min: -3.30  
 Std Dev: 0.81  
 Mean: 0.02  
 Median: 0.00  
 Surveyed Area: 2.0629 ha

### 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

### Stats

Max: 3.32  
 Min: -3.30  
 Std Dev: 0.86  
 Mean: 0.02  
 Median: 0.01

### Area 4 filtered data

Filename: J967-mag-Area4-proc-hpf.xcp  
 GPS based Proce5  
 1 Base Layer.  
 2 Unit Conversion Layer (UTM to OSGB36).  
 3 DeStripe Median Traverse:  
 4 High pass Uniform (median) filter: Window dia: 250  
 5 Clip from -3.00 to 3.00 nT

### Area 5 minimally processed data

Filename: J967-mag-Area5-proc.xcp  
 Northwest corner: 494068.73, 104694.48 m  
 Southeast corner: 494316.08, 104357.73 m  
 Dimensions  
 Survey Size (meters): 247 m x 337 m  
 X&Y Interval: 0.15 m  
 Source GPS Points: Active: 416992, Recorded: 416998

Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.12  
 Mean: 0.01  
 Median: 0.02

Composite Area: 8.3295 ha  
 Surveyed Area: 1.4809 ha

### 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

### Area 5 filtered data

Filename: J967-mag-Area5-proc-hpf.xcp  
 GPS based Proce5  
 1 Base Layer.  
 2 Unit Conversion Layer (UTM to OSGB36).  
 3 DeStripe Median Traverse:  
 4 High pass Uniform (median) filter: Window dia: 251  
 5 Clip from -3.00 to 3.00 nT

### Stats

Max: 3.32  
 Min: -3.30  
 Std Dev: 1.06  
 Mean: 0.02

## 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 PDF copy will be supplied to the West Sussex Historic Environment Record with greyscale images and abstraction layers made available 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      | J967-mag-[area number/name].asc<br>J967-mag-[area number/name].xcp<br>J967-mag-[area number/name]-proc.xcp | Raw data as ASCII CSV<br>TerraSurveyor raw data<br>TerraSurveyor minimally processed data |
| Graphics  | J967-mag-[area number/name]-proc.tif                                                                       | Image in TIF format                                                                       |
| Drawing   | J967-[version number].dwg                                                                                  | CAD file in 2018 dwg format                                                               |
| Report    | J967 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                                             |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Anomalies with an uncertain origin</b>         |                                                                                                   |                                                           |
| 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)                     |
| AS-ABST MAG POS UNCERTAIN                         |  255,127,0     | Polygon (cross hatched ANSI37)                            |
| <b>Anomalies relating to land management</b>      |                                                                                                   |                                                           |
| AS-ABST MAG BOUNDARY                              |  127,0,0       | Line, polyline or polygon (solid or cross hatched ANSI37) |
| <b>Anomalies with an agricultural origin</b>      |                                                                                                   |                                                           |
| AS-ABST MAG AGRICULTURAL                          |  Green 0,255,0 | Line or polyline                                          |
| <b>Anomalies associated with magnetic debris</b>  |                                                                                                   |                                                           |
| 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)                     |
| <b>Anomalies with a modern origin</b>             |                                                                                                   |                                                           |
| AS-ABST MAG DISTURBANCE                           |  132, 132, 132 | Polygon (hatched ANSI31)                                  |
| AS-ABST MAG SERVICE                               |  132, 132, 132 | Line or polyline                                          |
| <b>Anomalies with a natural origin</b>            |                                                                                                   |                                                           |
| AS-ABST MAG NATURAL FEATURES                      |  204,178,102   | Polygon (cross hatched ANSI37)                            |

Table 3: CAD layering

## Appendix F – copyright and intellectual property

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Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex

