GEOPHYSICAL SURVEY REPORT

Land at Sugworth Farm, Borde Hill, Haywards Heath

Client

Archaeology South-East

Survey Report

18089

Date

October 2020

Survey Report 18089: Land at Sugworth Farm, Borde Hill, Haywards Heath

Survey dates	30 September – 2 October 2020
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2. SURVEY TECHNIQUE

Detailed magnetic survey (magnetometry) was chosen as the most efficient and effective method of locating the type of archaeological anomalies which might be expected at this site.

Bartington Grad 601-2 Traverse Interval 1.0m Sample Interval 0.25m

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3 SUMMARY OF RESULTS

3.1 A magnetic survey of 8.1ha of land at Sugworth Farm, Haywards Heath has detected no anomalies that can be interpreted as having a definite archaeological origin. Several uncertain trends and discrete responses have been detected in the dataset and have been categorised as Uncertain. Most of these anomalies are likely to be due to modern or agriculture processes; however, an archaeological provenance cannot be entirely ruled out for the responses in the south of Area 3. A band of increased response within Area 3 that is relatively uniform in shape has been assigned to the category of *Uncertain*. In the west of Area 2 several parallel linear trends are likely to be due to modern ploughing. An amorphous band of increased response, within which are a number of more discrete anomalies are likely to be due to natural processes. Landscaping in the south of Area 2 which is associated with a former brickwork has resulted in magnetic disturbance within the vicinity.

4 INTRODUCTION

4.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by **Archaeology South-East**.

4.2 Site details

NGR / Postcode	TQ 325 259 / RH17 5NL
Location	The site is located 12km south of Crawley and 6.5km north of Burgess Hill. The survey area is bounded to the south by Balcombe Rd, to the west by Borde Hill Ln and to the east houses off Orchard Way.
HER	West Sussex County Council
District	Mid Sussex
Parish	Ansty and Staplefield Civil Parish
Topography	Gently undulating
Current Land Use	Pasture
Geology (BGS 2020)	Bedrock: Cuckfield Stone Bed - sandstone, calcareous Lower Tunbridge Wells Sand - sandstone, siltstone and mudstone Wadhurst Clay Formation – mudstone Superficial: Head - clay, silt, sand and gravel
Soils (CU 2020)	Soilscape 8: Slightly acid loamy and clayey soils with impeded drainage.
Archaeology	Only one heritage asset is located within the survey area. The putative route of the north-south orientated London-Hassocks Roman road (Margary road no. 150) is marked by the Ordnance Survey and falls within the survey area. Two trenches were dug by machine across the suggested alignment in 1990 for WSCC in advance of construction of a car park at Haywards Heath College (c. 850m south of the survey area) [SMR reference: 4976 – WS3614]. Likewise, excavation on the putative alignment at Beech Hurst Gardens, Butlers Green Road, in 2003, found no evidence of the Roman road (c. 2km south of the survey area [SMR reference: 6797 – WS6826]. However, geophysical survey and trenching in 1998-9 to the south-west of Haywards Heath revealed evidence of a sandstone metalled road, c.50m west of the route marked by the Ordnance Survey. This could explain the absence of evidence for the Roman road during the archaeological investigations to the north (ESCC 2005). A search of Heritage Gateway revealed no further heritage assets within the survey area. The grade II listed Sugworth Farmhouse lies 250m north of the survey area (HG 2020).

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Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	8.1 ha

4.3 Aims and Objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

5 RESULTS

The survey has been divided into three survey areas (Areas 1-3) and specific anomalies have been given numerical labels [1] [2] *which appear in the text below, as well as on the Interpretation Figure(s).*

5.1 *Probable / Possible Archaeology*

5.1.1 No magnetic responses have been recorded that could be interpreted as being of definite archaeological interest.

5.2 *Uncertain*

5.2.1 A number of discrete segmented ditch-like and pit-like responses [1] are visible in the dataset in the south of Area 3. They lack the defined morphology of anomalies that would normally be interpreted as having an archaeological provenance and they form no discernible pattern. Therefore, they have been classified as *Uncertain*; however, an archaeological origin cannot be entirely dismissed.

