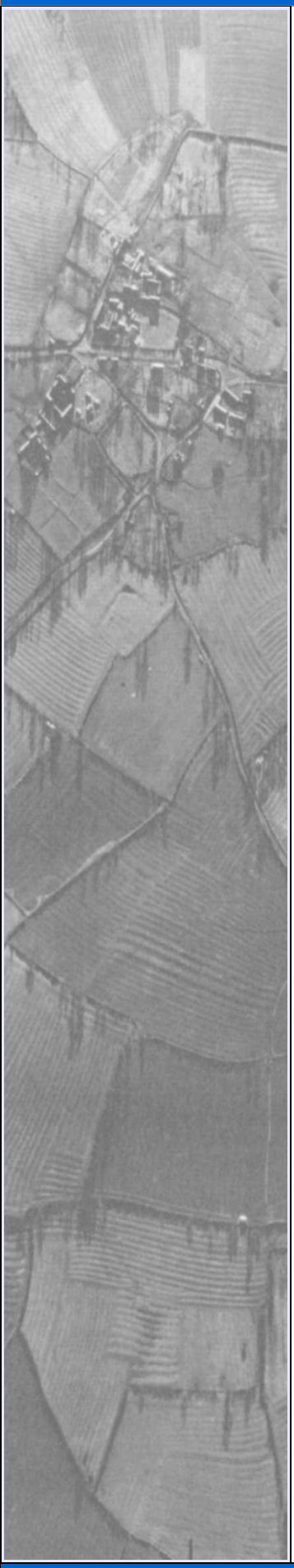

Land north of West Camel Road
Queen Camel
Somerset

MAGNETOMETER SURVEY REPORT

for

A & S Case

Kerry Donaldson & David Sabin

January 2019

Ref. no. J773

ARCHAEOLOGICAL SURVEYS LTD

Land north of West Camel Road
Queen Camel
Somerset

Magnetometer Survey Report

for

A & S Case

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

Survey dates – 9th & 10th January 2019
Ordnance Survey Grid Reference – **ST 59110 24515**

Somerset HER no. 39437

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SUMMARY

A geophysical survey, comprising detailed magnetometry, was carried out within a single field at Queen Camel in Somerset. The eastern part of the field has been subject to previous geophysical surveys and evaluation and contains a Roman villa which lies within a complex of rectilinear enclosures. This part of the site was re-surveyed to be able to place anomalies located within the rest of the field in context. The results demonstrate the presence of structural remains and surrounding enclosure ditches associated with the villa in the eastern part of the site. A number of discrete positive responses lie to the west of the villa enclosure and it is possible their morphology could indicate an association with burials. Within the central part of the site there is evidence for further enclosures on a slightly different orientation to the villa complex which have been truncated by a trackway that is associated with the villa. These enclosures could relate to an earlier prehistoric field system and a more complex enclosure further to the north could be associated. In the western part of the site there are numerous rectilinear enclosures flanking the trackway and revealing several phases of development. Some of these contain and truncate earlier ring ditches associated with round houses.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned to undertake a magnetometer survey of an area of land north of West Camel Road, Queen Camel, Somerset for landowners Andrew and Shiona Case. The survey was agreed by Michael Heaton (Michael Heaton Heritage Consultants) in consultation with Somerset County Council and Richard Edge of planning consultants Assetsphere.

1.1.2 The survey has been carried out within a single field of 8.4ha. The eastern part of the field contains a previously surveyed Roman villa, this has been re-surveyed in order to place anomalies in context.

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 results will help with the overall Masterplan for the development. 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 The survey and report generally 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) Standard and Guidance for Archaeological Geophysical Survey.* Note: currently Historic England (2018) no longer support the guidelines set out in English Heritage (2008) Geophysical survey in archaeological field evaluation and there are currently no plans to update the document. As a consequence other sources of written guidance referring to this document may be out of date and/or contain unsupported information (e.g. Chartered Institute for Archaeologists, 2014).

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 lines; broken or fragmented anomalies may well correspond closely with subsurface truncation.

1.4 Site location, description and survey conditions

1.4.1 The site is located on land to the north of West Camel Road on the western edge of Queen Camel in Somerset. It is centred on Ordnance Survey National Grid Reference (OS NGR) ST 59110 24515, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 8.4ha within a single pasture field.