Map of survey area



● Survey location

Site centred on OS NGR  
SU 94165 04710

SCALE 1:25 000



SCALE TRUE AT A3

DRAWN BY  
KTD

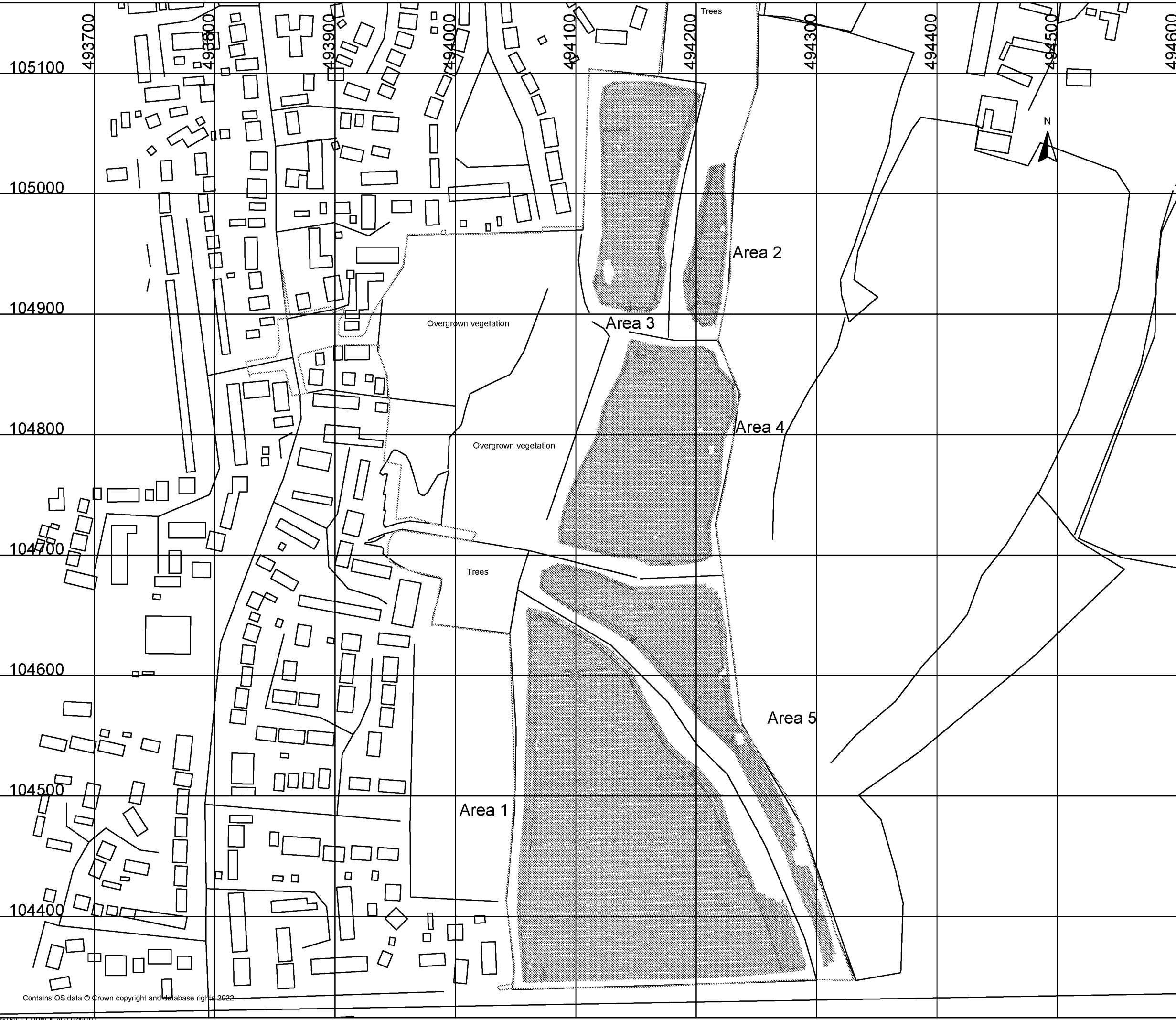
CHECKED BY  
DJS

FIG 01



Development boundary

Surveyable area





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Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex

Referencing information

Referencing grid to OSGB36 datum at 100m intervals

 494100 104600

 Survey tracks

 Survey track start

 Survey track stop

 Development boundary

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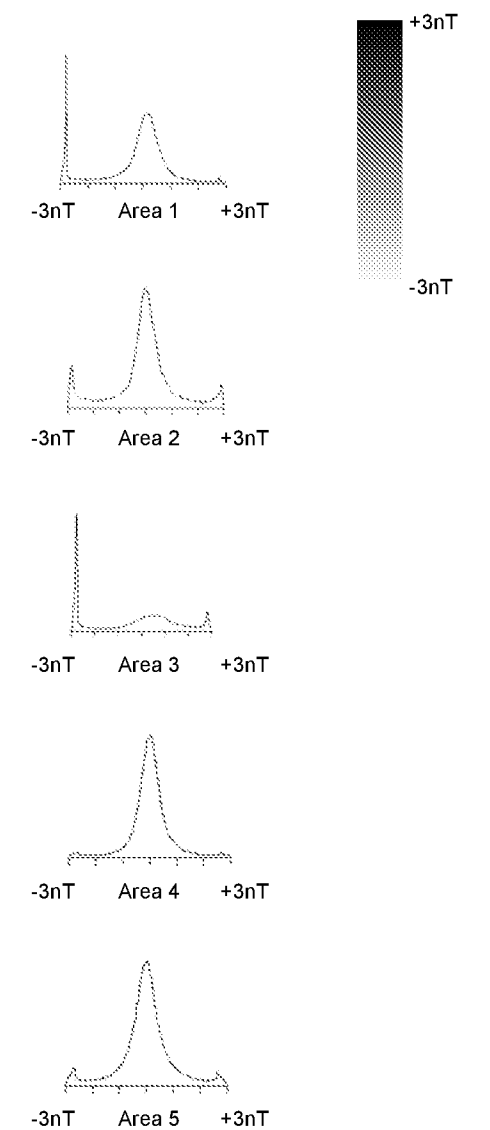
DRAWN BY  
KTD