5.2.2 In Area 3 a band of increased response [2] that is not typical of ferrous anomalies but is very similar to geological effects has been recorded. Within this band are a number of discrete responses but these lack definition and context. They have a similar magnetic signature to some of the anomalies in Area 2 which has been categorised as *Natural* (see 5.4.1). The ordnance survey has marked a putative location of a Roman road and this falls close to these responses. Consequently, the anomalies have been assigned to the category of *Uncertain* but are likely to be due to natural processes.

5.2.3 A short linear response [3] in Area 2 is ditch like in form but it is isolated and lacks an archaeological context; therefore, it has been classified as *Uncertain*. It is likely to be associated with past agricultural activity or is a natural effect.

5.2.4 Several magnetically weak trends and pit-like anomalies have been recorded throughout the survey areas. They lack context and form no obvious patterns; therefore, they are likely to be due to natural or agricultural activity and have been assigned to the category of *Uncertain*.

5.3 *Agricultural – Ploughing*

5.3.1 Numerous closely spaced, parallel and magnetically weak linear anomalies have been detected in the west of Area 2. These are likely to be due to relatively modern ploughing.

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5.4 *Natural / Geological / Pedological / Topographic*

5.4.1 A band of amorphous and sinuous responses have been detected in Area 2 and are generally magnetically weak. They are therefore likely to be natural, associated with pedological variations. The band is also visible of aerial photography (see Figures 04 and 05).

5.5 *Ferrous / Magnetic Disturbance*

5.5.1 An area of magnetic disturbance has been recorded in the south of Area 2 and coincides with the location of a former brickworks that can be seen on historic mapping (see Figures 04 and 05). The responses are likely to be associated with the landscaping or dumping of waste material from the brickworks.

5.5.2 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

6 DATA APPRAISAL & CONFIDENCE ASSESSMENT

6.1 Historic England guidelines (EH 2008) Table 4 states that the typical magnetic response on the local soils / geology is generally poor. The results from this survey indicate the presence of natural responses and ploughing; as a consequence, there is no *a priori* reason why archaeological features would not have been detected, if present.

7 CONCLUSION

7.1 The magnetometer survey has not recorded any anomalies that could be interpreted as being of definite archaeological interest. A number of discrete and linear trends have been detected in the dataset and they are likely to be due to modern or natural processes; however, an archaeological origin should not be ruled out entirely for the responses in the south of Area 3. A zone of increased response has been recorded in Area 3 and has been categorised as uncertain. Though it's close proximity to the projected course of a Roman road should be borne in mind. Several parallel linear trends within the magnetic data are evidence of relatively modern ploughing. Located within Area 2 a second band of increased response has been detected and this is likely to be due to natural processes. Magnetic disturbance in the south of Area 2 is likely to be due to activity associated with a former brickworks.

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8 REFERENCES

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Appendix A - Technical Information: Magnetometer Survey Method, Processing and Presentation

Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad* 601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

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Presentation of results and interpretation

The presentation of the results includes a ‘minimally processed data’ and a ‘processed data’ greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the ‘Interpretation’ drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: Abbey Wall or Roman Road. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: Probable, or Possible Archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification Possible.

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Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology / Probable Archaeology	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
Service	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

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Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.

