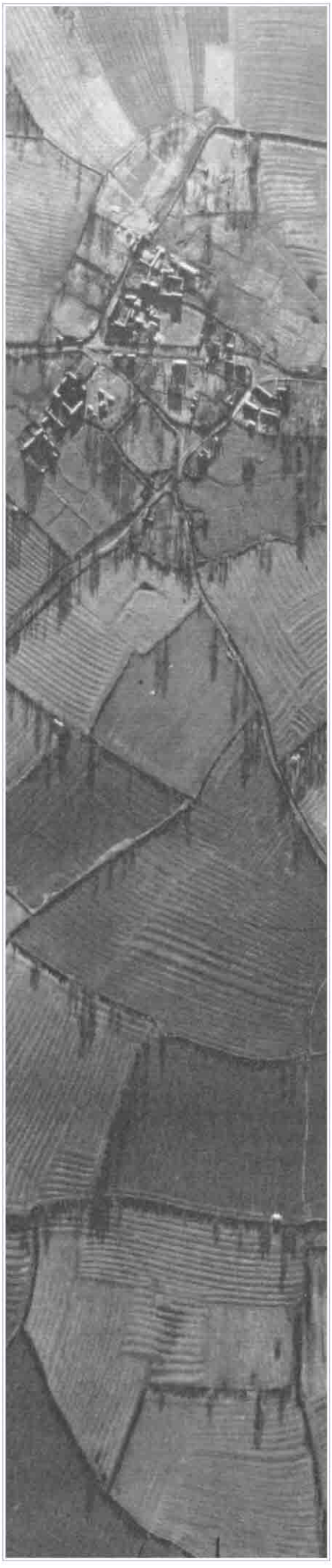

ARCHAEOLOGICAL SURVEYS LTD

GEOPHYSICAL SURVEY REPORT

Overton Hill
Avebury

Magnetometer Survey

for

Oxford Archaeology

David Sabin and Kerry Donaldson

October 2008

Ref. no. 250

ARCHAEOLOGICAL SURVEYS LTD

Overton Hill
Avebury

Magnetometer Survey

for

Oxford Archaeology

Fieldwork by David Sabin
Report by David Sabin BSc (Hons) MIFA and Kerry Donaldson BSc (Hons)

Survey date - **October 3rd and 4th 2008**

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SUMMARY

A geophysical survey was carried out over 2.5ha along the proposed route of an underground electricity cable close to The Sanctuary and Bronze Age barrows on Overton Hill near Avebury, Wiltshire. The cable route passes 100m to the west of the Sanctuary and possibly extends across the purported line of the West Kennet Avenue to the south of the A4. The proposed route also lies between two Bronze Age barrows. The magnetometer survey located two positive curvilinear anomalies that relate to the outer ditches of the Bronze Age barrows. Several discrete low magnitude responses were also located which may indicate pit-like features, although an archaeological origin could not be confidently attributed to them. The presence of two buried services to the west of the Sanctuary, along the purported line of the West Kennet Avenue, caused widespread strong magnetic disturbance which could prevent the location of archaeological features.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Oxford Archaeology, on behalf of Scottish and Southern Energy Plc, to undertake a geophysical survey along the proposed route of an underground electricity cable within the vicinity of The Sanctuary, Avebury. The work forms part of a scheme to remove visually intrusive elements within Avebury World Heritage Site. The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Oxford Archaeology (2008).

1.1.2 The complete survey area lies within Avebury World Heritage Site designated in 1986 under the UNESCO World Heritage Convention. A licence to carry out geophysical survey was granted by English Heritage by virtue of powers contained in Section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983). The licence covers The Sanctuary and Monuments within Avebury National Trust Estate, Overton Hill, Avebury, Kennet, Wiltshire (Case no.SL00000359, Monument no.21761).

1.2 Survey aims and techniques

1.2.1 The aims of the survey are set out in the WSI (Oxford Archaeology, 2008). It is hoped that the survey will 'enhance, in detail, the physical boundaries of known and unknown archaeological features near to, and within, the line of the proposed works'. The survey 'would provide information to allow this and any future works at The Sanctuary to be mitigated'.

1.2.2 Magnetometry is a highly effective and efficient means of archaeological prospection recommended for survey over large areas. The survey and report

generally follow the recommendations set out by English Heritage, 2008: *Geophysical survey in archaeological field evaluation*.

1.3 Site location, description and survey conditions

1.3.1 The survey area is formed by a corridor centred approximately over the proposed route of the underground cable, see Figures 01 and 02. The minimum width of the corridor is 30m. The route is separated into five different areas. Areas are labelled 1-5 from west to east, and each area represents survey data collected across 30m wide grids of similar orientation. Areas 1- 3 lie within the parish of Avebury, Areas 4 and 5 are located within the parish of West Overton.

1.3.2 Area 1, lying at the western end of the route, starts at a lane linking the village of East Kennet to the A4 and is approximately 180m long and 30m wide. The field rises towards the north east and the surface consisted of bare earth that had been rolled and drilled.

1.3.3 Area 2 links the eastern end of Area 1 to the A4 at its northern end. The area crosses from bare earth to grassland, the field boundary defined by a dilapidated wire fence. The Sanctuary lies approximately 90m to the east of the survey corridor. The grassland area contains an electricity pole and transformer supported by steel cables. The survey corridor is 120m long and 30m wide.

1.3.4 Area 3 runs along the northern side of the A4 starting opposite Sarsen Kennels at its western end and finishing at The Ridgeway at its eastern end, see Plate 1. The field surface mainly consisted of bare earth which had been rolled and drilled. The eastern end of the area crossed into rough grassland and weeds that have grown over debris associated with a demolished cafe. The survey area is approximately 300m from west to east and narrows towards the west from a maximum width of 60m.

Plate 1: Area 3 on Overton Hill looking towards the west

1.3.5 Area 4 starts at The Ridgeway, opposite the end of Area 3, and continues west south west to pass between two barrows, see Plate 2. The area is approximately 120m long and 30m wide. Ground cover consisted of long grass with patches of nettles and thistles.

Plate 2: Area 4 crossing between barrows to the east of The Ridgeway

1.3.6 Area 5 starts at the south eastern end of Area 4 and runs parallel to the A4 as far as a pump house. The area lies within two fields, both with grass cover, which are separated by wire fencing and a hedgerow. This section is approximately 150m long and 30m wide.

1.3.7 The ground conditions across most of the site were considered to be favourable for the collection of magnetometry data. However, poor survey conditions were encountered towards the eastern end of Area 3 due to the presence of scrubby growth over the site of a demolished cafe. Long grass and areas of nettles and thistles also created poor conditions within Area 4.

1.3.8 Weather conditions during the first day of survey, October 3rd, were breezy with prolonged sunny periods and occasional hail and sleet showers. Conditions on the second day of survey, October 4th, were fine with light winds.

1.4 Site history and archaeological potential

1.4.1 It is beyond the scope of this report to comment in detail on the large number of monuments within the Avebury World Heritage Site. A number of archaeological monuments and features lie in close proximity to the survey areas and these are outlined within the Written Scheme of Investigation (Oxford Archaeology, 2008). The information set out below has been taken directly from that document with additional information from the Wiltshire SMR.

SMR number	SM number	Description	NGR
SMR: SU16NW611		An undated round barrow damaged by the northern edge of the A4, located on the southern edge of the survey area. Now built over.	411850 168080
SMR: SU16NW612		An undated round barrow damaged by the northern edge of the A4, located on the southern edge of the survey area.	411810 168150
SMR: SU16NW659	SM21719	Bronze Age bell barrow surrounded by a berm or platform and an outer ditch. Proposed cable route passes between this and SU16NW660.	411920 168080
SMR: SU16NW660	SM21719	Bronze Age bell barrow which contained a cremation burial and is also surrounded by a berm and outer ditch.	411940 168130
SMR:SU16NW661	SM21719	Bowl barrow situated between SU16NW660 and SU16NW662 to form a triple barrow.	411950 168140
SMR:SU16NW662.	SM21719	Bronze Age bell barrow containing primary and secondary human burials.	411960 168160
SMR: SU16NW693		Prehistoric trackway crosses survey area from north to south (The Ridgeway).	
SMR: SU16NW756		A probable ring ditch observed on aerial photographs, possibly indicating the site of another round barrow. Located on the southern edge of the survey area.	411670 168110
SMR: SU16NW106	SM28131/01-02	A stone avenue extending from the henge monument at Avebury to the Sanctuary on Overton Hill for a distance of approximately 2.3 km. Originally formed by two, roughly parallel, rows of stones. The rows on average 15m apart with the stones sited approximately 20m apart. The West Kennet Avenue was drawn by 1723 extending northwestwards from the Sanctuary. The survey area may cross this feature perpendicularly (Area 2).	
SMR: SU16NW696		Located at the south west corner of the survey area is an undated enclosure ditch visible as a faint cropmark.	411550 168040
SMR: SU16NW555		An undated cemetery located immediately east of the Sanctuary and just outside the eastern extent of the southern area.	411840 168020
SMR:SU16NW464		Possible medieval village earthworks 100m west of the southern area.	411560 168100
SMR: SU16NW657	SM 21722	Bronze age round barrow situated to the south east of the Sanctuary.	411890 167970
SMR: SU16NW658		Site of barrow, probably excavated in 1720 by Stukeley and contained an unburnt skeleton with amber and glass beads.	411900 168030
SMR: SU16NW610	SM 21762	Although scheduled by English Heritage in 1994	411830 167930

		as a bowl barrow, this circular feature, located approximately 100m to the east of Area 2, is believed to have been a windmill mound by the OS.	
SMR: SU16NW107	SM21761	The Sanctuary itself is located 100m east of the southern area (Area 2) and comprises of 2 concentric circles of stones and 4 circles of postholes with a common centre.	411820 168020

