Butterfly Solar Farm
Wrexham

Archaeological Geophysical Survey

National Grid Reference: SJ 33963 45632
AOC Project No: 40759
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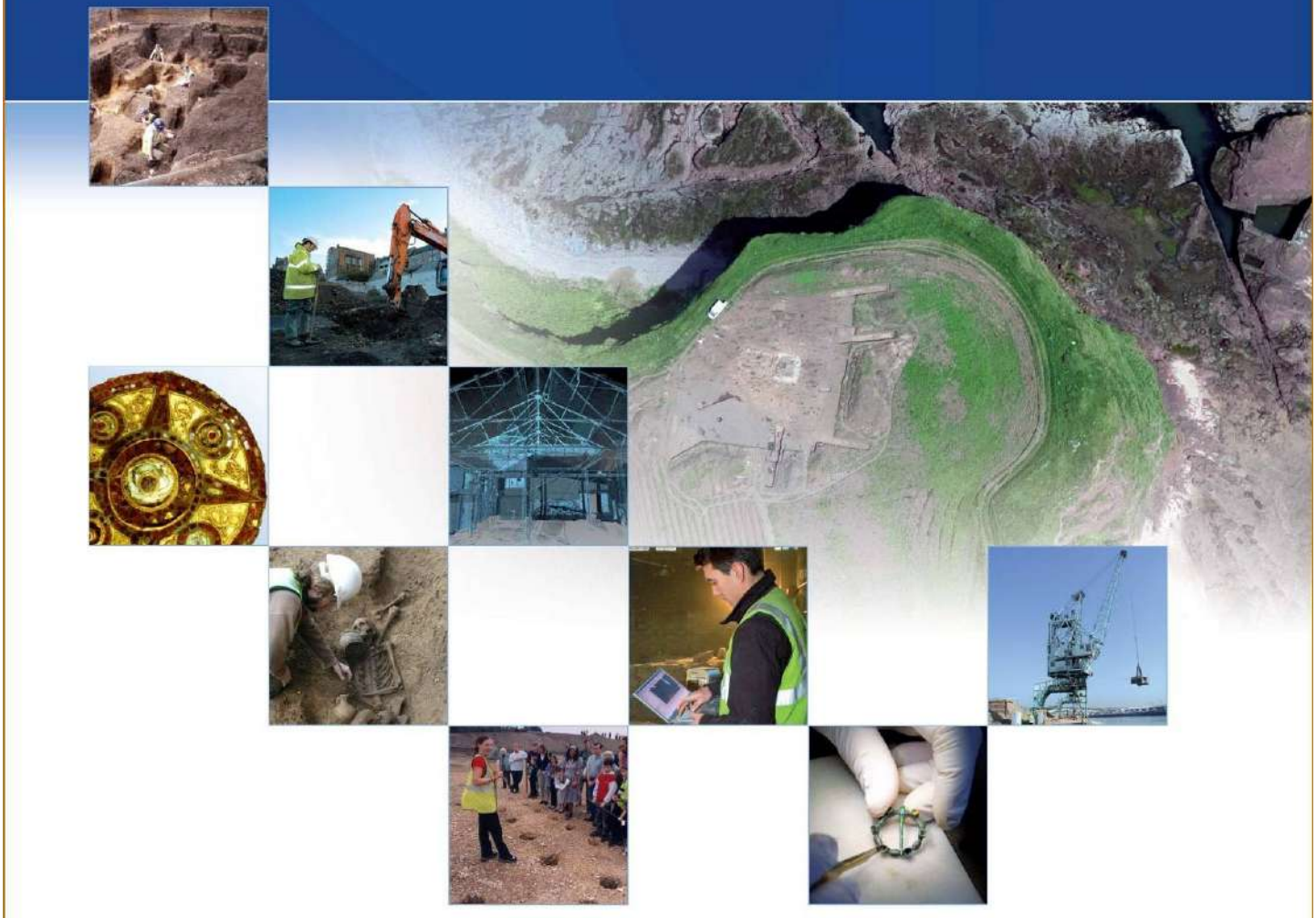

AOC Archaeology Group

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Butterfly Solar Farm, Wrexham

Archaeological Geophysical Survey

On Behalf of:	**Axis** **Well House Barns** **Brelton** **Chester** **CH4 0DH**
National Grid Reference (NGR):	**SJ 33963 45632**
AOC Project No:	**40759**
OASIS IC	**aocarcha1-526997**
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This document has been prepared in accordance with AOC standard operating procedures.