Plate 1: Survey area looking north east

1.4.3 The land is generally flat with a slight slope down towards the north, boundaries are mainly hedgerows. Several sources of magnetic disturbance were identified within the boundaries and these are associated with steel gates, a steel water trough and other steel objects at the rear of residential gardens along the south eastern part of the site. In addition, a pavilion and steel container immediately to the east of the field, within the existing playing field, were also identified as likely sources of magnetic disturbance.

1.4.4 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were mainly fine but cold.

1.5 Site history and archaeological potential

1.5.1 In 2007 a concentration of Roman coins, building materials and tesserae was uncovered by metal detectorists in the far eastern corner of the field. A geophysical survey was carried out by English Heritage (now Historic England) using magnetometry over the wider villa area with targeted earth resistance survey over the villa buildings (Payne, 2008). The results of the survey show that the villa sits within a series of regular enclosure ditches and trackways. Subsequent small scale evaluation indicated that the mosaic pavement had been greatly disturbed through medieval ploughing, but was likely to date to the late 4th century. Evidence for a hypocaust was also uncovered, as well as a possible remote bath-house to the south west of the main villa structure, which had been revealed by the earth resistance survey. The site had been extensively robbed for building materials in antiquity (Graham, 2009).

1.5.2 Further geophysical surveys within the vicinity have been carried out by Thames Valley Archaeological Services (TVAS). These include magnetometry

carried out in the north eastern corner of the present survey area (Buczek. & Dawson, 2012b), to the south and south east of the villa complex (Buczek. & Dawson, 2012a and Dawson, 2013) and evaluation in the field to the south (Weale, 2013). Further archaeological excavation within the field to the south of the villa uncovered not only evidence for further Roman features including a linear trackway, field/enclosure system and a corn drying oven, but also an early/middle Bronze Age settlement underlying the medieval ridge and furrow (Newton, 2018).

1.5.3 The known archaeological features within and immediately adjacent to the site indicates that there is a very high potential for further archaeological features to exist within the survey area.

1.6 Geology and soils

1.6.1 The underlying geology is mudstone and limestone from the Langport Member, Blue Lias Member and Charmouth Mudstone Formation (Lower Lias) (BGS, 2017).

1.6.2 The overlying soils are from the Oxpasture association which is a stagnogleyic argillic brown earth. It consists of a fine, loamy over clayey soil with slowly permeable subsoil and slight seasonal waterlogging (Soil Survey of England and Wales, 1983).

1.6.3 Magnetometry carried out over similar geology and soil has produced good results. The site is, therefore, considered suitable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

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

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

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

metamorphic rock may also result in magnetic thermoremnance.

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

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20 Hz. 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 range of recording data between ±0.1nT and ±2500nT. They are linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of 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 ±2500nT and clipped for display at ±20nT with values over 15nT highlighted in red and those under -15nT highlighted in blue. The data has also been clipped at ±10nT and ±3nT in order to highlight weaker anomalies. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 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.

2.3.5 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. With regard to the Sensys MXPDA, 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.

2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2016, creating DWG (2010) file formats. All images are externally

referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

2.3.7 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.

2.3.8 A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within the survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.

2.3.9 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over approximately 8.4ha within a single pasture field.

3.1.2 Magnetic anomalies located can be generally classified as positive responses of archaeological potential, positive anomalies of an uncertain origin, anomalies relating to 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. Anomalies located within each survey area have been numbered and are described in 3.4 below with subsequent discussion in Section 4.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. Localised magnetic disturbance was encountered adjacent to the modern steel objects outlined in 1.4.3; however, it is unlikely that it has obscured other anomalies of archaeological origin.

3.2.2 Anomalies located by the survey demonstrate notably stronger enhancement within the western third of the field and correlate with a darker brown soil visible during the survey and on aerial images (Google Earth, 2019). In order to further understand the magnetic variation across the field, mass specific magnetic susceptibility measurements were carried out on three topsoil

samples taken from the western side (darker soil), central northern part and north eastern parts of the field, well to the north of the Roman villa.