Table 1: List of archaeological monuments and features within and surrounding the survey area

1.5 Geology and soils

1.5.1 The underlying geology is chalk (BGS 2001).

1.5.2 The overlying soils across the site are from the Andover 1 association which are brown rendzinas. These consist of shallow, well drained calcareous silty soils over chalk on slopes and crests with deep calcareous and non-calcareous fine silty soils in valley bottom and striped soil patterns locally. (Soil Survey of England and Wales 1983)

1.5.3 Detailed magnetometer surveys carried out over chalk often achieve good results due to the clear contrast between the magnetically enhanced fill of the archaeological features and the subsoil or chalk into which they are cut.

2 METHODOLOGY

2.1 Technical synopsis

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

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

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

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

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a Bartington Grad601-2 gradiometer. This instrument effectively measures a magnetic gradient between two fluxgate sensors mounted vertically 1m apart. Two sets of sensors are mounted on a single frame 1m apart horizontally. The instrument is extremely sensitive and is able to measure magnetic variation to 0.1nanoTesla (nT). All readings are saved to an integral data logger for analysis and presentation

2.2.2 The instrument is operated according to the manufacturer's instructions with consideration given to the local conditions. An adjustment procedure is required, prior to collection of data, in order to balance the sensors and remove the effects of the Earth's magnetic field; further adjustment is required during the survey due to instrument drift often associated with temperature change. It may be very difficult to obtain optimum balance for the sensors due to localised magnetic vectors that can be associated with large ferrous objects, geological/pedological features, 'magnetic' debris within the topsoil and natural temperature fluctuations. Imperfect balance results in a heading error often visible as striping within the data; this can be effectively removed by software processing and generally has little effect on the data unless extreme.

2.2.3 The Bartington gradiometer undergoes regular servicing and calibration by the manufacturer. A current assessment of the instrument is shown in Table 1 below.

Date of calibration/service	16th May 2008
Sensor type	Bartington Grad - 01 – 1000 Nos. 084 and 085
Bandwidth	12Hz (100nT range) both sensors
Noise	<100pT peak to peak
Adjustable errors	<2nT

Table 2: Bartington fluxgate gradiometer sensor calibration results

The instrument was considered to be in good working order prior to the survey with no known faults or defects.

2.2.4 Data were collected at 0.25m centres along traverses 1m apart. The survey area was separated into 30m by 30m grids giving 3600 recorded measurements per grid. This sampling interval is very effective at locating archaeological features and is the recommended methodology for archaeological prospection (English Heritage, 2008).

2.2.5 The survey grids were set out to the Ordnance Survey OSGB36 datum using a Penmap RTK GPS. The GPS is used in conjunction with Leica's Smartnet service where positional corrections are sent via a mobile telephone link. Positional accuracy of around 10 – 20mm is possible using the system.

2.3 Data processing and presentation

2.3.1 Magnetometry data downloaded from the Grad 601-2 data logger are analysed and processed in specialist software known as ArcheoSurveyor. The software allows greyscale and trace plots to be produced for presentation and display. Survey grids are assembled to form an overall composite of data (composite file) creating a dataset of the complete survey area. Appendix B contains specific information concerning the survey and data attributes and is derived directly from ArcheoSurveyor; this should be used in conjunction with information provided by Figure 02.

2.3.2 Only minimal processing is carried out in order to enhance the results of the survey for display. Raw data are always analysed as processing can modify anomalies. The following schedule sets out the data and image processing used in this survey:

- clipping of the raw data at ±30nT to improve greyscale resolution,
- clipping of processed data at ±3nT to enhance low magnitude anomalies,
- zero median/mean traverse is applied in order to balance readings along each traverse.

(Reference should be made to Appendix B for details on the processing used for each survey area).

Data processing explanation notes:

Clipping
Clipping replaces the values outside the specified minimum and maximum with those values. The process is useful for displaying detail as extreme values are removed allowing greyscale shades to be allocated to a narrower range of values which improves the definition of anomalies.

Zero Median/Mean Traverse
The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise slight differences between the set-up and stability of gradiometer sensors and can remove striping.

2.3.3 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. 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 assessment of features within each survey area. Where further

interpretation is possible, or where a number of possible origins should be considered, more detailed discussion is set out in Section 4.

2.3.4 The main form of data display used in this report is the greyscale plot. Magnetic data are also displayed as a trace plot. Both 'raw' and 'processed' data have been shown followed by an abstraction and interpretation plot.

2.3.5 Graphic raster images in bitmap format (.BMP) are initially prepared in ArcheoSurveyor. Regardless of survey orientation, data captured along each traverse are displayed and processed by ArcheoSurveyor from left to right. Prior to displaying against base mapping, raster graphics require rotating anticlockwise to restore north to the top of the image. Greyscale images are rotated by AutoCAD, traceplots are rotated using ArcheoSurveyor. Rotated traceplots are derived from interpolated datasets and can be considered as representative only as the raw data will have been modified to a minor degree.

2.3.6 The raster images are combined with base mapping using AutoCAD LT 2007 creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.. A digital archive including raster images is produced with this report allowing separate analysis if necessary, see Appendix C below.

3 RESULTS

3.1 General overview

3.1.1 The detailed magnetic survey was carried out over a total of five survey areas covering an area of 2.5ha. Geophysical anomalies located can be generally classified as positive curvilinear anomalies of archaeological origin, positive linear and discrete anomalies of an uncertain 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 will be outlined below with subsequent discussion in Section 4.

3.1.2 Data quality generally appears good. Surface conditions were poor within Area 4 due to the presence of thistles, nettles and long grass but this does not appear to have been detrimental to the data. A significant zone of magnetic disturbance, caused by underground services, was located across Area 2 immediately to the south of the A4. Wire fencing and services adjacent to the A4 has caused widespread, though relatively low magnitude, magnetic disturbance along the southern side of Area 5. The eastern end of Area 3 contains much magnetic disturbance associated with the remains of a demolished cafe.

3.1.3 The listing of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross reference to the abstraction and interpretation plot. Sub-headings are then used to group anomalies with similar characteristics for each survey area.

Anomalies with an archaeological origin

Positive anomalies

The category is used where anomalies have the characteristics of a range of archaeological features such as pits, ring-ditches, enclosures etc..

Anomalies with an uncertain origin

Positive anomalies
Negative anomalies 

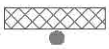
The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features but equally relatively modern features, geological/pedological features and agricultural features should be considered.

Anomalies with a modern origin

Magnetic disturbance
Strong multiple dipolar linear anomaly - pipeline/service 

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 such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present.

Anomalies associated with magnetic debris

Magnetic debris
Strong discrete dipolar anomaly 

The response often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. Magnetic debris often occurs where there has been dumping or ground make-up and is related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and may therefore be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to

ferrous objects within the topsoil.

3.2 Areas 1 and 2

Centred on OS NGR 411675 167975 see Figures 03, 06, 09 and 12.

Anomalies with an uncertain origin

(1) – Very weak fragmented positive linear anomalies.

(2) – Discrete positive anomalies may represent pit-like features but an anthropogenic origin cannot be determined.

Anomalies associated with magnetic debris

(3) – Strong discrete dipolar anomalies are responses to ferrous objects and material in the topsoil.

Anomalies with a modern origin

(4 & 5) – Strong multiple dipolar linear anomalies are a response to underground services or pipelines and have resulted in widespread magnetic disturbance in the north of Area 2.

3.3 Area 3

Centred on OS NGR 411720 168115 see Figures 04, 07, 10 and 13.

Anomalies with an uncertain origin

(6) – A positive linear anomaly extending across the centre of the survey area and oriented north north east to south south west. It is possible that this relates to a cut feature; however, an archaeological origin cannot be confidently attributed.

(7) – A positive curvilinear anomaly situated towards the western end of the survey area.

(8) – Low magnitude and fragmented positive linear anomalies.

(9) – Discrete positive responses, some of which appear to be in groups, may indicate pit-like features.

(10) – Positive anomalies that are more elongated and slightly stronger than anomalies (9).

Anomalies associated with magnetic debris

(11) – Strong discrete dipolar anomalies are responses to ferrous or magnetically

thermoremnant material within the survey area.