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Non-Technical Summary

AOC Archaeology Group was commissioned by Axis to undertake an archaeological geophysical survey, using the magnetic gradiometry method to investigate the potential for buried archaeological remains prior to a proposed solar development at Butterfly Farm, Wrexham, centred at NGR SJ 33963 45632.

The survey area totals 136ha, of which 134.7ha were successfully completed. This is split into three contiguous blocks of survey with a western central and eastern block. The western cluster of parcels lies immediately east of A483 and is centred on SJ 31629 46360. The central cluster is situated east and west of Marchwiel Road, north of the B5426 and centred on SJ 33963 45632. The eastern cluster is located south of Kiln Lane and centred on SJ 36804 46073.The western block is largely pasture on sloping land, whereas the central and eastern blocks are lower lying, flatter and in use for arable (maize) cultivation. The 1.25ha that could not be surveyed were areas where ground conditions at the time of survey meant work could not be safely completed due to deep mud, standing water and tractor ruts.

The geology of the survey area has produced strong anomalies in response to human activity, as evidenced by the strong anomalies related to ploughing in the western part of the survey area. This tendency combined with noise related to green waste in the central and eastern parts of the survey area has reduced confidence in the interpretation of the data as it is likely that weaker anomalies have been masked by these stronger enhancements. However, as the survey has successfully identified anomalies of archaeological interest in all three survey blocks, as well as known features attested on historic maps, it is unlikely that substantial archaeological remains have gone undetected by the surveys.

In the western block, a probable oval enclosure of roughly 95m by 75m has been identified on a spur of higher ground overlooking Black Brook and the course of Wat's Dyke, which pass this survey block to the east. Anomalies interpreted as possible field systems or further enclosures have been identified to the north and west of this feature. There are also potential internal features within the hilltop enclosure. In the central survey area, there are isolated linear anomalies interpreted as possible portions of boundaries or enclosures of uncertain date.

In the eastern survey block, a possible ring ditch has been identified with a diameter of around 15m, suggesting it is funerary in nature rather than settlement. There are linear and curvilinear anomalies of uncertain date and form that are also possibly of archaeological interest in close association with this anomaly.

Historical features such as former boundaries and tracks have also been identified in all three survey blocks, and in the central and eastern areas there are a high number of former ponds, likely to be related to marl pits, throughout the survey area.

Ridge and furrow cultivation marks are also present in all three areas, but especially prominent in the western block; this is likely to be a result of differential survival due to differences in subsequent land use, rather than a reflection of the actual distribution of medieval arable fields.

Generally speaking, the results are consistent with the known archaeological background of the area which suggests little in the way of prehistoric activity (though the ring ditch, if actually present, is likely prehistoric in date), with the area coming into agricultural use in the medieval period, continuing to the present day, albeit with different uses of the enclosed land over time. The presence of the hilltop enclosure overlooking the Wat's Dyke boundary work hints that this feature may date to the early medieval period, but this is not possible to ascertain solely on the geophysical data.

1 Introduction

1.1 AOC Archaeology Group was commissioned by Axis for RWE Renewables UK Lld to undertake an archaeological geophysical survey using magnetic gradiometry of three clusters of land between Johnstown Interchange A483 and Bango-On-Dee in the Borough of Wrexham. The survey was commenced on 5th July 2024 for a period of 2 weeks in the western and central survey blocks. Work in the eastern survey block commenced on 29th October 2024 and was completed on 27th November 2024 as part of a wider programme of archaeological assessment in advance of the proposed development of the site. The planned survey area was 136ha, of which 134.74 ha was completed, c.1.3ha was unsuitable for survey due to ground conditions.