3.2.3 The magnetic susceptibility measurements were made using a Bartington MS2 with MS2B sensor. The average value obtained from the western sample (X_{lf}) = **64.5** $10^{-8}m^3kg^{-1}$ with a frequency dependence (X_{FD}) of **9.5%**. The average value from the central northern part of the field (X_{lf}) = **11.4** $10^{-8}m^3kg^{-1}$ with a frequency dependence (X_{FD}) of **4.5%**. The average value from the north eastern part of the field (X_{lf}) = **18.5** $10^{-8}m^3kg^{-1}$ with a frequency dependence (X_{FD}) of **4.3%**.

3.2.4 The measurements demonstrate significantly high levels of enhancement within the western part of the field with low to moderate levels in the central northern and north eastern parts; however, it should be noted that only a small number of samples were taken which may not be fully representative. The variation in frequency dependence (X_{FD}) may also be significant in that the western part of the field has much higher value than the other areas. The X_{FD} value is an indication of the amount of very fine superparamagnetic material within the soil which is often associated with burning and biological activity. The inference from these measurements is that the dark soil relates to intensive human activity and occupation over a long period within the western part of the field with lower levels of activity to the east, and that it is unlikely that the variation in the strength of anomalies located by the magnetometer is related to rapid geological changes across the survey area.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	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.
Anomalies with an agricultural origin	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, hearths and nail spreads from former wooden structures or rooves and may, therefore, be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around these features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 359110 124515, see Figs 03 – 11.

Anomalies of archaeological potential

(1) - Situated within the eastern part of the site is evidence for structural remains associated with the previously surveyed and evaluated Roman villa which is surrounded by rectilinear enclosures.

(2) - Situated 70m to the west of the outer villa enclosure is a parallel linear ditch that has been truncated by ridge and furrow. It joins the northern flanking ditch of the trackway (5) and the parallel orientation of the anomaly indicates that it is likely to be contemporary with the villa complex.

(3) - Located within the central northern part of the survey area are a number of weakly positive rectilinear anomalies forming an enclosure with internal divisions. The response is weak (<2nT) and generally not parallel with other anomalies within the site; however, its date and function is uncertain.

(4) - In the central southern part of the survey area are a number of rectilinear enclosures which appear to have been truncated by the trackway ditches (5). The weak response, lack of clearly defined internal features and truncation by the later trackway ditches may indicate that these enclosures relate to an earlier prehistoric field system.

(5) - Extending along the southern part of the survey area are two broadly parallel linear anomalies that form the flanking ditches of an east west oriented trackway. They are approximately 16m apart at the eastern end, extending to 21m apart where they are joined by linear anomaly (2). As they extend westwards they are 10m apart, and in the far west they diverge to form a north south oriented trackway flanked by enclosures (11, 12 & 13).

(6 & 7) - The survey area contains a number of discrete positive responses. Lying within the central part of the site are a group of at least four discrete responses (6), with two further discrete anomalies (7) immediately west of the outer enclosure of the Roman villa. These anomalies appear to relate to cut features with archaeological potential and their morphology could indicate that they are associated with burials.

(8) - Situated towards the south western corner of the field (Figs 10 & 11) is a positive curvilinear anomaly that appears to relate to a ring ditch feature with a diameter of 19m. In the north eastern part of the ring ditch there is a large pit and a possible complex entrance.

(9) - The southern part of the site contains a large enclosure, defined on its northern side by the southern ditch of the trackway (5) and containing ring ditch (8), several rectilinear enclosures and trackways. There is evidence for several phases of construction and use, with two weakly positive linear anomalies in the eastern part of this complex being a continuation of anomalies (4) which appear to be overlain by a trackway.

(10) - In the western part of the site are a group of positive curvilinear anomalies that relate to a series of intercutting ring ditches that are associated with prehistoric round houses. The data indicate at least eleven ring ditches within this part of the site and at least one further ring ditch situated 35m further west on the western edge of the field.

(11) - A rectilinear enclosure is partially formed by the northern ditch of the trackway (5). The outer and inner enclosure ditches appear to have partially truncated the earlier ring ditches (10).

(12) - Located to the north of enclosure (11) are further square and rectilinear enclosures. There is evidence for internal features including intense burning or possible industrial activity. As they extend to the north they tend to be much less magnetically enhanced which relates to less burnt and humic material within the ditches further away from the settlement core.

(13) - A large number of intercutting rectilinear enclosures lie on the far western

edge of the site. These are associated with enclosures (11 & 12) to the east of the trackway that separates them. The multi-phased enclosures contain at least one earlier ring ditch, with evidence for several others that may have been severely truncated and are, therefore, not clearly defined.