(12) – Strong dipolar responses to magnetically thermoremnant and ferrous material associated with the former cafe that previously existed in this area.

Anomalies with a modern origin

(13) – Magnetic disturbance from ferrous material.

3.4 Areas 4 and 5

Centred on OS NGR 412015 168105 see Figures 05, 08, 11 and 14.

Anomalies with an archaeological origin

(14) – A positive curvilinear anomaly likely to represent an outer barrow ditch. Although not recorded on the base mapping, it is similar to the partial outer ditch recorded on the most northerly of this barrow formation.

(15) – Positive curvilinear anomaly relating to the outer ditch of the most southerly barrow.

Anomalies with an uncertain origin

(16) – Discrete low magnitude positive responses may indicate pit-like features.

(17) – Diffuse positive anomalies may relate to cut features but this is not certain.

Anomalies associated with magnetic debris

(18) – Strong discrete dipolar anomalies relate to ferrous or magnetically thermoremnant material within the topsoil.

(19) – Patches of magnetic debris are likely to relate to spreads of magnetically thermoremnant material.

Anomalies with a modern origin

(20) – Zones of magnetic disturbance have been caused by the presence of ferrous material within surrounding fencing.

(21) – Multiple dipolar linear anomaly, between the two barrows, may be a response to the remains of wire fencing.

4 DISCUSSION

4.1

4.1.1 Within the eastern part of the survey in Area 4, an outer ditch to barrow SU16NW660 has been located. This feature is not indicated on base mapping; however, the barrow is part of a triple barrow grouping comprising two bell barrows flanking a smaller bowl barrow. The outer ditch is similar to one recorded on base mapping for SU16NW662, to the north, which is shown as a partial ditch surrounding the northern side of the barrow. It is possible that this feature is an unrecorded partial outer ditch on the southern side of the triple barrow group.

4.1.2 Area 3 contains the location of a former barrow, SU16NW661, and a possible ring-ditch, SU16NW756. The former barrow has been destroyed and the strong magnetic debris in this area has obscured any subtle anomalies. There is no evidence for the location of the possible ring-ditch within the results of the survey.

4.1.3 The West Kennet Avenue is known to have extended along the route of the A4 from the east of West Kennet (Smith, 1965). It is then purported to have continued to the south of the A4 towards The Sanctuary. William Stukeley drew and planned both the West Kennet Avenue and The Sanctuary in 1723 (Malone, 1989). Area 2 crosses this route although unfortunately, a widespread zone of magnetic disturbance caused by the presence of two underground services may have obscured more subtle features.

5 CONCLUSION

5.1

5.1.1 The magnetometry survey along the proposed cable route has not located anomalies that can be readily identified as of archaeological potential with the exception of two curvilinear positive anomalies associated with extant barrows. However, it should be considered that a number of anomalies could not be confidently interpreted and these may relate to features of archaeological significance. Notable anomalies that fall within the uncertain classification are a group of possible pit-like features within Area 3, to the north of the A4.

5.1.2 Magnetic disturbance and magnetic debris, located within Areas 2 and 3 respectively, may well obscure features. Area 2 possibly crosses the route of the West Kennet Avenue but severe magnetic disturbance due to underground services was located over a significant proportion of the survey zone. The widespread magnetic debris at the eastern end of Area 3, associated with a demolished cafe, may have obscured features immediately to the west of The Ridgeway.

6 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 gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature. If no enhanced feature is present the field measured by both sensors will be similar and the difference close to zero.

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 – survey and data information

Area 1 raw

COMPOSITE
Filename: Area1-raw.xcp
Instrument Type: Grad 601 (Magnetometer)
Units: nT
Surveyed by: on 04/10/2008
Assembled by: on 10/10/2008
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Origin: Zero

Dimensions
Composite Size (readings): 120 x 180
Survey Size (meters): 30 m x 180 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 3.50
Mean: 0.39

Processes: 2
1 Base Layer
2 Clip from -30 to 30

Source Grids: 6
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd
5 Col:0 Row:4 grids\05.xgd
6 Col:0 Row:5 grids\06.xgd

Area 1 processed

COMPOSITE
Filename: Area1-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.79
Mean: 0.02

Processes: 4
1 Base Layer
2 Clip from -30 to 30
3 DeStripe Median Traverse: Grids: All
4 Clip from -3 to 3

Source Grids: 6 as above

Area 2 raw

COMPOSITE
Filename: Area2-raw.xcp
Instrument Type: Grad 601 (Magnetometer)
Units: nT
Surveyed by: on 04/10/2008
Assembled by: on 10/10/2008
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Origin: Zero

Dimensions
Composite Size (readings): 120 x 120
Survey Size (meters): 30 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 14.38
Mean: -1.03

Processes: 2
1 Base Layer
2 Clip from -30 to 30

Source Grids: 4
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd

Area 2 processed

COMPOSITE
Filename: Area2-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.54
Mean: 0.10

Processes: 4
1 Base Layer
2 Clip from -30 to 30
3 DeStripe Median Traverse: Grids: All
4 Clip from -3 to 3

Source Grids: 4 as above

Area 3 raw

COMPOSITE
Filename: Area3-raw.xcp
Instrument Type: Grad 601 (Magnetometer)
Units: nT
Surveyed by: on 04/10/2008
Assembled by: on 10/10/2008
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Origin: Zero

Dimensions
Composite Size (readings): 240 x 300
Survey Size (meters): 60 m x 300 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 8.12
Mean: -0.84

Processes: 2
1 Base Layer
2 Clip from -30 to 30

Source Grids: 18
1 Col:0 Row:2 grids\07.xgd
2 Col:0 Row:3 grids\08.xgd
3 Col:0 Row:4 grids\09.xgd
4 Col:0 Row:5 grids\10.xgd
5 Col:0 Row:6 grids\15.xgd
6 Col:0 Row:7 grids\16.xgd
7 Col:0 Row:8 grids\17.xgd
8 Col:0 Row:9 grids\18.xgd
9 Col:1 Row:0 grids\01.xgd
10 Col:1 Row:1 grids\02.xgd
11 Col:1 Row:2 grids\03.xgd
12 Col:1 Row:3 grids\04.xgd
13 Col:1 Row:4 grids\05.xgd
14 Col:1 Row:5 grids\06.xgd
15 Col:1 Row:6 grids\11.xgd
16 Col:1 Row:7 grids\12.xgd
17 Col:1 Row:8 grids\13.xgd
18 Col:1 Row:9 grids\14.xgd

Area 3 processed

COMPOSITE
Filename: Area3-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.44
Mean: -0.01

Processes: 4
1 Base Layer
2 Clip from -30 to 30
3 DeStripe Median Traverse: Grids: All
4 Clip from -3 to 3

Source Grids: 18 as above

Area 4 raw

COMPOSITE
Filename: Area4-raw.xcp
Instrument Type: Grad 601 (Magnetometer)
Units: nT
Surveyed by: on 04/10/2008
Assembled by: on 10/10/2008
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Origin: Zero

Dimensions
Composite Size (readings): 120 x 120
Survey Size (meters): 30 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 3.22
Mean: -0.24

Processes: 2
1 Base Layer
2 Clip from -30 to 30

Source Grids: 4
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd

Area 4 processed

COMPOSITE
Filename: Area4-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.15
Mean: -0.05

Processes: 4
1 Base Layer
2 Clip from -30 to 30
3 DeStripe Median Traverse: Grids: All
4 Clip from -3 to 3

Source Grids: 4 as above

Area 5 raw

.
COMPOSITE

Filename: Area5-raw.xcp

Instrument Type: Grad 601 (Magnetometer)
Units: nT
Surveyed by: on 04/10/2008
Assembled by: on 10/10/2008
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Origin: Zero

Dimensions
Composite Size (readings): 120 x 150
Survey Size (meters): 30 m x 150 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 4.18
Mean: -0.68

Processes: 2
1 Base Layer
2 Clip from -30 to 30

Source Grids: 5
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd
5 Col:0 Row:4 grids\05.xgd

Area 5 processed

COMPOSITE
Filename: Area5-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.27
Mean: -0.20

Processes: 4
1 Base Layer
2 Clip from -30 to 30
3 DeStripe Median Traverse: Grids: All
4 Clip from -3 to 3

Source Grids: 5 as above

Appendix C – digital archive

Survey results are produced in hardcopy using A4 for text and A3 for plots (all plots are scaled for A3). In addition digital data created during the survey are supplied on CD. Further information on the production of the report and the digital formats involved in its creation are set out below.