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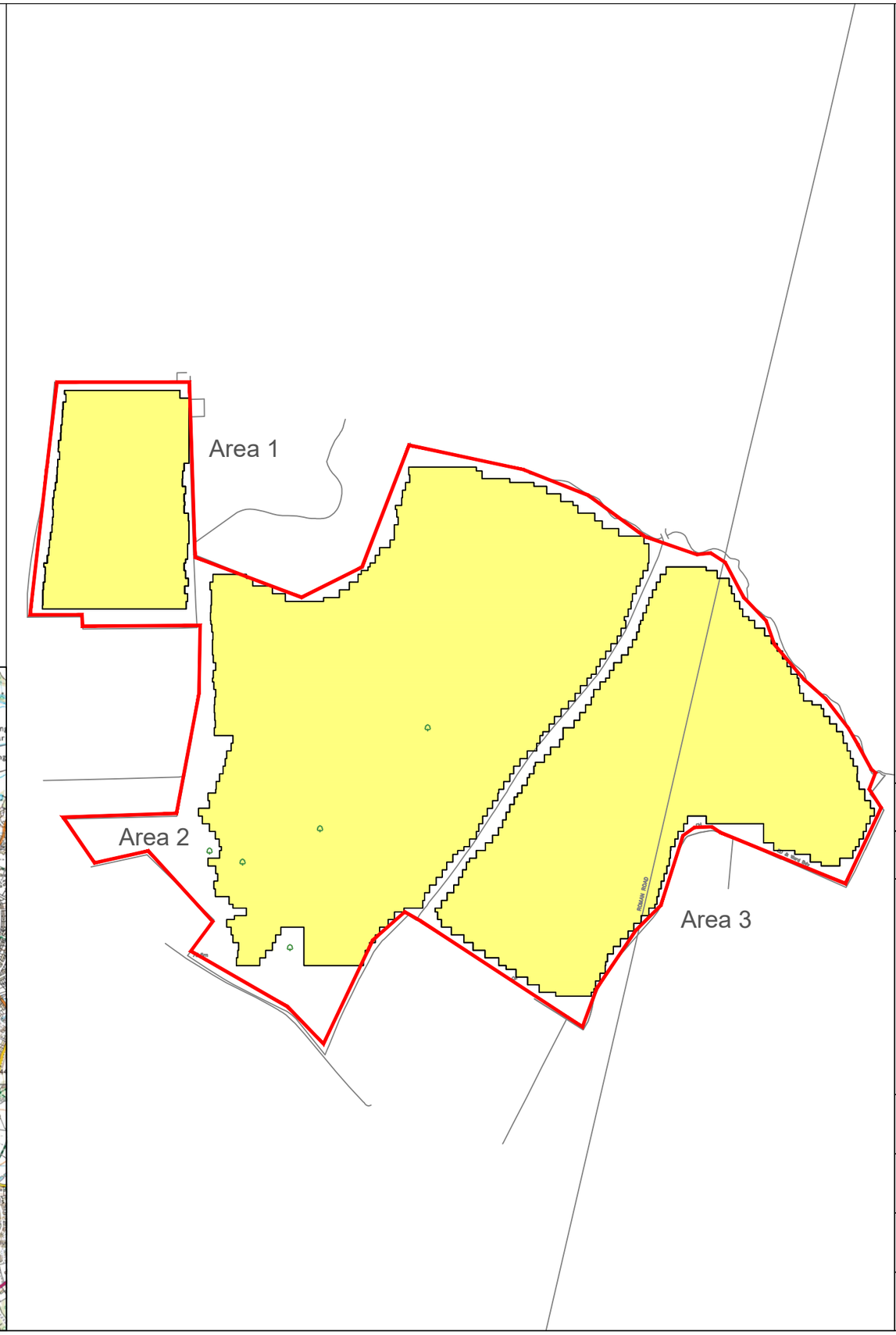

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Site Location

Magnetometer Survey

N

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Title:
Site Location

Client:
Archaeology South-East

Project:
18089 - Sugworth Farm, Borde Hill, Haywards Heath

Scale:
NOT TO SCALE

Fig No:
01

N

+2nT

-1nT

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Magnetometer Survey - Greyscale Plots