1.2 Archaeological geophysical survey uses non-intrusive and non-destructive techniques to determine the presence or absence of anomalies likely to be caused by archaeological features, structures or deposits, as far as is reasonably possible (CIfA 2014, updated 2020). It is therefore a common component of the process of evaluating the impact of development on the historic environment. It is also a key tool in archaeological research as it is non-destructive and able to cover large areas, to allow below ground interventions to be appropriately targeted.

1.3 This survey was carried out to provide information on the presence, character and extent of potential buried archaeological remains within the proposed development site. The significance of any such remains can only be determined with reference to further information; as such this report may form part of an assessment of significance, but cannot stand alone as such.

2 Survey Area Location and Description

2.1 The proposed development site (hereafter 'the survey area') covers three clusters of land parcels situated between the Johnstown Interchange of the A483 in the west to Bangor-On-Dee in the east. The western cluster of parcels lies immediately east of A483 and is centred on SJ 31629 46360. The central cluster is situated east and west of Marchwiel Road, north of the B5426 and centred on SJ 33963 45632. The eastern cluster is located south of Kiln Lane and centred on SJ 36804 46073.

2.2 The western most survey area covers 19.65ha across seven of fields consisting of six pasture fields and one cut silage field immediately east of A483 at Johnson Interchange across an access bridge from Haford Cottages (Figure 2). The central survey area covers 65.19ha across 16 field consisting of 11 fields of cut silage and five of young maize crop situated east and west of Marchwiel Road, north of the B5426. The eastern survey area covers 49.9ha, consisting of six harvested crop fields south of Kiln Lane. The topography of the western area slopes downhill north-northwest to south-southeast from c98m to c.93m above Ordnance Datum (aOD), the central area predominantly slopes downhill southwest to northeast from c.95m to c60m aOD, and the eastern area predominantly slopes downhill north to south from c.51m to c.15m aOD.

2.3 The recorded solid geology underlying the western survey area consists of mudstone of the Etruria formation, mudstone, sandstone and conglomerate of the Salop formation underlie the central survey area and the west of the eastern survey area, and sandstone of the Kinnerton Sandstone formation underlies the east of the eastern survey area. These geologies are overlain by superficial deposits of diamicton of Devensian, except for sand and gravel deposits in the southern half of the western survey area, (BGS 2025). The soils within the survey area are loamy and clayey, which are slowly permeable, seasonally wet and slightly acid but base-rich (Soilscapes 2025).

2.4 Magnetic gradiometry typically provides a variable result mudstone and sandstone geologies overlain by till and river terraces (David *et al.* 2008: 15). In this instance, the soil and geological environment of the survey area has both helped and hindered the interpretation of the survey results. On the one

hand, particularly in the western part of the survey area, the soils appear to be readily enhanced by human activity in the landscape, resulting in strong anomalies. However, this means that strong anomalies from medieval and later cultivation may be masking weaker anomalies in the same areas. The central and western parts of the survey area have different parent material and different local hydrologies which have resulted in heavier soils. These soils, in the few fields which do not appear to have been greatly altered by manuring and treatment, are not as readily enhanced as those in the west but they do have some natural degree of speckling and mottling evident in the results, reflecting natural variations. The soils in the central and eastern areas have however been heavily modified by the addition of what is likely to be 'green waste' – organic material added to the soils to improve their texture. Unfortunately this material is contaminated with small ferrous debris which forms a blanket of noisy response in the areas so treated. Where there are strong anomalies present, these can be seen through the making effect of the green waste, but it makes interpretation less secure, and masks weaker anomalies.

3 Archaeological Background

3.1 The archaeological background below is a summary of information from a Historic Environment Assessment (HEA) in preparation by AOC Archaeology, the methodology of which is outlined in a Environmental Impact Assessment Scoping Report (Axis 2024). The sites outlined below lie within the 1 km study area around the survey areas, the given numbers in the text refer to the asset/event number given in the HEA and should be followed up within that document as the full gazetteer has not been reproduced for brevity.

Prehistoric (500,000 BC – AD 43)

3.2 The only recorded remains associated with prehistory within the 1km study area include a Bronze Age ring-ditch (649) and prehistoric enclosures (646-648) at Royton, south of the eastern survey block.