This report has been prepared using the following software on a Windows XP platform:

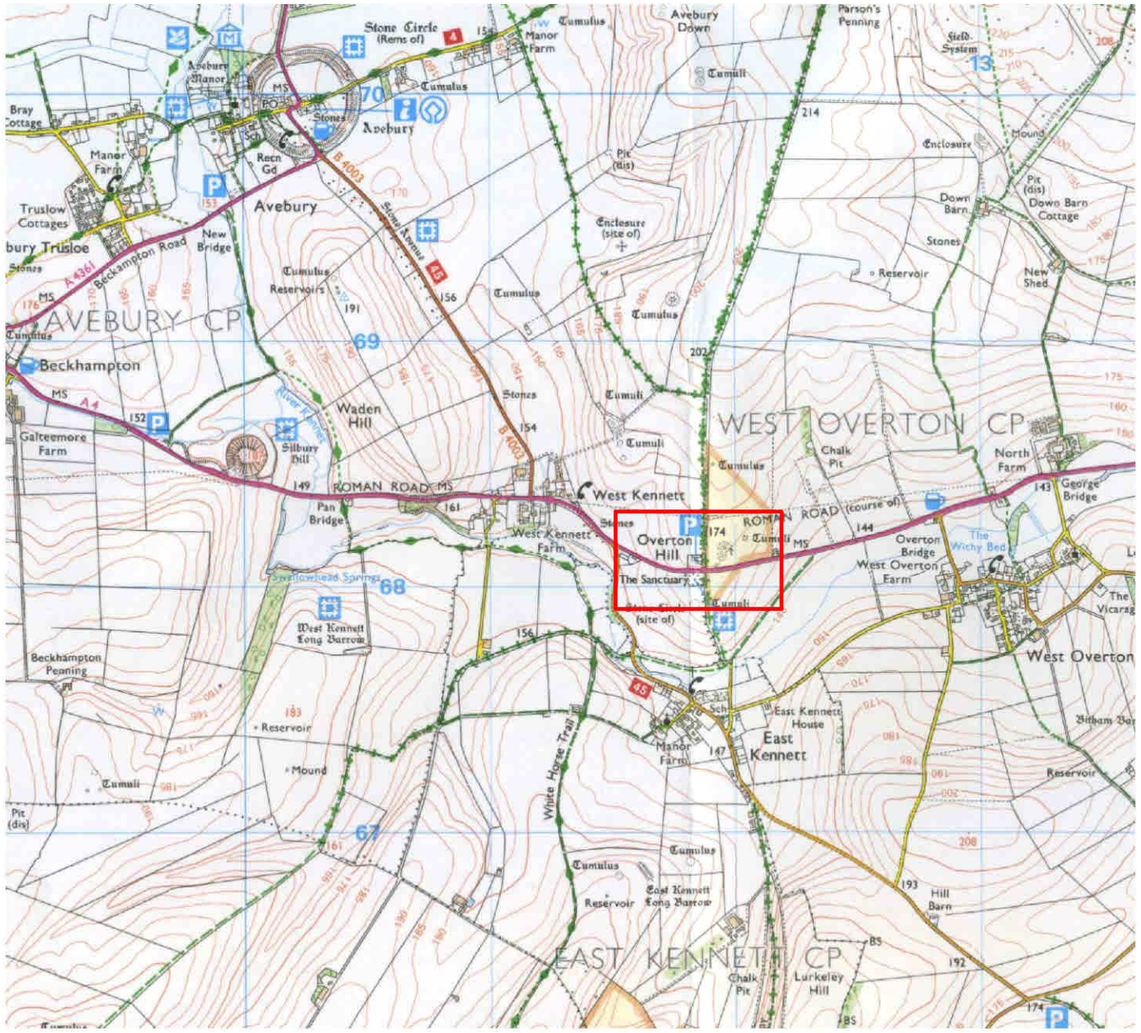
- ArcheoSurveyor version 2.1.4.4 (geophysical data analysis),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 2.2 Writer (document text),
- PDF Creator version 0.9 (PDF archive).

Digital data are supplied on CD ROM which includes the following files:

- ArcheoSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF,
- PDFs of all figures,
- photographic record in JPEG format.

The CD ROM structure is formed from a tree of directories under the title J250 Avebury – CD. Directory titles include Data, Documentation, CAD, PDFs and Photos. Multiple directories exist under Data and hold Grid, Composite and Graphic files with CSV composite data held in Export.

The CAD file contains externally referenced graphics that may be rotated , see 2.3.5, with separate A3 size layouts for each figure. Layouts are fixed using frozen layers and named views allowing straightforward plotting or analysis on screen. (Note – CAD files are prepared using AutoCAD's e Transmit function to produce a directory containing the digital drawing along with any externally referenced graphics which may need reloading).



Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Map of survey area

● Survey location

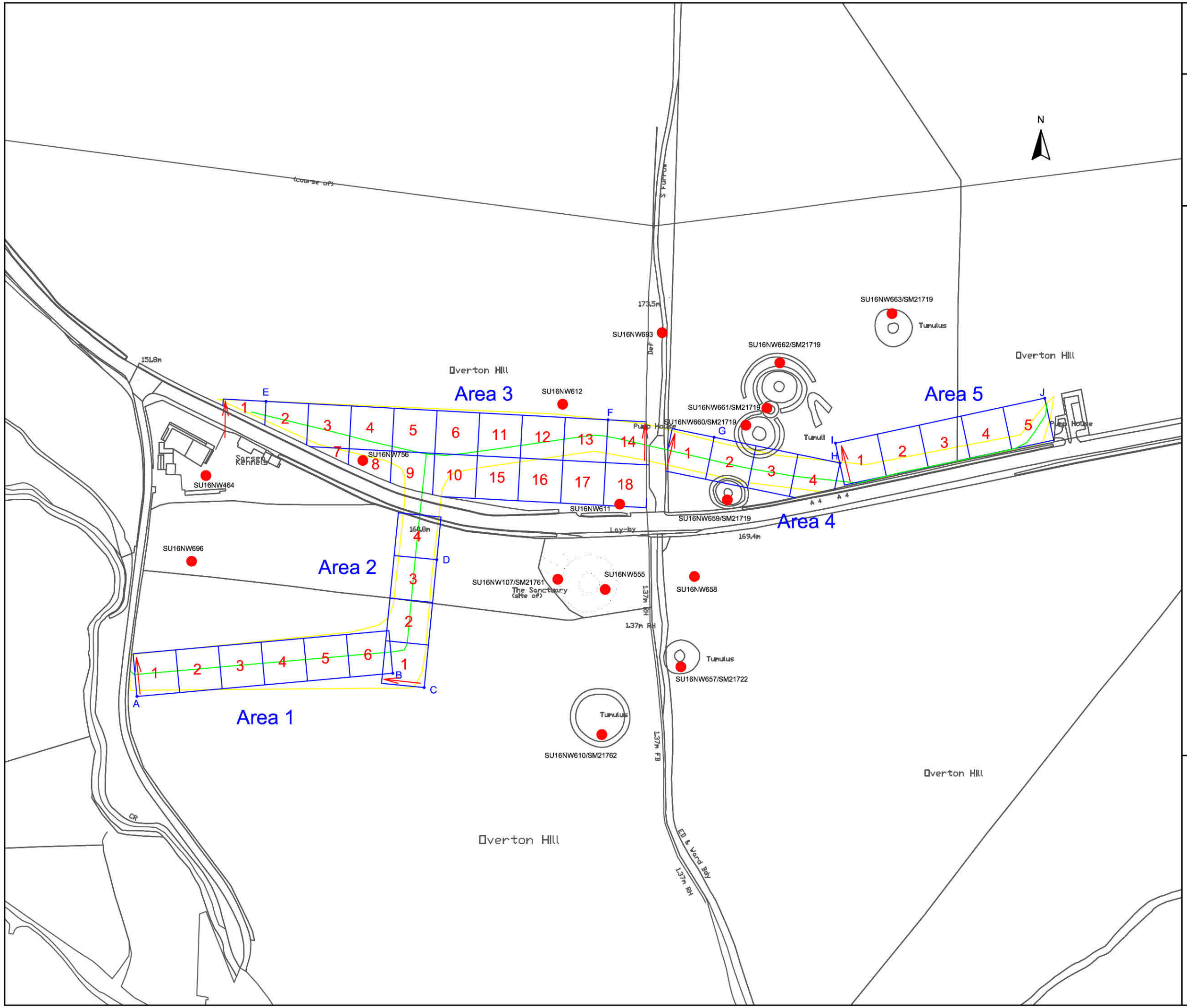
Site centred on OS NGR
SU 118 681

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01



Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Referencing information

Grid coordinates based on Ordnance Survey OSGB36 datum

Grids set out using RTK GPS with Leica Smartnet correction data RTCMv2 format

Survey grid size = 30m

A	411511.67	167945.28
B	411690.94	167961.48
C	411712.97	167951.50
D	411721.83	168041.07
E	411602.13	168151.95
F	411841.79	168139.07
G	411916.18	168126.84
H	412004.36	168108.83
I	412001.20	168122.74
J	412147.86	168154.20