Client:
Archaeology South-East

Project:
18089 - Sugworth Farm, Borde Hill, Haywards Heath

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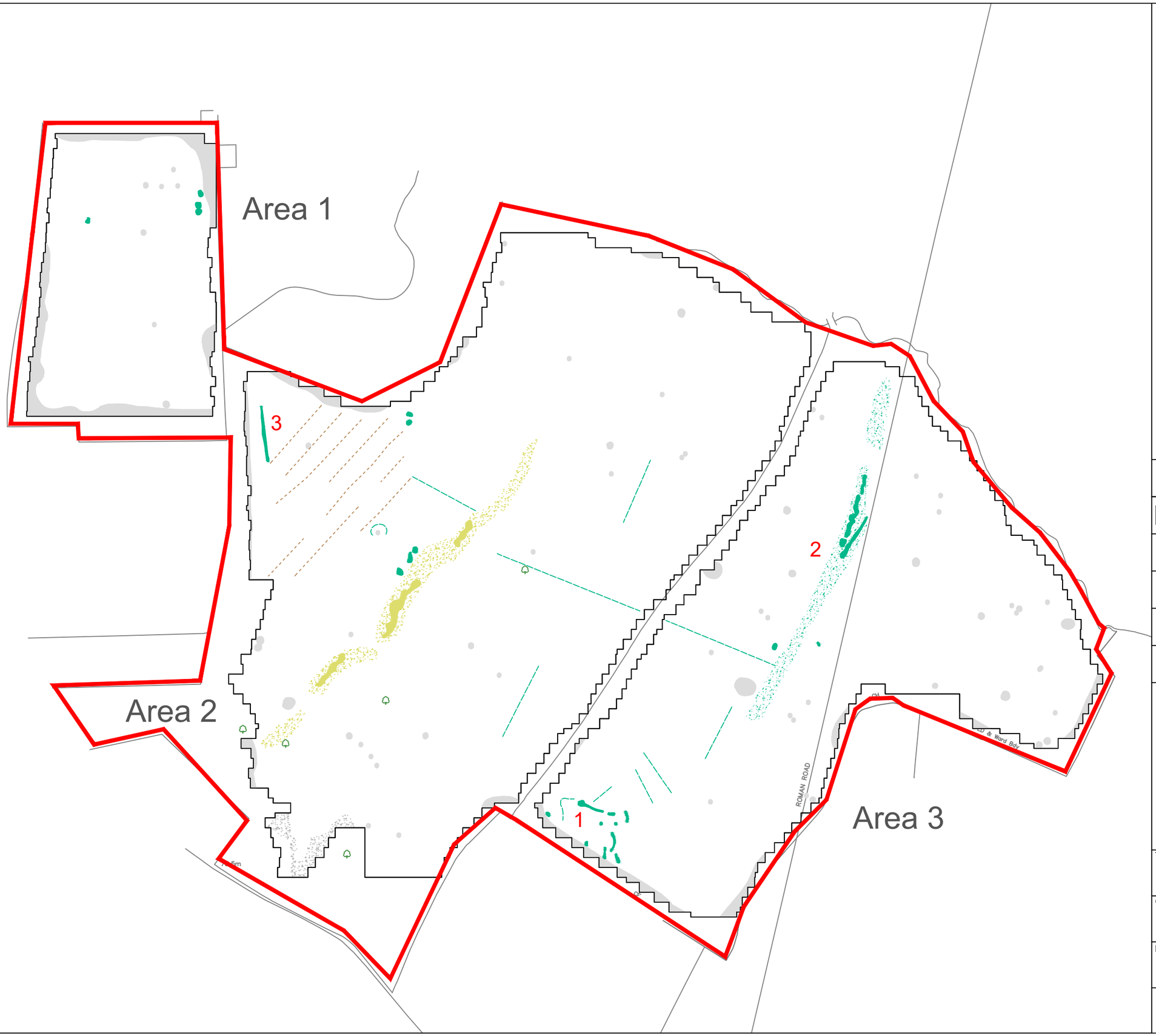

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KEY

	Uncertain Origin (Discrete Anomaly / Trend / Area of Increased Response)
	Agriculture (Plough)
	Natural (Discrete / Zone)
	Magnetic disturbance
	Ferrous

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Title:
Magnetometer Survey - Interpretation