Anomalies with an uncertain origin

(14) - In the north western part of the survey area a a number of discrete positive responses. It is not possible to determine if they relate to cut features.

(15) - A positive linear anomaly appears to lead from close to the north western corner of the villa outer enclosure ditch westwards towards enclosure (3). It is not clear if this relates to a cut, ditch-like feature between the two enclosures as the modern plough trend is on the same orientation and it is possible that it has been caused by agricultural activity.

Anomalies associated with land management

(16) - A positive linear anomaly, parallel with former ridge and furrow (17) contains strong dipolar responses along its length. This relates to a formerly mapped field boundary. The remnants of a pipe or service have caused magnetic disturbance close to the southern end.

Anomalies with an agricultural origin

(17) - Former ridge and furrow extends throughout the site. It has truncated many of the archaeological features.

(18) - The modern cultivation trend is generally parallel with the southern boundary and field margins. This has partially disturbed the fill of the archaeological ditches and enclosures. Not all anomalies have been abstracted.

Anomalies associated with magnetic debris

(19) - Magnetic debris is evident in the south western corner and along the southern edge further east. This relates to dumped magnetically thermoremnant material near the field entrance and around the field margins.

Anomalies with a modern origin

(20) - A negative linear anomaly is associated with strongly magnetic material and relates to a buried pipe or service in the eastern part of the site.

4 DISCUSSION

4.1.1 The survey was carried out in order to assess the archaeological potential of a

proposed development area within the centre of the field. Although the eastern part of the field had been previously subject to geophysical survey, this was included in the current survey to tie in the anomalies with those previously located. In order to gain a fuller understanding of the wider environs surrounding the proposed development area, the western part of the field was also surveyed in order to place anomalies in context.

4.1.2 Previous geophysical surveys have located a Roman villa, situated within a complex of rectilinear enclosures on the far eastern edge of the field (Payne, 2008, Buczek. & Dawson, 2012b). The results of this survey have added some detail to the external and internal structure of the villa (1) and support the evidence for potential furnaces associated with a hypocaust system. It also indicates that although there may be a few isolated pits beyond the confines of the villa enclosures, the villa complex does not appear to extend beyond its northern limit as defined by the outer enclosure ditch situated 90m to the north of the villa. It is, however, possible that there is an associated ditch (2) situated 70m to the east of of the villa complex.

4.1.3 Lying between the outer villa enclosure ditch and parallel ditch (2) are a number of discrete pits (7), with several others situated further west (6). These have dimensions of 1.6m to 2.6m in length and just under 1m in width (6) and 3m by 1.4m and 1.9m by 1m (7). While it is not possible to be certain of the date or function of the pit-like anomalies, the form and dimensions of the anomalies could suggest an association with inhumation burials. Such features are usually difficult to detect with geophysical survey techniques and although it is not certain that they are associated with burials, if they are, it is possible that there could be others that do not have sufficient magnetic contrast for them to be identified as anomalies.

4.1.4 The central part of the site contains a number of rectilinear enclosures (4) on a slightly different orientation to the villa complex. They are very weak (1-2nT) which indicates that they define an area that has been less intensively occupied then other enclosures seen elsewhere in the site (11). They also appear to have been truncated by a trackway (5) which is associated with the villa complex and further Iron Age and Roman features to the west. This truncation by the later trackway indicates that these enclosure ditches (4) pre-date it. Such features could therefore relate to an earlier prehistoric field system and a Bronze Age settlement has been recently excavated 100m to the east of these features (Newton, 2018). Located 50m to the north of the enclosures (4) is a more complex enclosure (3). It has a weak response and is on a slightly different orientation to all the other features seen across the site. It lies within 25m of the group of pits (6); however whether, there is any association cannot be determined.

4.1.5 The western part of the site contains evidence for several ring ditches (10) which relate to probable Iron Age round houses that have been truncated by Roman enclosures (11). They have an internal diameter of between 8m and 13m, although the majority are incomplete as there are several phases of construction and use. A larger, sub-circular ring ditch is situated to the south

(8), it has a diameter of 19m and a large pit at its terminus and its sub-circular appearance indicates that it is unlikely to relate to a round house, although it may have truncated one. A number of enclosures and a trackway are located close to the large ring ditch, but is it not clear if they are contemporary.