Romano-British (AD 43 – AD 410)

3.3 North of the central survey area at Wood House in Marchwiel, coins (526 and 527), spindle whorls (528), and a brooch (525), and other materials of this period are recorded as findspots (701-704),

Medieval (AD 410 – AD 1540)

3.4 Wat's Dyke, a major early medieval boundary work crosses the survey area just east of the western survey block. This is a scheduled monument, as described in the HEA under asset 35. There are further possibly related linear earthworks at Ruabon (695, 696), and a beacon site at Pentre Clawydd, beacon (694), north east of the western survey block.

3.5 Around the central block of the survey area, extant ridge and furrow earthworks are recorded at The (680-681), close to the central parts of this block. North west of the central block, the deserted medieval village of Old Sontley is visible as cropmarks (544). At Kiln Farm, north of the central blocked there is a moated area, claypits and extant ridge and furrow (383-384)'. Further extant ridge and furrow is recorded at Stryr-yr-hwch Farm (662), also just north of the central survey block. At Pentre Mailyn, east of the central block, the findspot of a Dress Hook (580) is recorded. South of here, and east of the centre of the central block, at Plasse there is a Moated site (603), and further ridge and furrow (605).

3.6 Northeast of the eastern survey block, there are extant areas of ridge and furrow at The Hollies (675-677), Chetwynd Grove, (296), and Hollyhedge (380). East of the eastern block, there are medieval farm buildings at Porthwgan (624), Pen-y-bryn (584) and Plas Fron (587). South of the eastern block, the findspot of a Seal Matrix is noted at Bangor is Y Coed (268).

3.7 In the medieval period, the central and eastern parts of the survey area seem to have been in active use for agriculture and settlement in small villages or around moated sites. In the western part of the survey area, the evidence for settlement and farming is less clear, but the boundary works and beacons suggest this was an active border area under contention.

Post-medieval – Industrial Period (AD 1540 – 1901)

3.8 Within the eastern survey area, features dating to the post medieval period include ponds at Gerwyn-Fechan ponds (346-348). Just outside the survey area further ponds and marl pits are recorded at Gerwyn-Fechan Marl pits (346-348) and an associated farmstead (345), Rosemead house and marl pit pond (642,643) also lie close to the area as does a farm building at Gwrych-teg (350),

3.9 Close to the central survey area, there are buildings at Plas Eyton (586-587), a milestone at Erbistock, FLT_RUBG03 (317) and farm buildings and well at The Groves (670-671), which all also date to this period.

3.10 The western survey area sees the most substantial changes during this period, with the Vauxhall colliery operating to the west and southwest of the survey block. Some elements of the colliery survive as buildings and tramways (688-692). Legacy colliery operated north of the western survey block, and a coal shaft survives there (386). A colliery and brickworks also operated at Hafod (359), immediately west of the western survey block, and many elements of this survive Hafod house, cottages, ponds and brickworks (358, 362, 363 and 365-377). There are also multiple buildings, both related to farms but also public buildings, New Hall House (652), Ty-coch, (682-687), Rhostyllen, (639), Rhosllanerchrugog, Mount Pleasant Baptist chapel (534) and a building at Kiln Farm (382). At Old Sontley ponds (547-572), farm buildings and footbridge (543 and 545) date to the post medieval period. The findspot of a shilling of James I (524) is recorded at Marchwiel.

3.11 In the central part of the survey area, the newer settlement of Crabtree Green with a church and blacksmiths (299-301) dates to this period. Numerous farm buildings are recorded as dating to this period: Crymbal Farm and a boundary stone (314 and 315) and a building at Round Woo (644). To the southwest, Gyfelia, Penyfron barn (706), Whitegate farm building (699), Gyfelia settlement, farmhouse footbridges and sluice (351-357), Aberderfyn Colliery (263), Moreton Manor farm, farm building and ponds (530-533) all date to this period. To the north, the North Wales Mineral Extension Railway (534), Bangor Road Milestone (269), Moreton Manor Farm, house and ponds (530-533), Yewtree Cottages (708), Ruabon, Moreton Farm, farmstead (650), The Willows farmstead and farm building (678, 679), and Stryt-yr-Hwch Farm (623) all date to this period. To the east: Plas Grong farm and building (589-590), a building at Plassey farm (591), Plassey platform (604) and ponds at Maelor Saesneg are all post medieval in date (399-519). Finally, to the southeast of the central block, buildings, spoil-heaps and tramway at Plas-y-Clawdd (606-611), a farm building at Eyton House (336) and a building at Pen-y-bryn (584) are also from this period.