Client:
Archaeology South-East

Project:
18089 - Sugworth Farm, Borde Hill, Haywards Heath

Scale:
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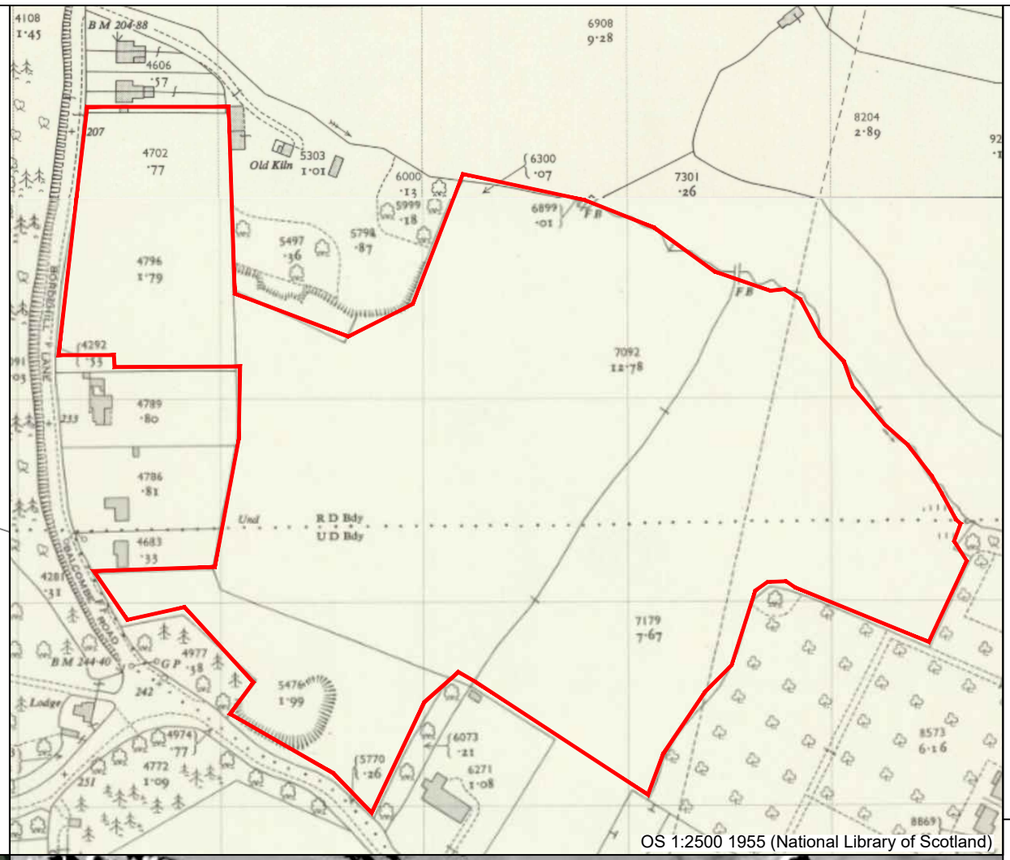

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-1nT

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Magnetometer Survey - Greyscale Plots / 1955 OS Mapping / Aerial Imagery / LIDAR

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18089 - Sugworth Farm, Borde Hill, Haywards Heath

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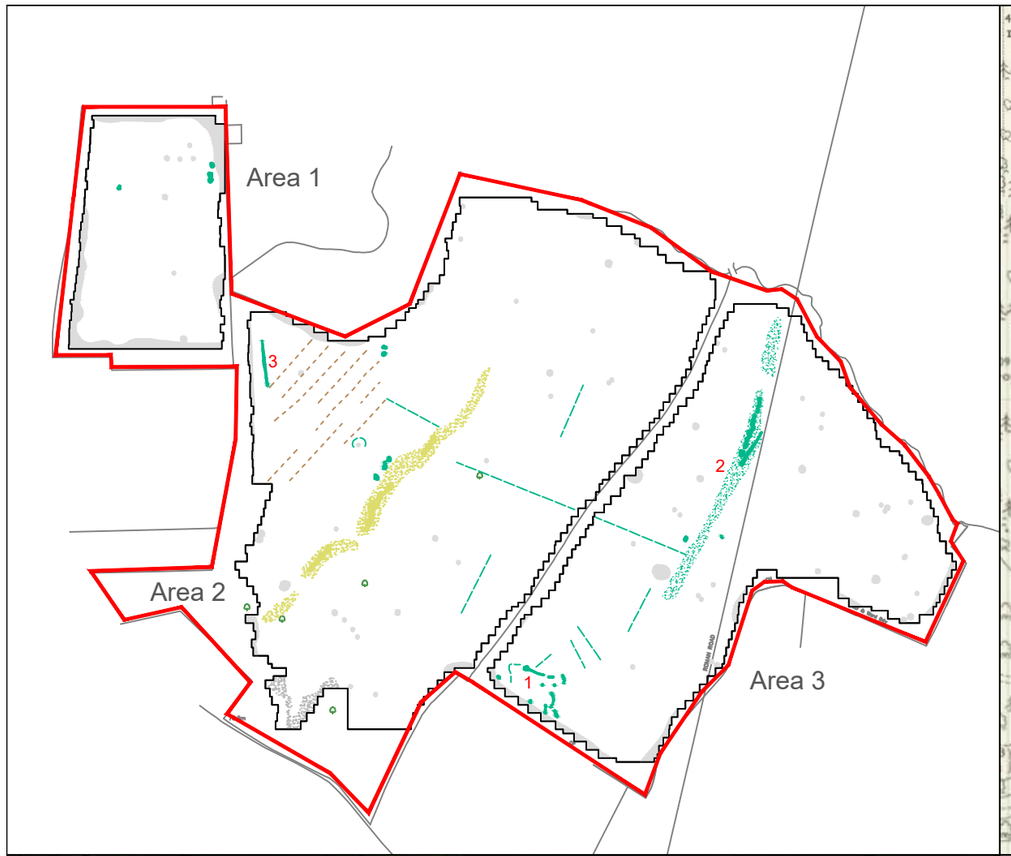