4.1.6 Numerous rectilinear enclosures have been identified in the western part of the site (11 & 12). The magnitude of the response on the southern and western sides of enclosure (11) is high (20-40nT) indicating that burnt and humic material associated with occupation debris has become incorporated into the ditches. The enclosures further north (12) are less magnetically enhanced, indicating that they are away from the main core of occupation and are likely to relate to small fields and paddocks. The occupation continues as a series of complex intercut enclosures to the west of the linear trackway. These enclosures contain at least one complete ring ditch, and possibly several others that have been severely truncated.

4.1.7 Measurement of the magnetic susceptibility of soil samples (see 3.2) was not part of the main objective of the survey and was carried out subsequently in order to clarify and improve understanding of the range of magnetic measurements recorded by the magnetometer, and the nature of a significantly darker brown soil in the western part of the survey area. The measurements infer a much more intensively utilised and occupied zone in the western part of the field with a much higher percentage of fine magnetic material, derived from burning and potentially biological activity, when compared to other areas. Although only 3 samples were measured from the site, the values obtained are consistent with the relative range of values obtained by the magnetometer from ditch-like anomalies i.e. much stronger anomalies in the west with lower readings in the central and north eastern areas.

5 CONCLUSION

5.1.1 The detailed magnetometry survey has clearly defined a series of rectilinear anomalies surrounding the Roman villa complex within the eastern part of the field. To the west of the complex the survey located several small clusters of pits. The dimensions of these pits could indicate an association with burials, although this cannot be confidently determined from geophysical survey.

5.1.2 In the centre of the site a number of weakly positive rectilinear anomalies appear to form a possible field system that has been truncated by a later trackway. An enclosure located in the central northern part of the site is more complex but isolated from other anomalies although it may be associated with the possible field system further to the south.

5.1.3 In the western part of the site there are a large number of rectilinear enclosures, ring ditches and trackways. The ring ditches are likely to relate to

prehistoric round houses and there is evidence for several phases of construction with many of them intercutting. These are partially overlain by enclosure ditches forming part of a trackway and also internal enclosure ditches. The Roman villa complex appears to be associated with the trackway, which is oriented east west in the southern part of the site and then extends north south in the western part of the site. It is flanked by numerous enclosures that have ditches containing very magnetic soil probably associated with burning. The anomalies weaken to the north which would generally indicate that they are away from the main core of habitation and activity.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material. Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field. Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried magnetic field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±5nT and ±3nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero (destripe) Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the baseline value of gradiometer sensors.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks, modern agricultural features and other large magnetic bodies within or adjacent to survey areas.

Low Pass Filtering

A mathematical process used to remove high frequency anomalies relating to uneven ground, vibration, etc.

Appendix C – survey and data information

Minimally processed data clipped at ±3nT
Filename: J773-mag-proc.xcp
Description: Imported as Composite from: J773-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 358913.20, 124718.43m
Southeast corner: 359316.25, 124331.73 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 2414682
Dimensions
Composite Size (readings): 2687 x 2578
Survey Size (meters): 403 m x 387 m
Grid Size: 403 m x 387 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.34
Mean: 0.03
Median: 0.00
Composite Area: 15.586 ha
Surveyed Area: 8.4598 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00 nT
5 Clip from -10.00 to 10.00 nT
6 Clip from -3.00 to 3.00 nT

Minimally processed data clipped at ±10nT

Filename: J773-mag-proc.xcp
Stats
Max: 11.05
Min: -11.00
Std Dev: 2.56
Mean: 0.11
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00 nT
5 Clip from -10.00 to 10.00 nT

Minimally processed data clipped at ±10nT

Filename: J773-mag-proc.xcp
Stats
Max: 22.10
Min: -22.00
Std Dev: 3.39
Mean: 0.17
Median: -0.01
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00 nT