CHECKED BY  
DJS

FIG 02

**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of minimally  
processed magnetometer data**



SCALE 1:3000



SCALE TRUE AT A3

DRAWN BY  
**KTD**

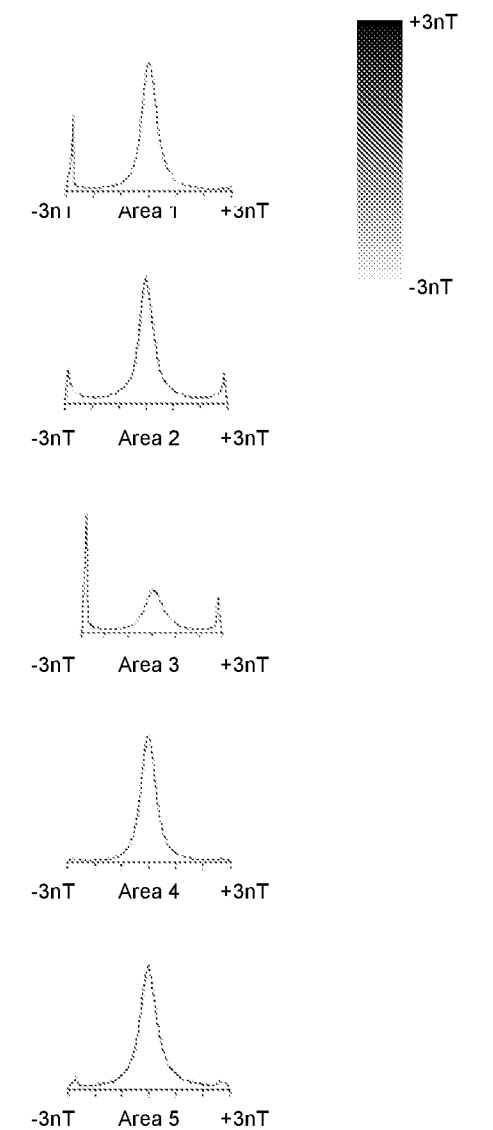
CHECKED BY  
**DJS**

**FIG 03**



**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of  
filtered magnetometer data**



SCALE 1:3000



SCALE TRUE AT A3

DRAWN BY  
**KTD**

CHECKED BY  
**DJS**

**FIG 04**

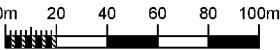


**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Abstraction and interpretation of  
magnetic anomalies**

- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - former field boundary
- Linear anomaly - of agricultural origin
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Variable magnetic response - of natural origin
- 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 1:3000



SCALE TRUE AT A3

DRAWN BY  
KTD

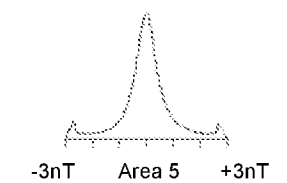
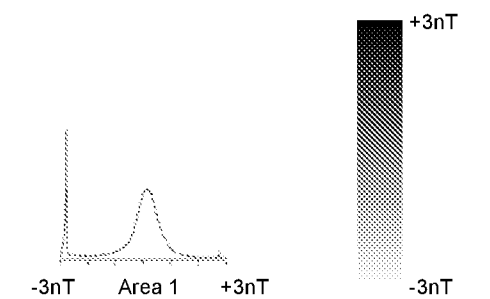
CHECKED BY  
DJS