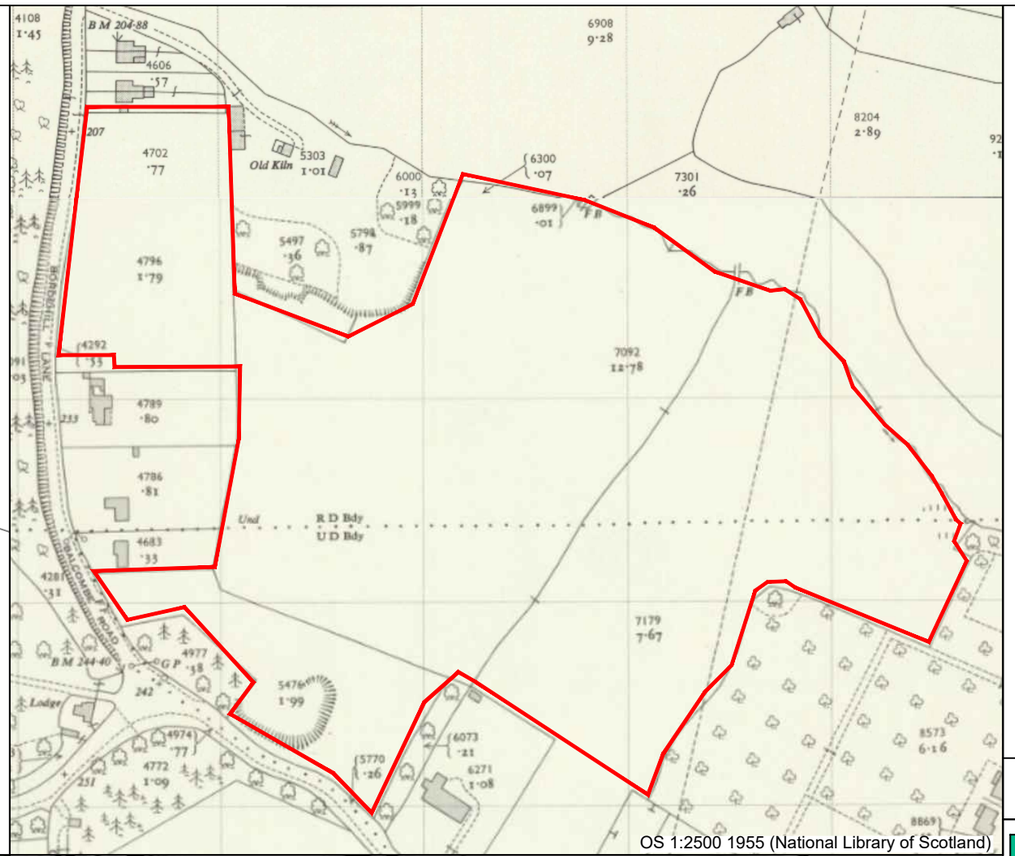

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KEY

	Uncertain Origin (Discrete Anomaly / Trend / Area of Increased Response)
	Agriculture (Plough)
	Natural (Discrete / Zone)
	Magnetic disturbance
	Ferrous

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Title:
Magnetometer Survey - Interpretation / 1955 OS Mapping / Aerial Imagery / LIDAR

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Fig No:
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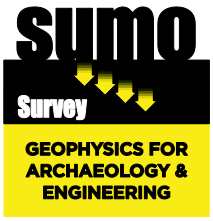

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