Survey start and traverse direction

1 Grid reference number and filename

Proposed cable route

Survey area

SMR entry - archaeological feature

SCALE 1:2500

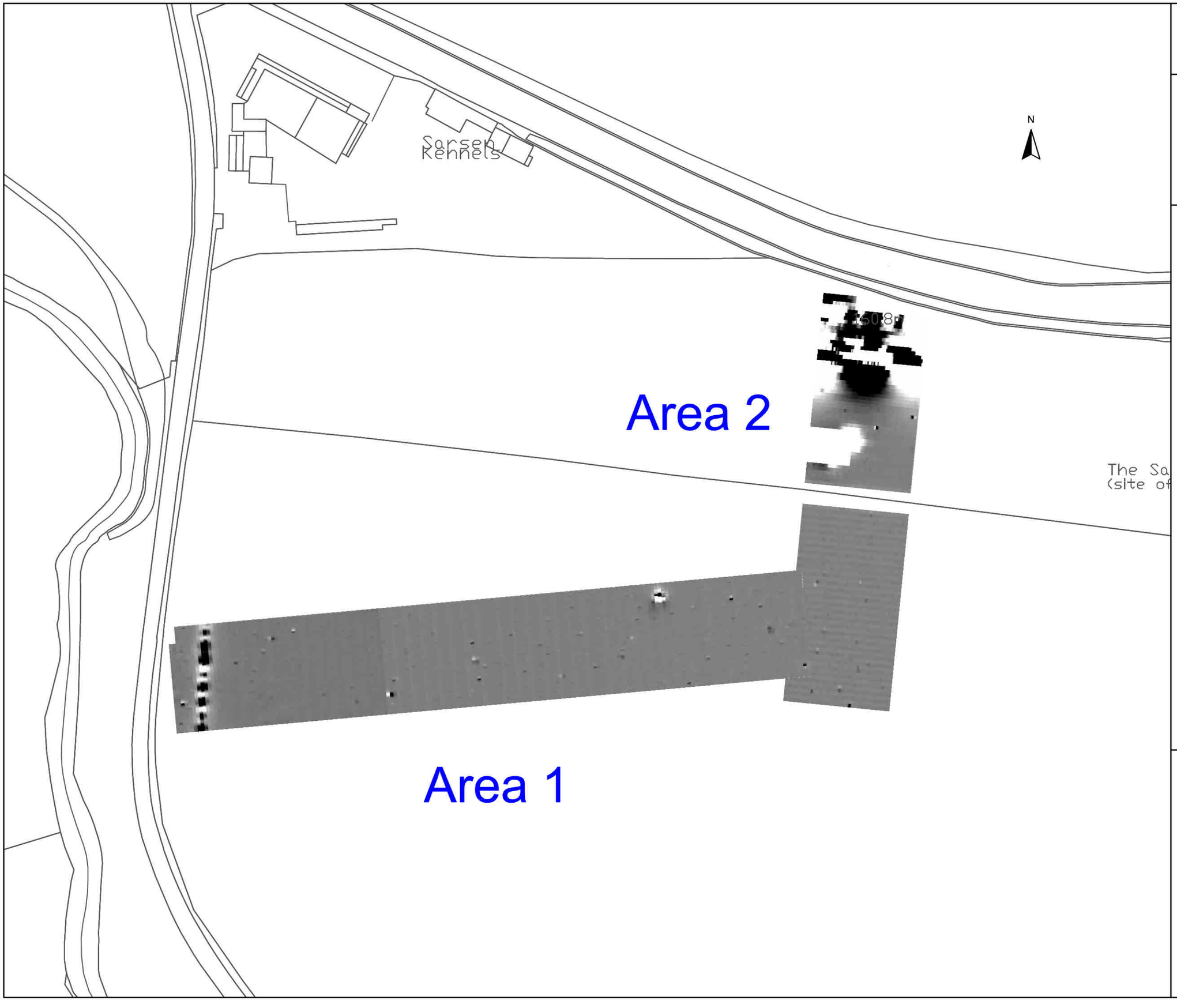
0m 50 100m

SCALE TRUE AT A3

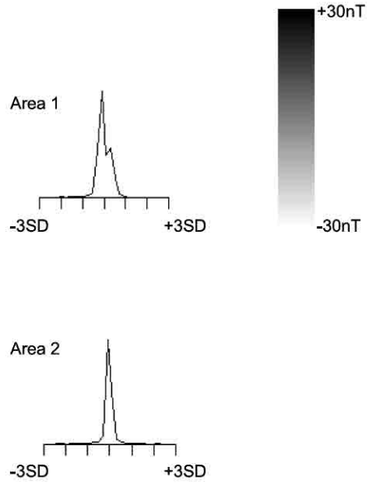
FIG 02

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury



Greyscale plot of raw magnetometer data - Areas 1 and 2



SCALE 1:1000

0m 10 20 30 40 50m

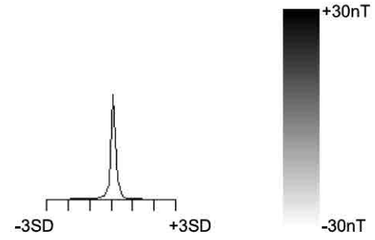
SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Greyscale plot of raw magnetometer data - Area 3



N

173.5m

Def

Overton Hill

Area 3

Pump House

Sarsen Kennels

Area 2

Lay-by

The Sanctuary (site of)

1.37m RH

1.37m RH

SCALE 1:1000

0m 10 20 30 40 50m

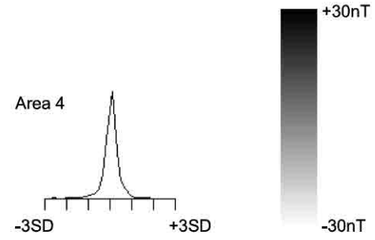
SCALE TRUE AT A3

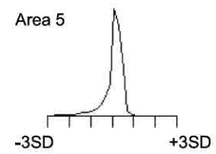
FIG 04

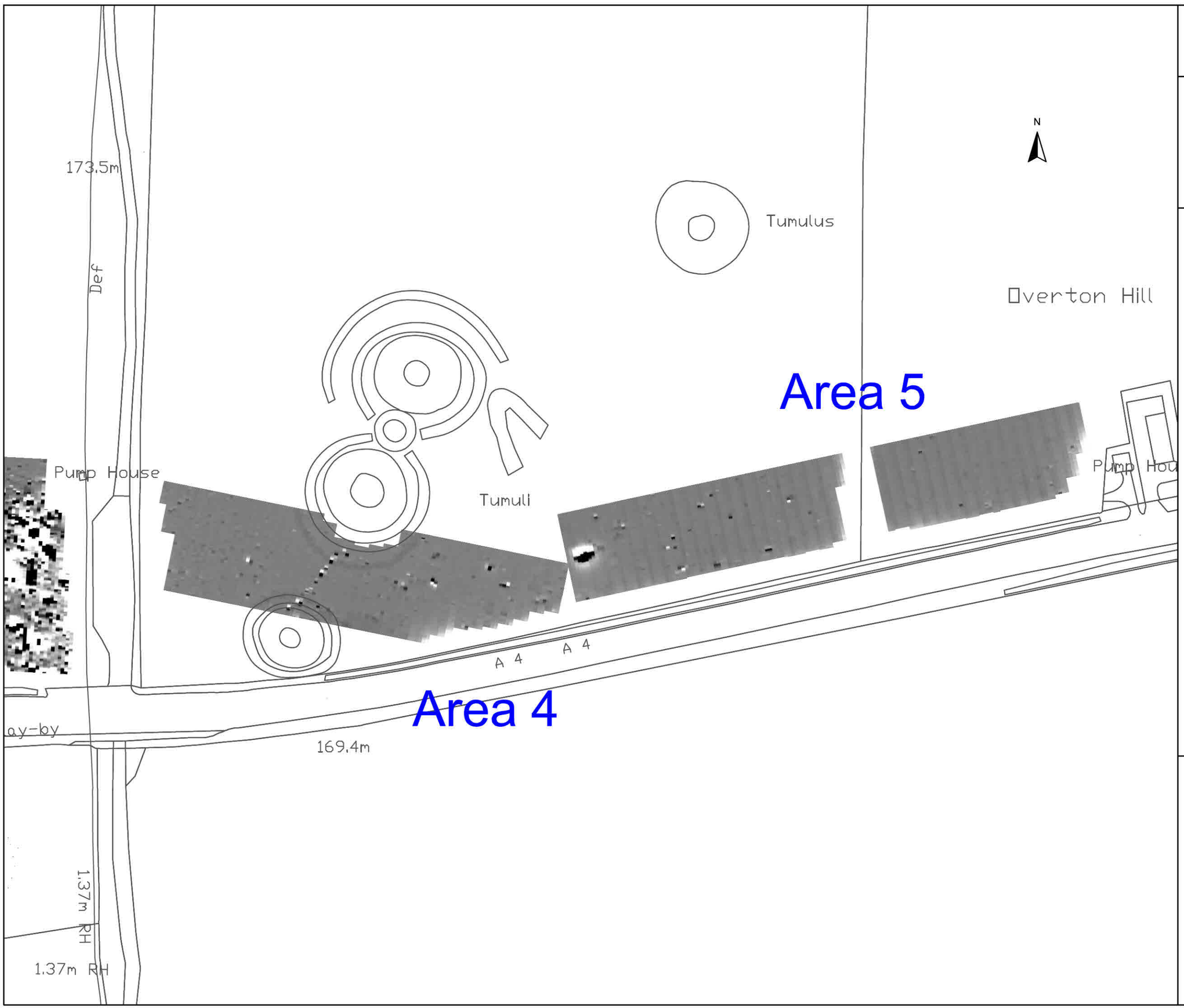
Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Greyscale plot of raw magnetometer data - Areas 4 and 5