FIG 05

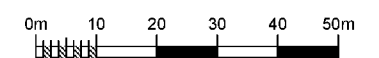


**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of minimally  
processed magnetometer data**



**SCALE    1:1250**



SCALE TRUE AT A3

DRAWN BY  
**KTD**

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**DJS**

**FIG 06**

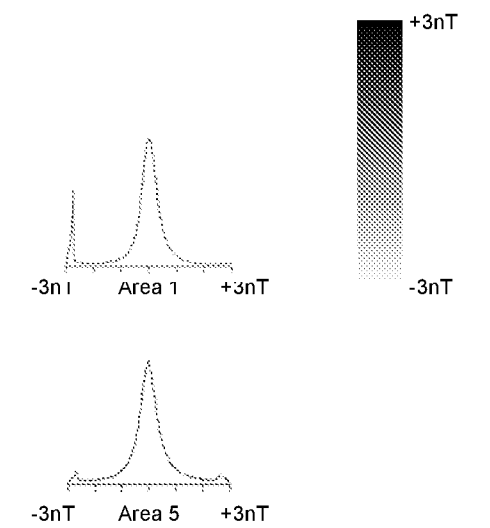
Trees

Area 1

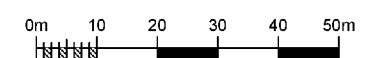
Area 5

**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of  
filtered magnetometer data**



**SCALE 1:1250**



SCALE TRUE AT A3

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**KTD**

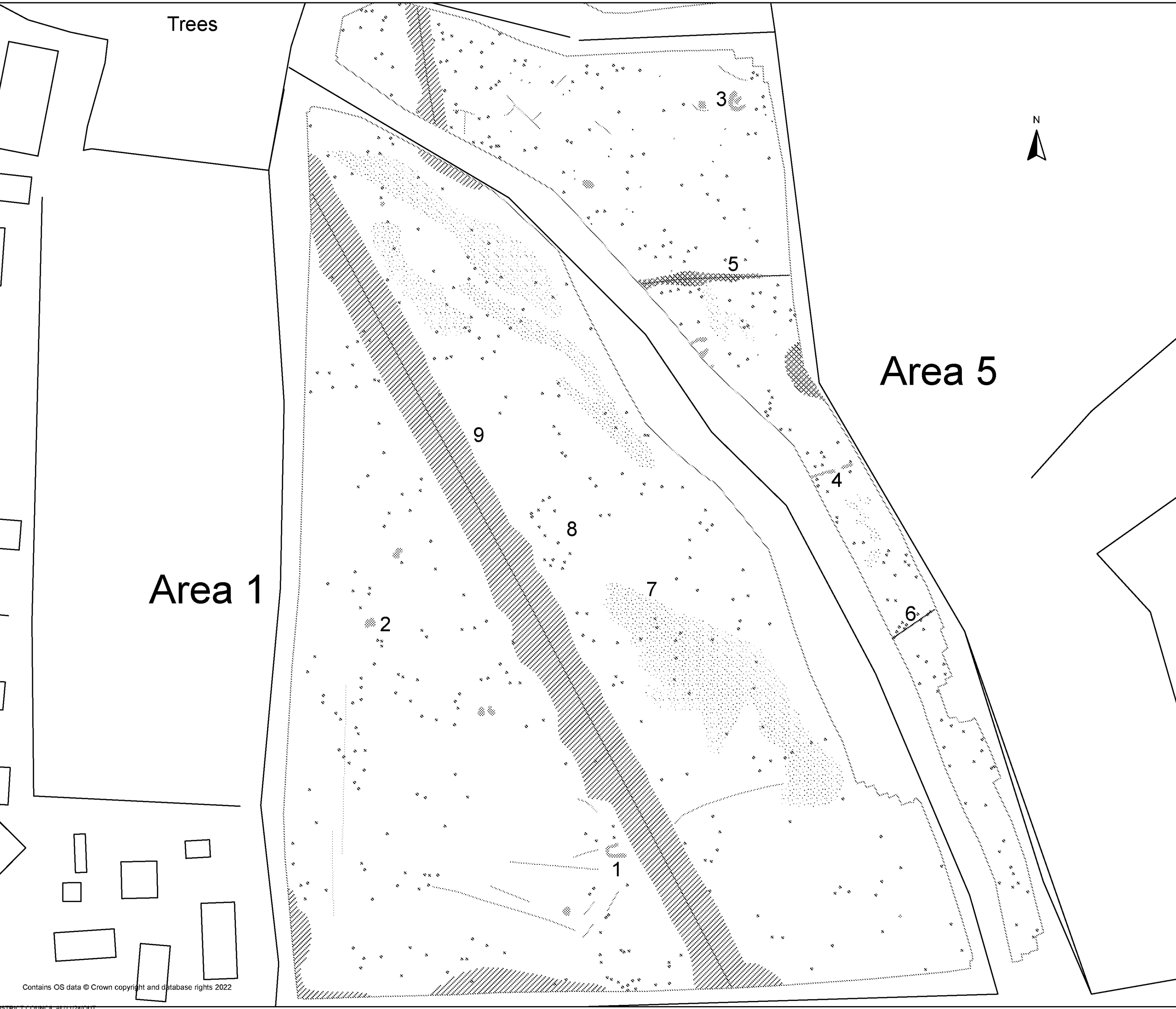
CHECKED BY  
**DJS**

**FIG 07**

Trees

Area 1

Area 5



Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex

Abstraction and interpretation of  
magnetic anomalies - south

- 