Appendix D – digital archive

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

A PDF copy will be supplied to the Somerset Historic Environment Record with printed copies 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	J773-mag-**[area number/name]**.asc J773-mag-**[area number/name]**.xcp J773-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J773-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J773-**[version number]**.dwg	CAD file in 2010 dwg format
Report	J773report.odt	Report text in Open Office odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index	Layer content
Anomalies with archaeological potential		
AS-ABST MAG POS DISCRETE ARCHAEOLOGY	Red 255,0,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS CURVILINEAR RING DITCH	Magenta 255,0,255	Polyline or polygon (solid)
AS-ABST MAG POS STRUCTURAL ARCHAEOLOGY	255,0,127	Line, polyline or polygon (solid)
AS-ABST MAG NEG STRUCTURAL ARCHAEOLOGY	0,78,36	Line, polyline or polygon (solid)
AS-ABST MAG POS ENCLOSURE DITCH	127,0,255	Line, polyline or polygon (solid)
Anomalies with an uncertain origin		
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)
Anomalies relating to land management		
AS-ABST MAG BOUNDARY	127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
Anomalies with an agricultural origin		
AS-ABST MAG AGRICULTURAL	Green 0,255,0	Line or polyline
AS-ABST MAG RIDGE AND FURROW	0,127,63	Line, polyline or polygon (cross hatched ANSI37)
Anomalies associated with magnetic debris		
AS-ABST MAG DEBRIS	132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR	132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin		
AS-ABST MAG DISTURBANCE	132, 132, 132	Polygon (hatched ANSI31)
AS-ABST MAG SERVICE	132, 132, 132	Line or polyline

Table 3: CAD layering

Appendix F – copyright and intellectual property

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Survey location

N

Archaeological Surveys Ltd

Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Map of survey area

Survey location

Site centred on OS NGR
ST 59110 24515

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

Archaeological Surveys Ltd

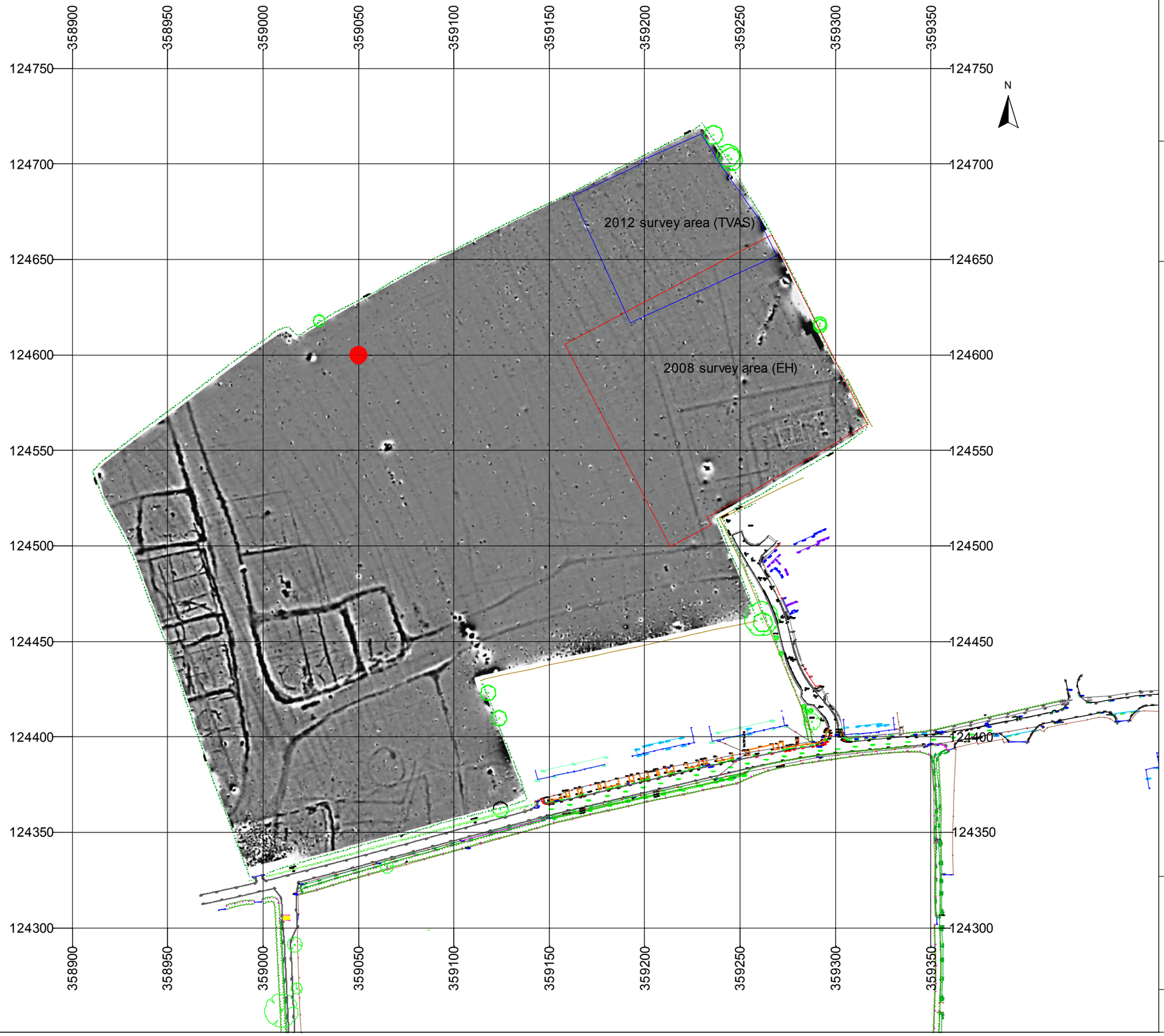
Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