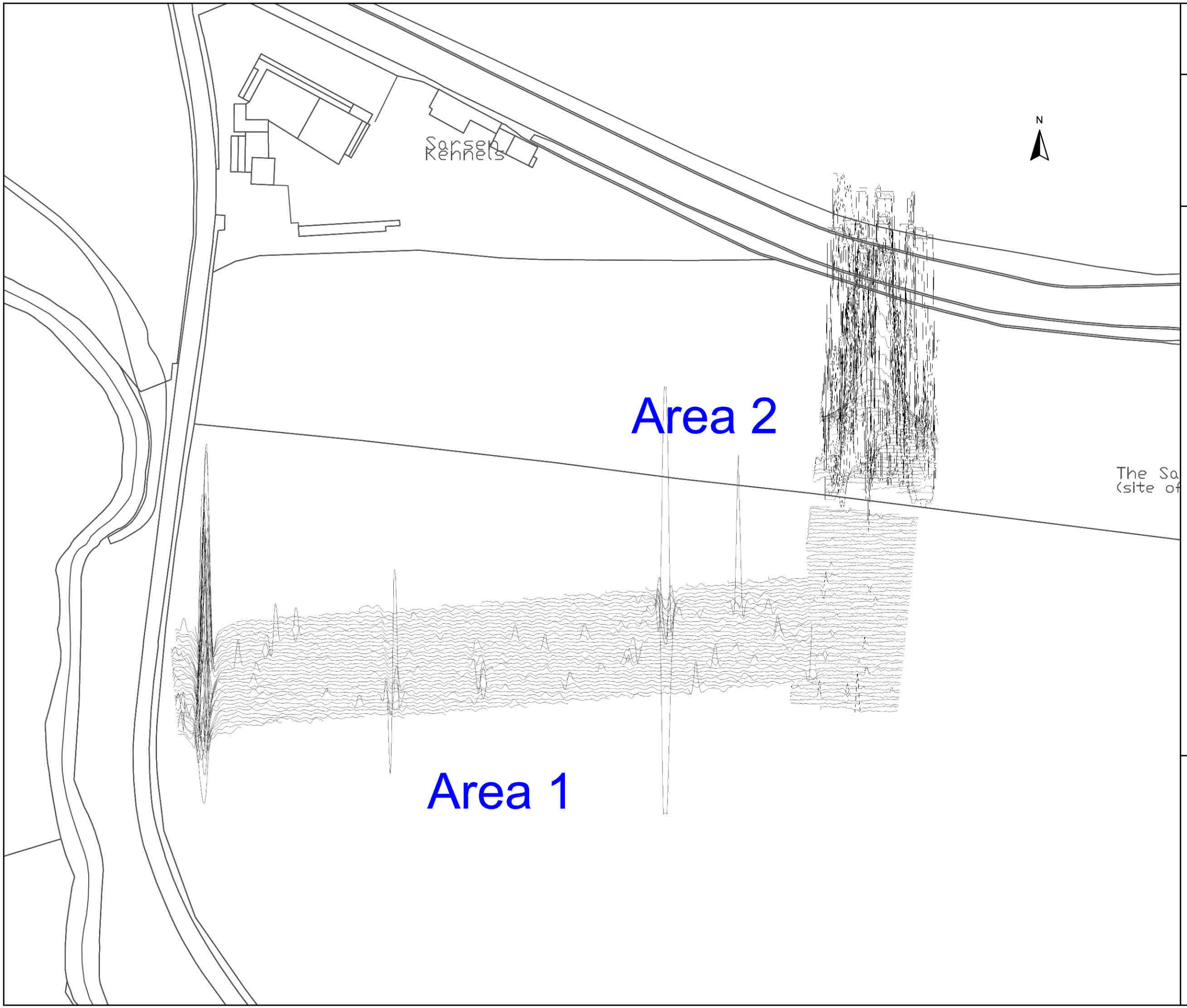


SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 05



Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Traceplot of raw magnetometer data - Areas 1 and 2

+30nT
+15nT
0nT
-15nT
-30nT

Approx 15nT/ cm vertical displacement.

SCALE 1:1000

0m 10 20 30 40 50m

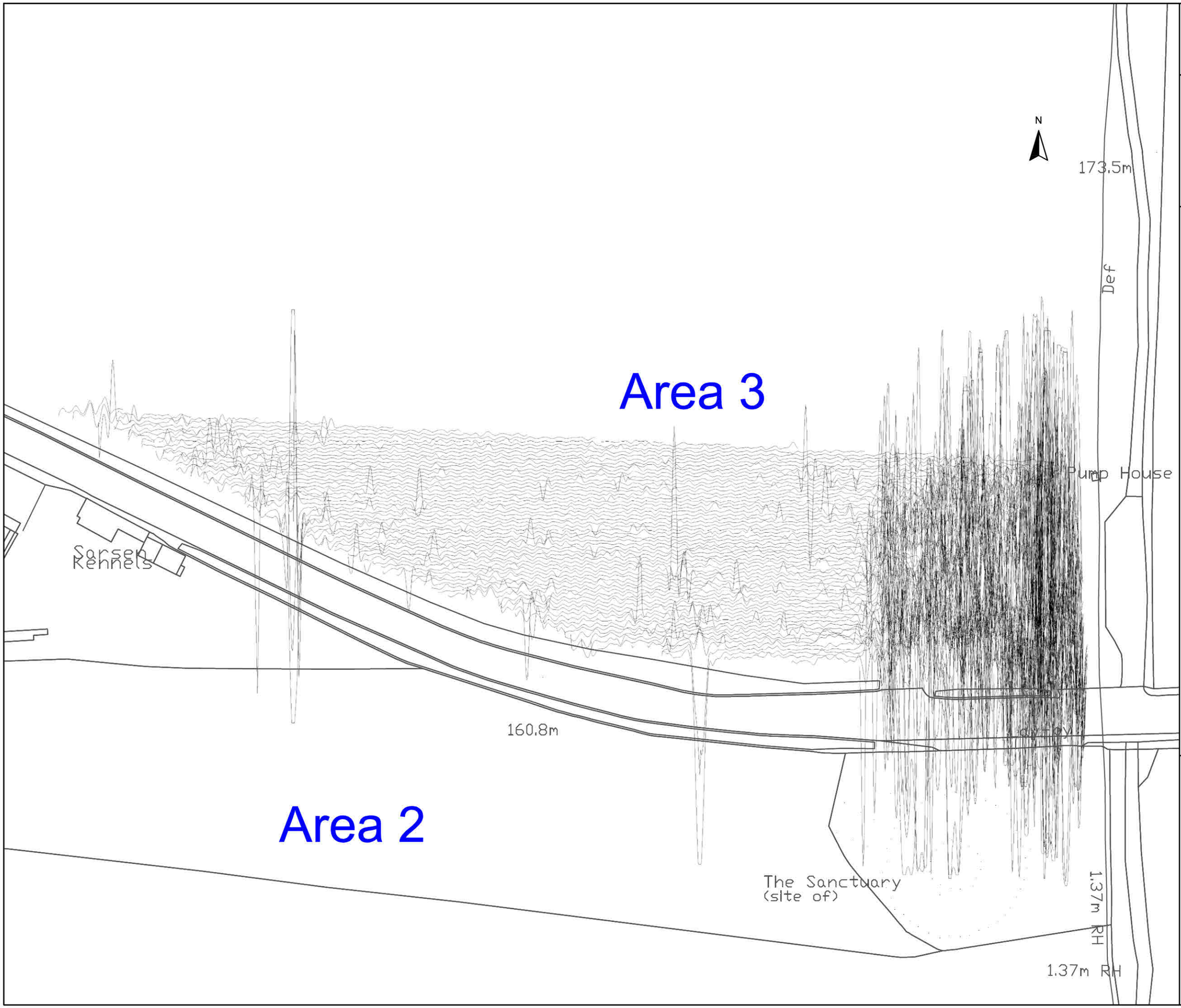
SCALE TRUE AT A3

FIG 06

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Traceplot of raw magnetometer data - Area 3



+30nT
+15nT
0nT
-15nT
-30nT

Approx 15nT/ cm vertical displacement.