Positive linear anomaly - possible ditch-like feature
- 

Positive linear anomaly - former field boundary
- 

Linear anomaly - of agricultural origin
- 

Discrete positive response - possible pit-like feature
- 

Variable magnetic response - of natural origin
- 

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

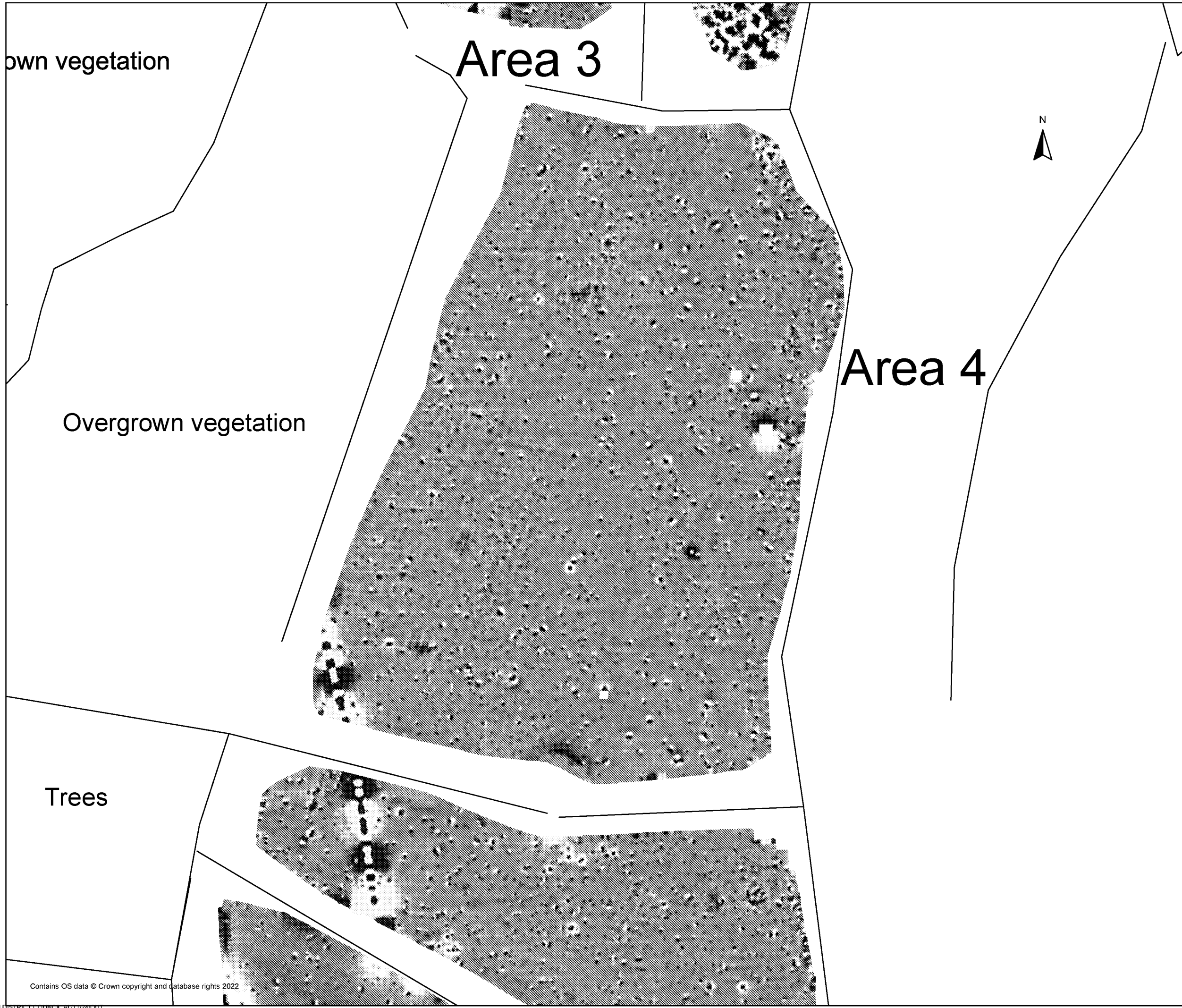
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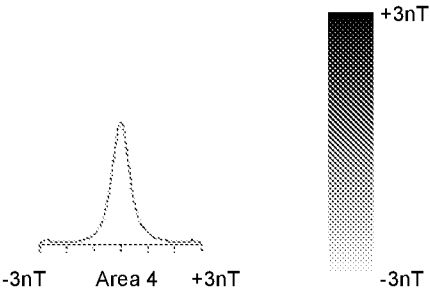
|                 |                   |        |
|-----------------|-------------------|--------|
| DRAWN BY<br>KTD | CHECKED BY<br>DJS | FIG 08 |
|-----------------|-------------------|--------|



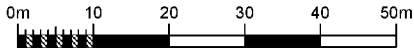
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Land at Westergate  
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West Sussex**