3.12 West of the eastern survey block, there is a listed house (246). To the north buildings at Pont-y-ffrwd (622-623 date to this period. Northeast of the eastern survey block, Maes y Nant house (520), an orchard at Chetwynd Grove (295), and a farm building. milestone and a marl pit at The Hollies (672, 674, 673) are all from this period. Finally, south of the eastern block, the farmstead at Gerwyn-Fechan (345), and a building at Royton farm (645) were built during this time.]

Modern (1901 – present)

3.13 Within the eastern survey area, the crash site of a Republic P-47C Thunderbolt 41-660 (625). At Plassey, close to the central survey area, further clays pits date to the modern period, as does quarrying to the south west of the western survey area at Hafod.

Unknown Date

3.14 Within the eastern survey area near Gerwyn Fechan there are linear cropmarks (342) of undetermined date, and south of the central area there is a further crop mark of an undated enclosure at The Fields (669).

4 Aims

4.1 The aim of the geophysical survey was to identify anomalies that suggest the presence of archaeological remains, in order to enhance the current understanding of the historical environment within the survey area.

4.2 Specifically, the aims of the gradiometer survey were:

- To locate, record and characterise any potential surviving sub-surface archaeological remains within the survey area
- To produce a comprehensive site archive (Appendix 1) and report

5 Methodology

5.1 The geophysical survey was undertaken between 05/07/2024 and 27/11/2024.

5.2 All geophysical survey work was carried out in accordance with current good practice specified in the EAC guidelines document (Schmidt *et al.* 2015), as recommended by Historic England, and in the Chartered Institute for Archaeologists' *Standard and Guidance for Archaeological Geophysical Survey* (2014, updated 2020).

5.3 Parameters and survey methods were selected that were suitable for the prospective aims of the survey and in accordance with recommended professional good practice (Schmidt *et al*. 2015).

5.4 Digital photographs of every survey parcel were taken before, during and after geophysical survey to show any changes to field conditions following the programme of works. The photos were downloaded and stored off site, and relevant examples are included as Plates # to # in this report.

5.5 The presence of crops of varying stages of growth within the survey period as well as wet ground conditions resulted in the use of three different data collection methods being employed for this survey. Most of the survey was carried out using an ATV towed Sensys cart system in the summer period, with a small amount being carried out by hand in the central area, and with a hand pushed cart in the western and central areas. In the winter, survey with the hand pushed cart was attempted in the eastern survey block, but conditions in much of the area were unsuitable due to wet ground and deep ruts, and so the rest of the area was collected using hand-held instruments. The methods for each instrument are described below.

5.6 Fluxgate gradiometer survey data was collected using three different systems: 69.84ha collected using a SENSYS cart system, 50.84ha collected with a Bartington 601-2 handheld system, and 15.06ha collected using a Bartington hand-pushed cart system.

5.7 The survey with the **Sensys MAGNETO® MXPDA towed-cart magnetometer system** utilised up to sixteen FGM650/3 fluxgate gradiometer sensors mounted upon a frame along with data logging equipment and batteries (see Appendix 2).

5.8 Data was collected using zig-zag traverses alongside a constant stream of GPS data collected through a Carlsen BRx7 GPS, enabling the collected data to be spatially georeferenced without the need for a

pre-determined grid system. The data and measured tracks were collected through the data acquisition unit MXPDA and visualised through a tablet computer in the front of the ATV.

5.9 The area surveyed using the SENSYS cart system was 69.84ha, 18.65ha in the western survey area and 51.19ha in the central survey area.

5.10 Following data collection the data was transferred onto a usb stick and transferred onto a PC for processing and visualisation using the bespoke Magneto (Sensys) software. The details of these processes can be found in Appendices 2 and 3.