SCALE 1:1000

0m 10 20 30 40 50m

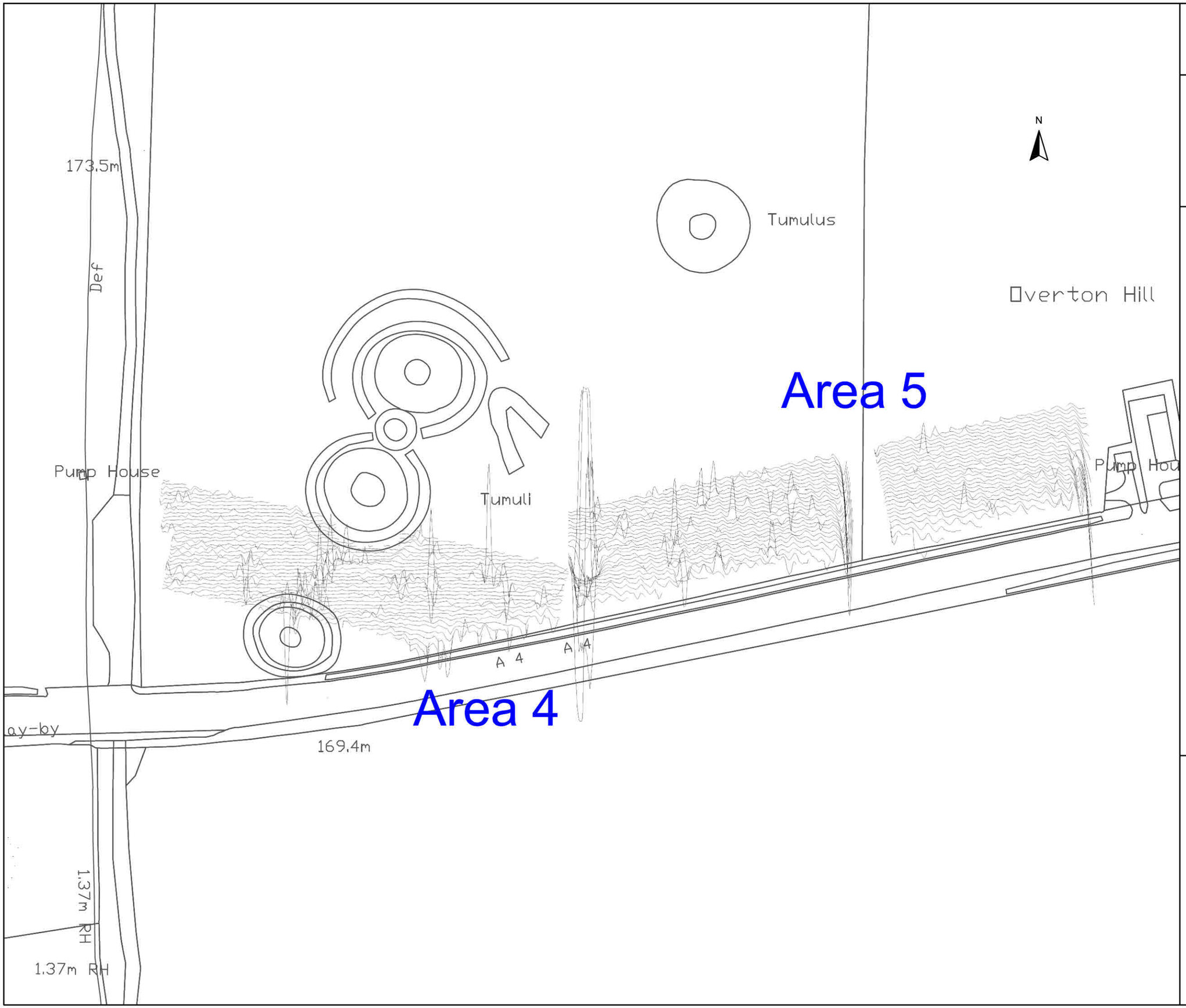
SCALE TRUE AT A3

FIG 07

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Traceplot of raw magnetometer data - Areas 4 and 5



+30nT
+15nT
0nT
-15nT
-30nT

Approx 15nT/ cm vertical displacement.

SCALE 1:1000

0m 10 20 30 40 50m

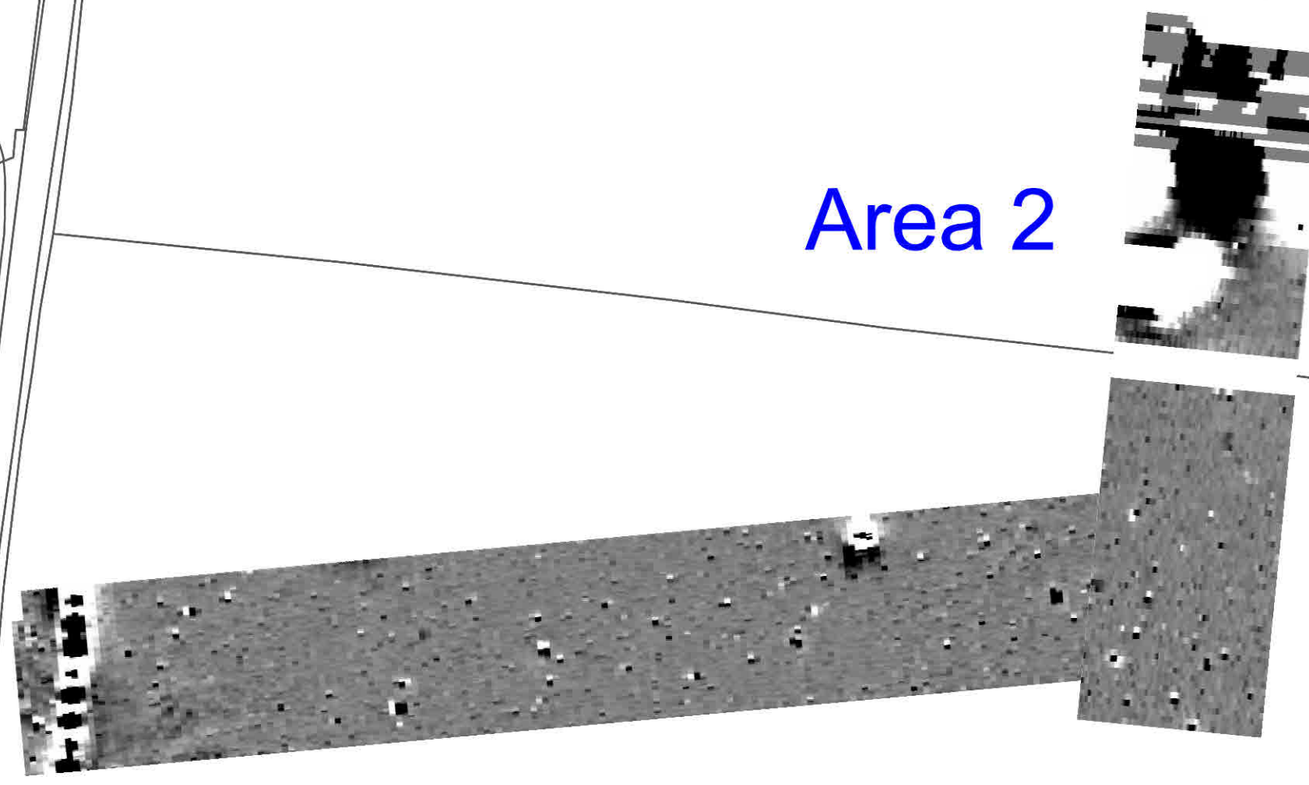
SCALE TRUE AT A3

FIG 08

Sarsen Kennels

N

Area 2

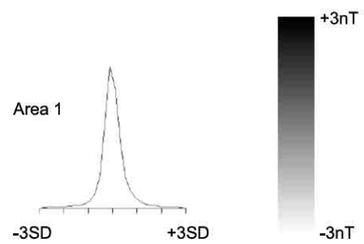


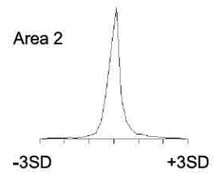
Area 1

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Greyscale plot of processed magnetometer data - Areas 1 and 2





SCALE 1:1000

0m 10 20 30 40 50m

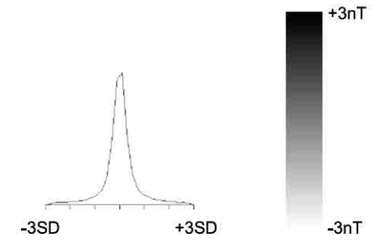
SCALE TRUE AT A3

FIG 09

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Greyscale plot of processed magnetometer data - Area 3



N

173.5m

Def

Overton Hill

Area 3

Pump House

Sarsen Kennels

160.8m

Lay-by

Area 2

The Sanctuary
(site of)