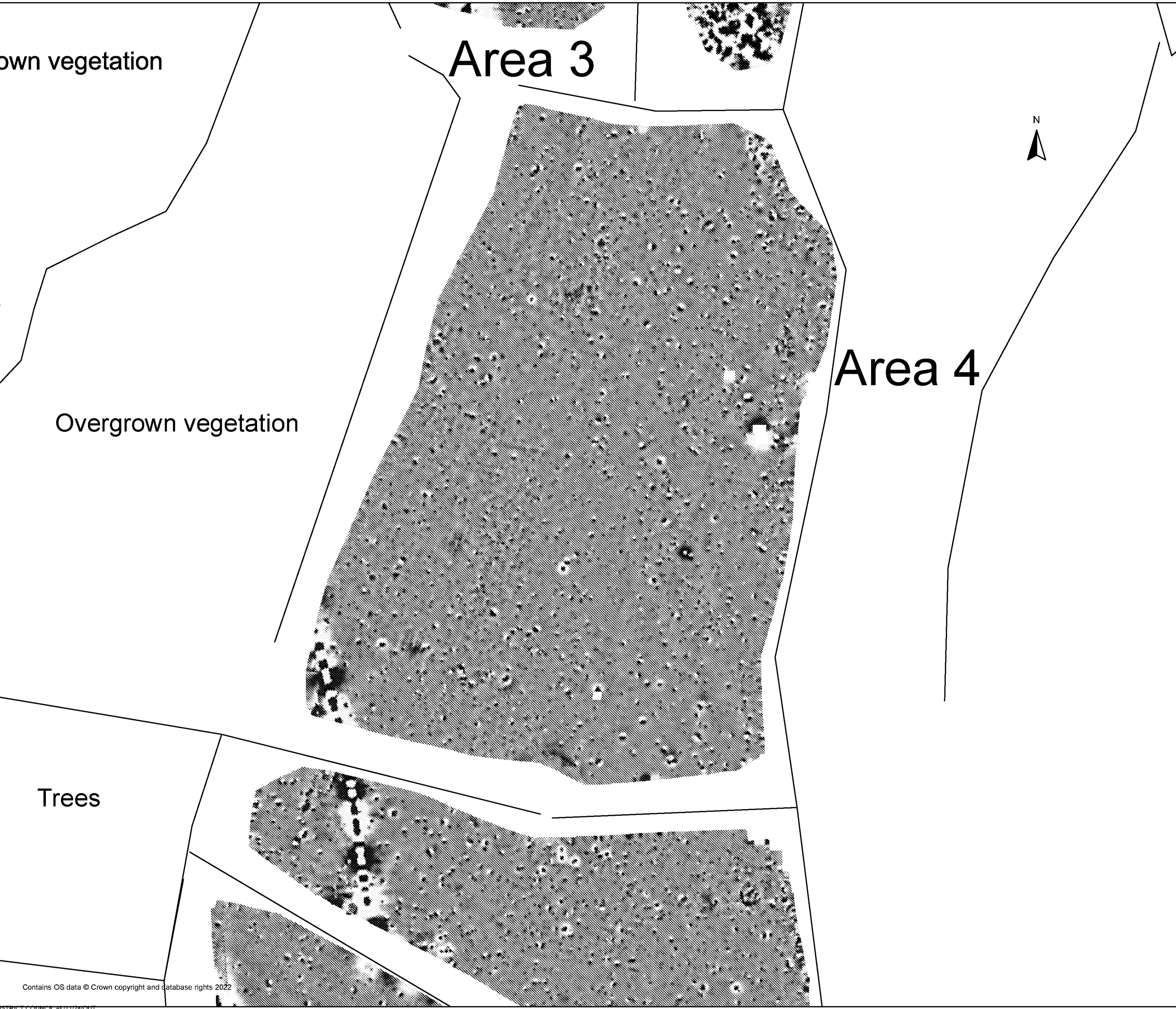
**Greyscale plot of minimally  
processed magnetometer data -  
centre**



SCALE 1:1000

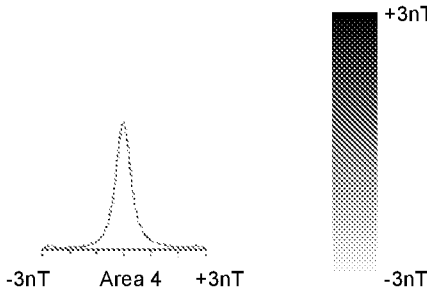


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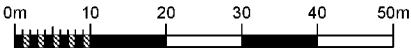