5.11 Survey using the **Bartington Grad601-2 hand-held system** utilised two fluxgate gradiometers (see Appendix 2). The survey was conducted within a grid system, across grids measuring 30m by 30m which were marked out using temporary markers at each grid node.

5.12 Grid nodes were set out and recorded using a Trimble R8 / R10 dGPS with an error no greater than +/- 0.05m. The GPS system uses the Trimble “VRS Now” service to provide instant access to real-time kinematic (RTK) corrections enabling an accuracy of < 2cm. It was connected via a SIM card run on the Vodafone network with good cellular signal in the survey areas, meaning a repeater was not required.

5.13 Data was collected in the field using zig-zag traverses, with a sample interval of 0.25m and a traverse interval of 1m. Approximately 50.84 ha, 12.44ha in the central survey area and 38.4ha in the western survey area were collected using this method.

5.14 Before each session of use, each gradiometer was balanced around a single set up point within the survey area specifically chosen for use by all instruments used in the survey. This point is magnetically quiet and balancing the machine around this point, produces a more uniform dataset throughout and allows all data to be plotted with ease within a standard range as appropriate to the survey environment. Striping of the data may occur due to instrument drift; it is decided in the field if this is within a sensible and acceptable limit; if it is not, the grid(s) in question are re-collected.

5.15 The gradiometer data were downloaded using Bartington Grad601 PC Software v313 and processed using Geoscan Geoplot v4.0, the details of which can be found in Appendices 2 and 3. Data processing, storage and documentation were carried out in accordance with the good practice specifications detailed in the guidelines issued by the Archaeology Data Service (Schmidt and Ernenwein 2009).

5.16 **S**urvey using the **Bartington Non-Magnetic Cart** system utilised six Grad-01 fluxgate gradiometer sensors mounted upon a carbon fibre frame, along with data logging equipment and batteries (see Appendix 2). Before each session of use, the cart system was balanced around a single set up point within the Site specifically chosen for being magnetically quiet. Balancing the machine around this point produces a more uniform dataset throughout and allows all data to be plotted with ease on the same palette.

5.17 Data was collected using zig-zag traverses alongside a constant stream of GPS data collected through a Trimble R10 GPS, enabling the collected data to be spatially georeferenced without the need for a pre-determined grid system. The data was logged on a laptop mounted to the cart using Geomar MLGrad601 software.

5.18 The area surveyed using the Bartington cart system was 69.84ha, 1ha in the western survey area, 2.56ha in the central survey area and 11.5ha in the eastern survey area.

5.19 The data was downloaded from MLGrad601 and converted into a .xyz file in Geomar MultiGrad601 before being processed along with the GPS data in TerraSurveyor v3.0.34.10. The details of these processes can be found in Appendices 2 and 3.

5.20 With each survey technique, care was also taken to attempt to avoid metal obstacles present within the survey area, such as metal objects within and adjacent to the survey area as gradiometer survey is affected by 'above-ground ferrous disturbance' and avoiding these improves the overall data quality and results obtained.

5.21 Interpretations of the data were created in ArcGIS Pro and the technical terminology used to describe the identified features can be found in Appendix 4.

6 Results and Interpretation

6.1 The gradiometer survey results from all three instruments have been visualised as greyscale plots, with the processed data plotted at -1nT to 2nTas seen in Figures 3 and 5. These were combined in the GIS and used alongside current and historical maps to produce an interpretation of the data, which can be seen in Figures 4 and 6. An individual characterisation of the numbered identified anomalies of interest labelled in Figure 6 is given below. Figure 7 shows minimally processed data plotted as XY traces at 50nT/cm at A3.

6.2 Appendix 4 contains a guide to the interpretation categories employed and the logic used to assign anomalies to specific classes, as well as a short discussion of how past human activity results in these anomalies, however, some important points are noted below:

6.3 The classes have three sub-types (generally): anomalies (typically indicated by a solid colour polygon), spreads (a stippled polygon) and trends (a line with a colour matching the polygon colour). *Anomalies* refer to distinct changes in the survey data which suggest an abrupt boundary between materials below ground, such as a cut feature with a magnetically contrasting fill. *Spreads* of enhanced material refer to diffuse areas of altered magnetic contrast which suggest a localised spread of material with a magnetic contrast within the topsoil or ploughzone. Linear *trends* are less distinct and are typically visible as linear patterning in the overall texture of the data. A common example of these is the striping effect caused by recent ploughing.