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

359050 124600



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SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 02

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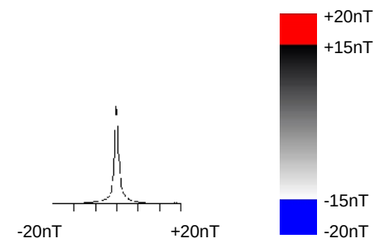
Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Greyscale plot of minimally processed magnetometer data clipped at ±20nT



SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 03

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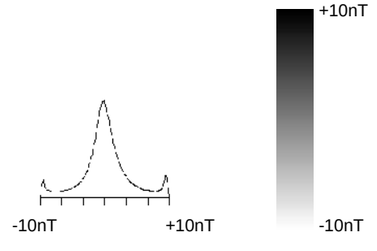
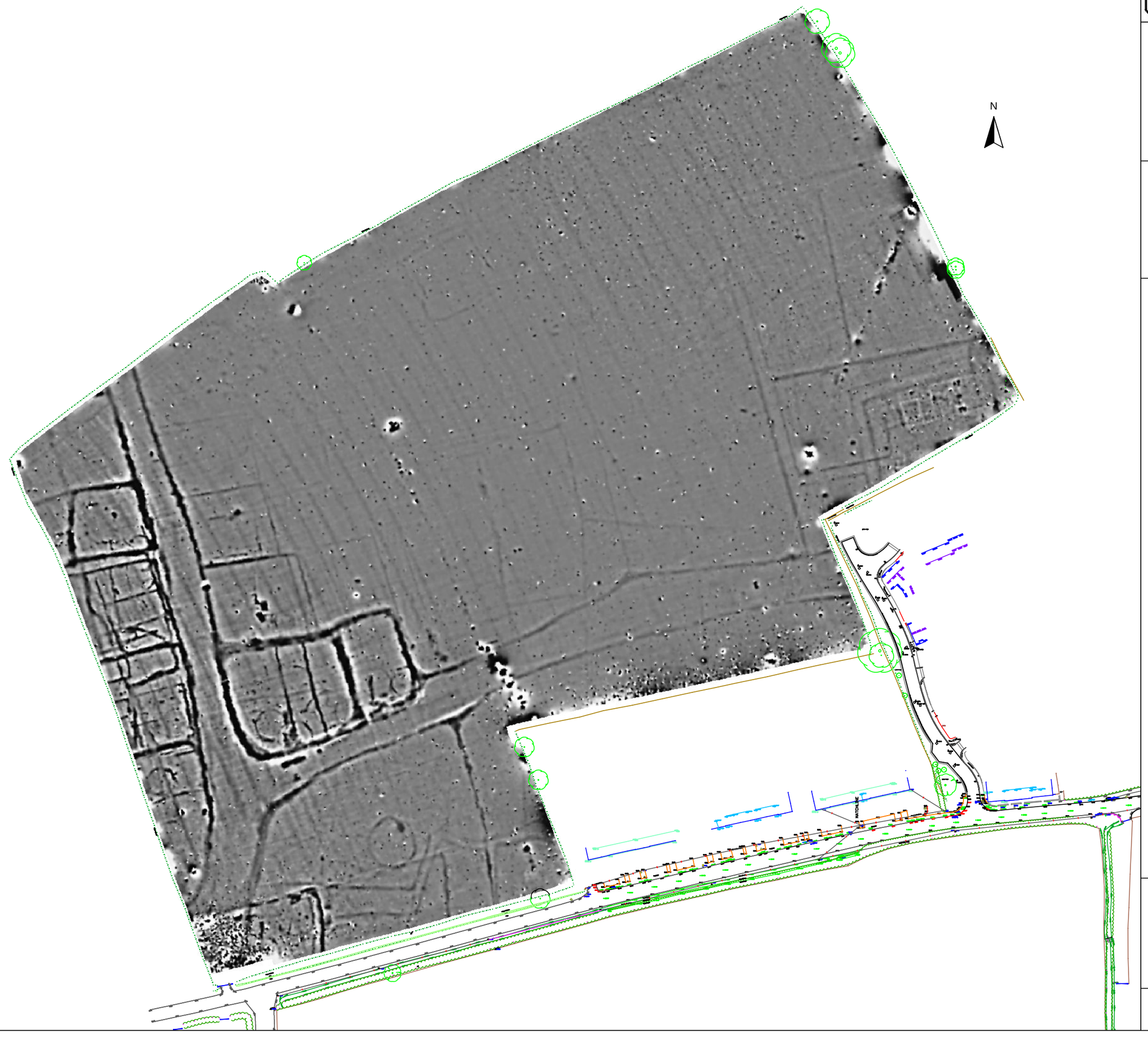
Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Greyscale plot of minimally processed magnetometer data clipped at ±10nT