**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of  
filtered magnetometer data -  
centre**



**SCALE 1:1000**

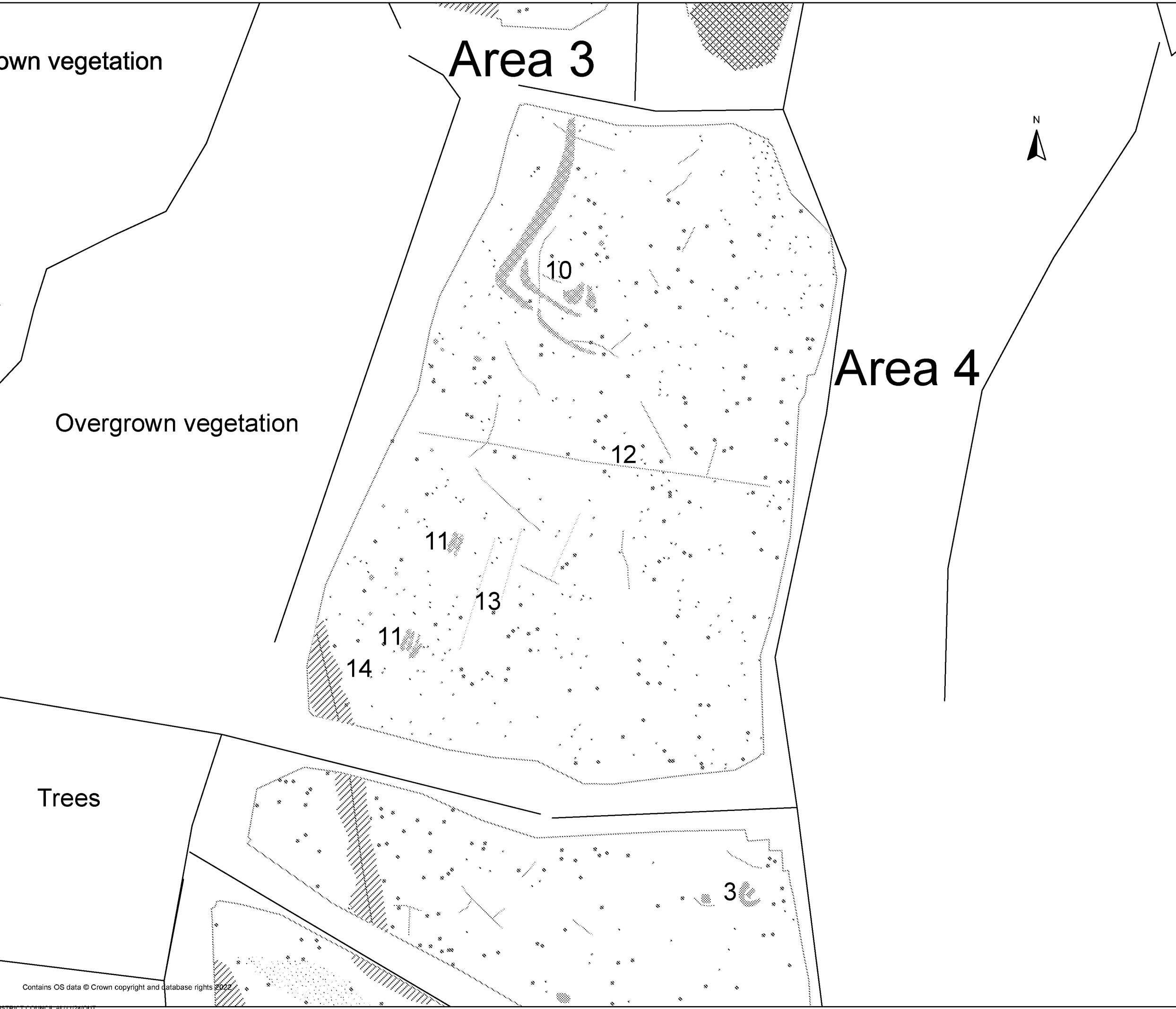


SCALE TRUE AT A3

DRAWN BY  
**KTD**

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**DJS**

**FIG 10**



Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex

Abstraction and interpretation of  
magnetic anomalies - centre

- 

Positive linear anomaly - possible ditch-like feature
- 

Linear anomaly - of agricultural origin
- 

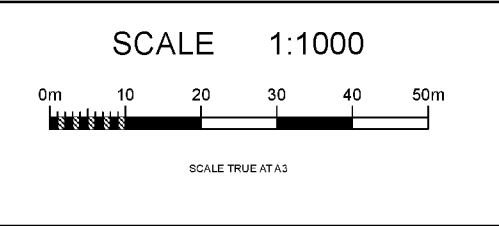
Discrete positive response - possible pit-like feature
- 

Positive anomaly - magnetically enhanced material
- 

Magnetic disturbance from ferrous material
- 

Strong multiple dipolar linear anomaly - pipeline / cable / service
- 

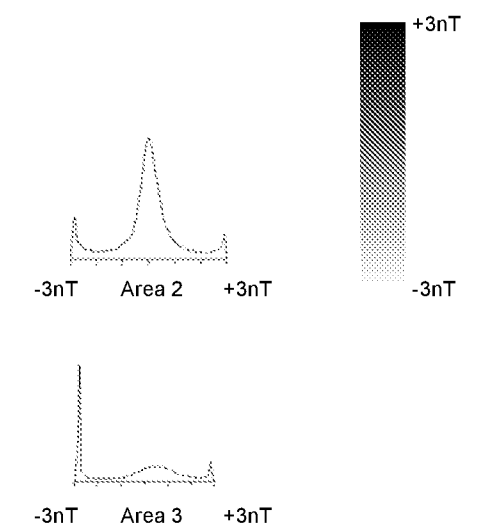
Strong dipolar anomaly - ferrous object





**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of minimally  
processed magnetometer data -  
north**

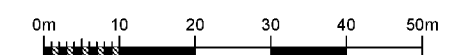


Area 2

Area 3

own vegetation

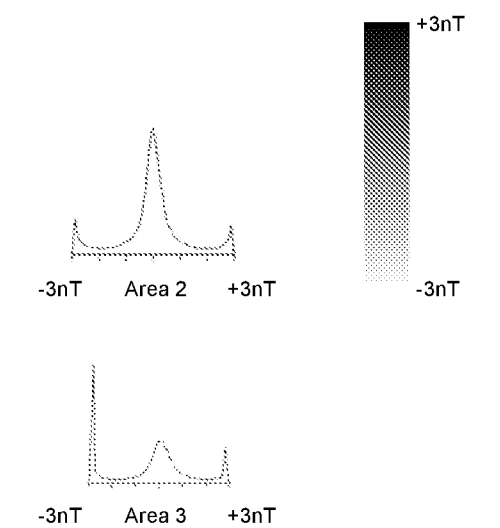
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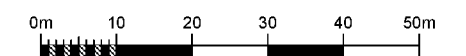
SCALE TRUE AT A3