6.4 Anomalies placed in the '*Uncertain'* class may have an archaeological origin, but other explanations are equally likely. Where any particular interpretation is *more* likely than others, the anomaly is assigned to that class.

6.5 The definite '*Archaeology'* class is only used for anomalies with no other possible explanation, either due to their diagnostic characteristics or because they are corroborated by other sources such as previous interventions within the survey area. Anomalies with magnetic characteristics or morphologies that suggest an archaeological origin will generally be assigned to the '*Possible Archaeology'* class.

6.6 The anomaly type '*Ferrous Spike'* is assigned to strong dipolar anomalies which cover a small spatial area and have a characteristic appearance in the XY traces of the survey data. These are strongly likely to be of recent origin in the form of magnetic or ferrous debris within the topsoil; 'spikes' of other origin will be assigned to their appropriate classification.

6.7 A distinction is made between modern *disturbance* from strongly ferrous materials within or adjacent to the survey area, such as the strong dipolar 'halos' produced by services like gas mains, and spreads of material within the topsoil causing noise that is assumed to have a recent origin. Generally speaking,

'*Modern Disturbance'* occurs at a distance from a magnetic source, whereas *modern magnetic spreads/debris* are related to material directly at that location.

6.8 Generally, only anomalies (or groups thereof) of a likely archaeological or historical origin have been assigned an anomaly number on the interpretation figures. However, anomalies interpreted as resulting from other processes that are integral to the discussion of the results have also been assigned anomaly numbers.

Western Block

6.9 This survey block is the least impacted by the green waste spreading (a type of soil improvement that can introduce small metal pieces into the topsoil), probably because recent land use has been as pasture aside from the southern most field, marked W7 in figure 2.2. In the central fields of the block there are strong anomalies characteristic of ridge and furrow cultivation, with slightly curved alternating positive and negative linear trends in a variety of orientations. The strength of these anomalies suggests that the soils here are readily enhanced in response to human activity. In the southern large parcel, there is some banding characteristic of variations in the underlying geology, along with a degree of natural speckling which is also evident in the rest of the area away from the strong cultivation trends. Two services cross this survey block, though neither of them have strong disturbance haloes impeding interpretation. Overall of the three survey blocks, this area has the highest confidence in the interpretation as the soils appear to be receptive to enhancement, but there has been less modern adulteration of them resulting in less noise and easier to discern anomalies.

Archaeology, possible archaeology

6.10 In the eastern side of the central part of the survey area, in parcel W2, there is a curving strong positive anomaly, characteristic of a cut feature with an enhanced fill **W_A**. This is mirrored by a weaker positive anomaly forming an opposing arc **W_B** – together these enclose an oval area of roughly 95m by 70m on a slight spur overlooking Black Brook and Wat's Dyke immediately to the east of here. There is an area of general enhancement (**W_B**) and further linear (**W_C**) anomalies within the enclosed area, The enclosure boundary and the internal features all seem to underlie the ridge and furrow anomalies in this location. North of this in the same parcel there is a further discontinuous linear positive anomaly **W_**E, which may be a further boundary ditch or possibly the headland from cultivation. In the parcel north of this, W1, concentrated in the western part, there are a series of positive linear anomalies and trends which are in a roughly rectilinear pattern **W_F**, but without continuity between elements. These are possibly undated field boundaries or enclosures. Similar anomalies continue south into the western edge of parcel W2.

6.11 In the southern edge of W4, there is a strongly positive linear anomaly running east-west that makes a right-angled turn to the south out of the survey parcel **W_G**. This is characteristic of a boundary or sub-enclosure but does not match those depicted on available maps and so may predate them. There are further ephemeral rectilinear trends in the east of this parcel which may be further weakly enhanced ditches or boundaries.