1.37m RH

1.37m RH

SCALE 1:1000

0m 10 20 30 40 50m

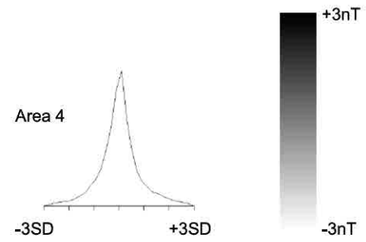
SCALE TRUE AT A3

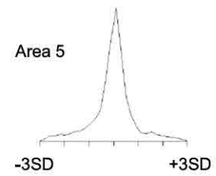
FIG 10

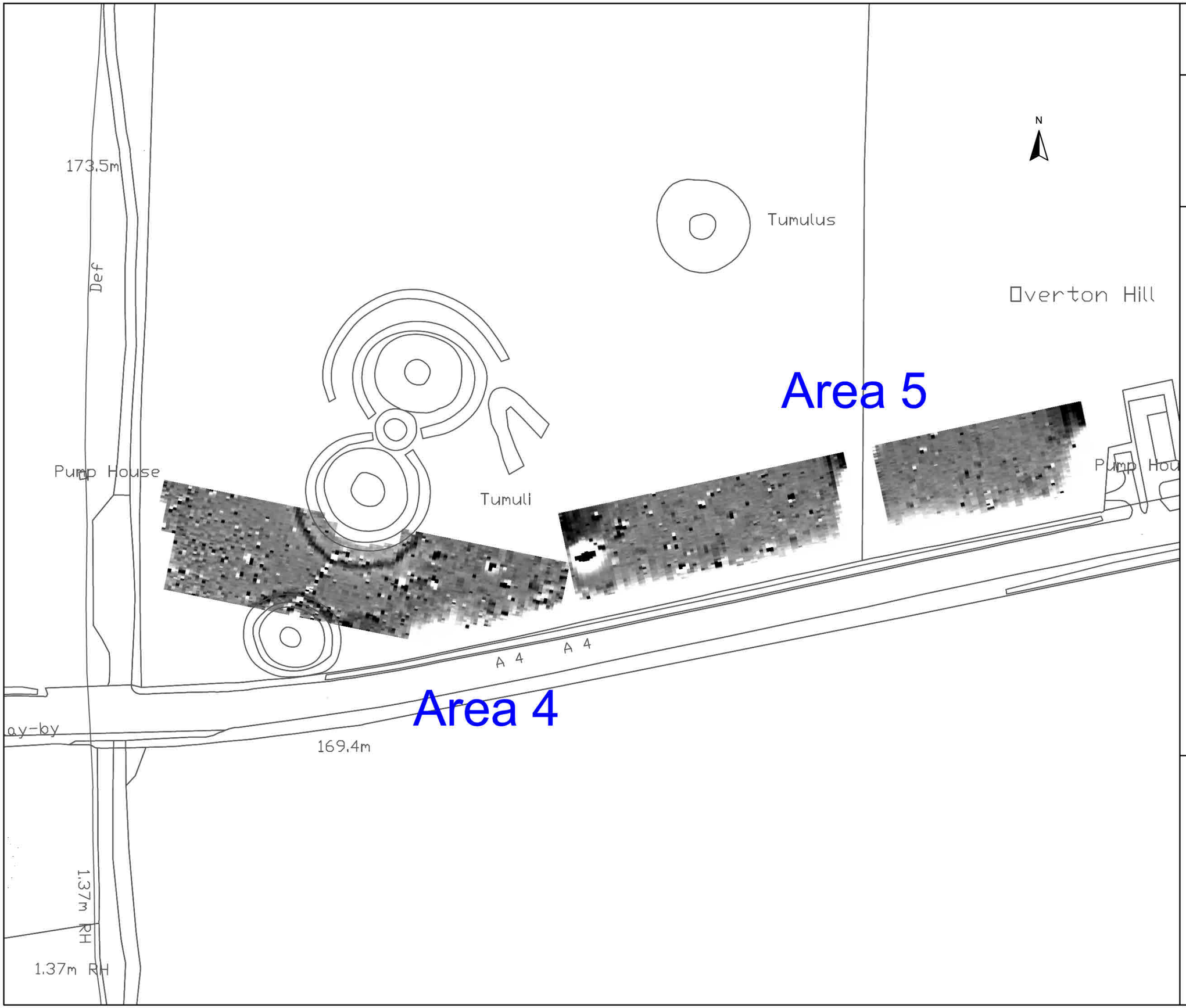
Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Greyscale plot of processed magnetometer data - Areas 4 and 5







SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 11

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Abstraction and interpretation of magnetometer anomalies - Areas 1 and 2

- Positive linear anomaly of uncertain origin - possible ditch-like feature
- Discrete positive response of uncertain origin - possible pit-like feature
- Magnetic disturbance from ferrous material/ services
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

Area 2

Area 1

Sarsen Kennels

160.8m

N

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 12

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury

Abstraction and interpretation of magnetometer anomalies - Area 3

N

173.5m

Def

Overton Hill

Area 3

12

7

6

11

Pump House

9

8

13

10

Sarsen Kennels

160.8m

Lay-by

Area 2

5

The Sanctuary (site of)

1.37m RH

2

1.37m RH

- Positive linear anomaly of uncertain origin - possible ditch-like feature
- Discrete positive response of uncertain origin - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

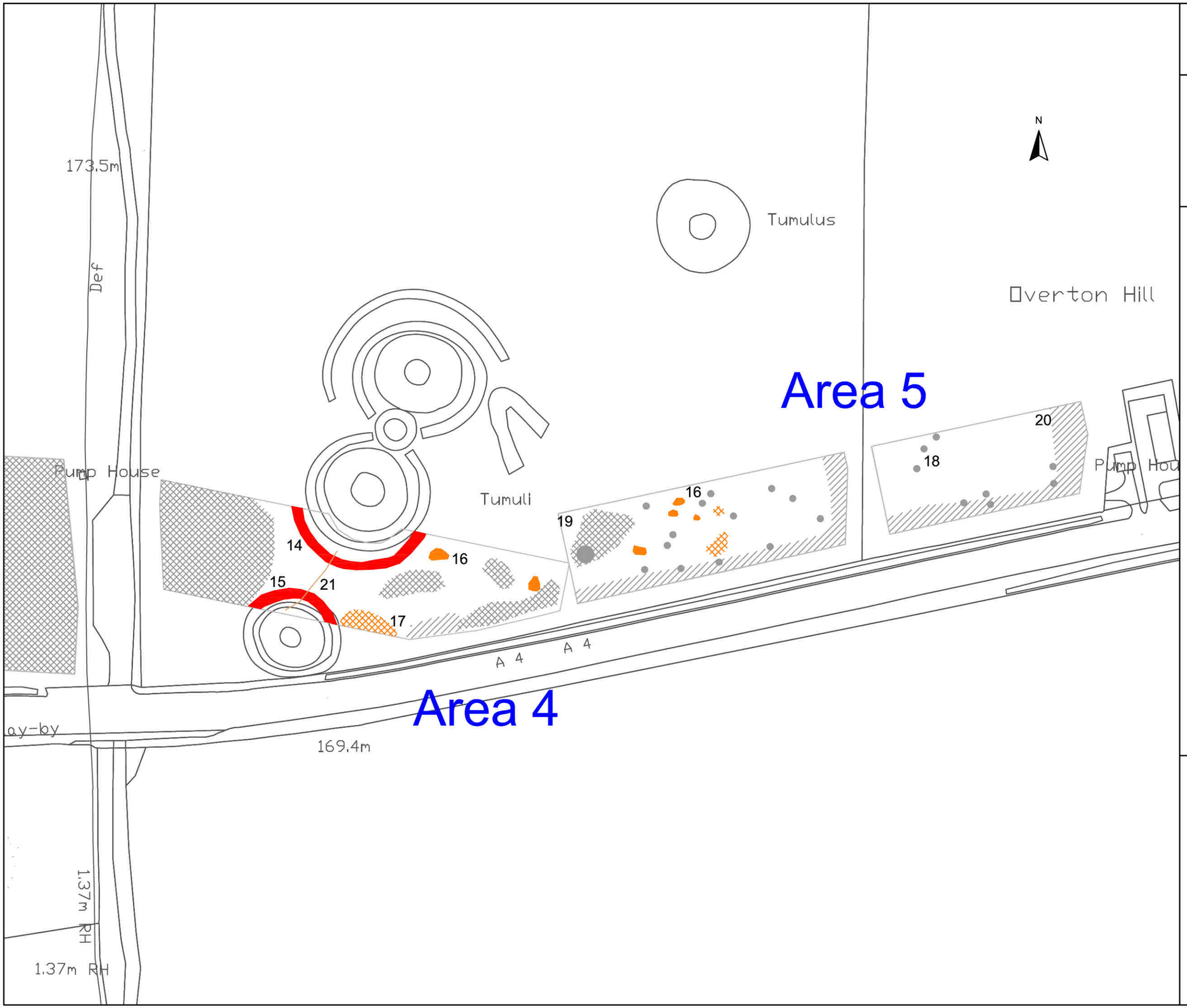
0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 13

Archaeological Surveys Ltd

Geophysical Survey
Overton Hill
Avebury



Abstraction and interpretation of magnetometer anomalies - Areas 4 and 5

- Positive curvilinear anomaly - barrow ditch
- Positive linear anomaly - possible ditch-like features
- Multiple dipolar linear anomaly - remains of wire fencing?
- Discrete positive response of uncertain origin - possible pit-like feature
- Positive anomaly of uncertain origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 14