**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Greyscale plot of  
filtered magnetometer data -  
north**



**SCALE 1:1000**

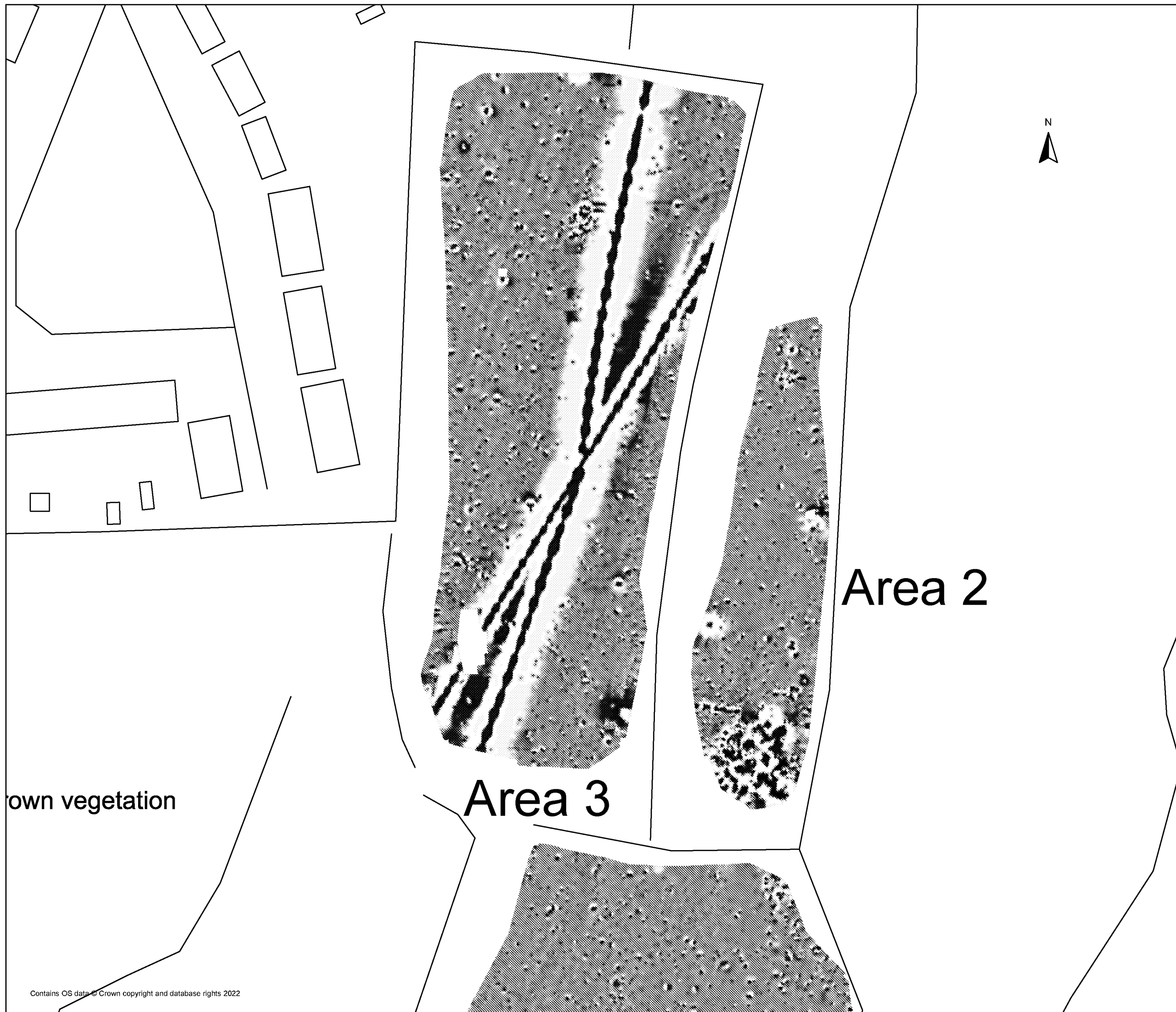


SCALE TRUE AT A3

DRAWN BY  
**KTD**

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**DJS**

**FIG 13**



own vegetation

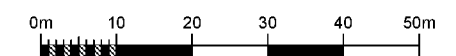


**Geophysical Survey  
Land at Westergate  
Aldingbourne  
West Sussex**

**Abstraction and interpretation of  
magnetic anomalies - north**

- Linear anomaly - of agricultural origin
- Magnetic debris - spread of magnetically thermoremanent/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000



SCALE TRUE AT A3

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FIG 14