SCALE 1:1500

0m 10 20 30 40 50m

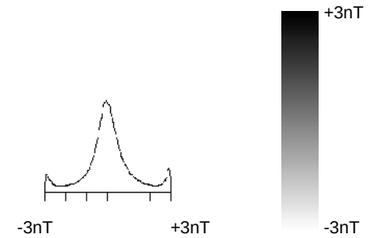
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

Archaeological Surveys Ltd

Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

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



SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05

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Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - cut feature of archaeological potential
- Positive rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Negative linear anomaly - structural remains assocaited with Roman villa
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Linear anomaly - ridge and furrow
- Positive linear anomaly - former field boundary
- Discrete strong positive response - possibly associated with burning
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - service / pipe
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 06

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Queen Camel
Somerset

Abstraction and interpretation of magnetic anomalies with an archaeological origin

- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear/rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Negative linear anomaly - structural remains assocaited with Roman villa
- Discrete strong positive response - possibly associated with burning
- Discrete positive response - cut feature of archaeological potential

SCALE 1:1500

0m 10 20 30 40 50m

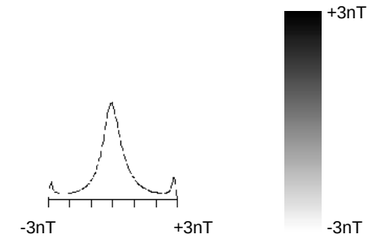
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 07

Archaeological Surveys Ltd

Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Greyscale plot of minimally processed magnetometer data - east



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 08

Archaeological Surveys Ltd

Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Abstraction and interpretation of magnetic anomalies - east

N

17
15
3
14
6
7
1
2
4
5
16
20
11

- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear/rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Negative linear anomaly - structural remains assocaited with Roman villa
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Linear anomaly - ridge and furrow
- Positive linear anomaly - former field boundary
- Discrete strong positive response - possibly associated with burning
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - service / pipe
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

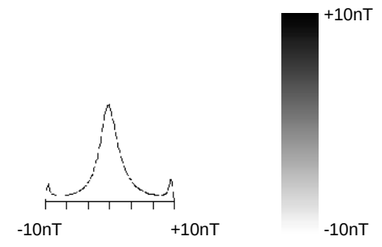
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 09

Archaeological Surveys Ltd

Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Greyscale plot of minimally processed magnetometer data - west



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 10

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Geophysical Survey
Land north of West Camel Road
Queen Camel
Somerset

Abstraction and interpretation of magnetic anomalies - west

N

- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear/rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Linear anomaly - ridge and furrow
- Positive linear anomaly - former field boundary
- Discrete strong positive response - possibly associated with burning
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - service / pipe
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 11