6.12 In the central part of parcel W8 there is a linear group of strongly enhanced discrete anomalies marked **W_H**. These may be discrete features such as pits, but they may also be a stronger version of the natural mottling seen to the west of these anomalies (discussed below). They may also relate to marl extraction, and therefore be a mixture of natural and human in origin.

Historical Features

6.13 In the western part of parcel W8, a weakly positive linear trend, **H_i** has been identified in a location that corresponds to a former field boundary shown on the 1st edition Ordnance Survey maps of the area; as shown in Figure 4.0.

Unclear Origins

6.14 Though the results in this block of the survey are clearer than elsewhere in the survey, there are still anomalies that have been difficult to place in any category with certainty. There are two spreads of material forming dipolar responses, marked **W_J.** These are similar to the anomalies associated with former ponds and marl pits seen in the central and eastern survey blocks, but no such ponds are marked on the available historic maps in this location.

6.15 A group of strongly positive linear anomalies **W_K** in the southwest corner of W1, which have a morphology similar to the herringbone pattern of field drains, but with difference magnetic characteristics than would be expected for these.

6.16 They do lie close to the former field boundary, which is flanked to the east by further similar linear trends, **W_L**. These may be ploughing trends or may be former boundaries representing different phases of a boundary that has migrated east-west over time.

6.17 Further weakly enhanced linear trends, or linear breaks in the background texture of the survey results have been identified throughout the western block. These may result from any of a number of causes with equal likelihood, such as historical or recent cultivation, natural variations, or past human activity of possible archaeological interest. The features causing these anomalies are likely to be shallow or ephemeral.

Agricultural

6.18 The central and northern parts of the survey block have clear alternating linear positive and negative anomalies characteristic of ridge and furrow cultivation, some of which is clearly medieval in date as indicated by the curving lines. These occur on multiple orientations both overall, and in some areas, overlying each other. There are multiple orientations within one modern field, as in W2, which suggests this parcel was subdivided into smaller fields in the past.

6.19 In the south and west of the survey block, there is some evidence of more recent cultivation in the form of more closely spaced, and less clear linear trends. These are indicated with dashed lines, and only a representative sample have been drawn so as not to dominate the interpretation plots. Ploughing trends of this character are later in date, either from the post-medieval period or the much more recent or immediate past.

Non – Archaeology

6.20 Two services cross the survey area, both with distinct and different anomaly characteristics. The first crosses the area roughly north-south, **W_M**. The anomaly consists of a linear series of discrete positive anomalies with a corresponding negative halo at set distance from each other. The halo of disturbance is relatively small and has little impact on the interpretation on nearby anomalies. This magnetic pattern has been observed before in older services such as water conduits, but also in association with modern fibreoptic cables for high-speed data connections.

6.21 The other service crosses the northern part of the survey block from the south west to the north-east, **W_N**, and terminates somewhere between parcels W5 and W2, though there is a linear trend of uncertain origin which may relate to the removal of a section of this service. The anomaly is a series of irregular alternating positive and negative strong anomalies, with a somewhat wider halo of

magnetic disturbance. The anomaly polarity and form is somewhat irregular, suggesting the service may not be intact below ground.

6.22 A band of gentle variation in the background texture and general magnetic anomaly strength has been identified along the western and northern sides of parcel W7. This type of banding typically originates from natural variations in the soils or parent material of the survey area.

6.23 The expected magnetic disturbance associated with modern infrastructure is also preset within the survey results, with halos along field margins related to ferrous material used in the boundaries. There are also strong anomalies and disturbances from overhead powerlines which cross parcels W2 and W1. These disturbances have not caused significant problems for the interpretation of the survey results. There are also numerous ferrous spikes, especially in areas affected by the green waste – these have not been drawn so as not to overwhelm the interpretation drawings.

Central Block

6.24 In the central block of the survey, the results have been affected to a moderate degree by both a generally noisy and readily enhanced background magnetic environment, and the probable introduction of green waste as a soil improver in the majority of the parcels. This has overall resulted in a noisy overall appearance where dense recent ploughing trends are the most visible anomalies. Nonetheless it has been possible to recognise patterns within the noise, or stronger anomalies that have not been fully masked by it, and which are discussed below.

Archaeology, possible archaeology

6.25 No anomalies have been identified in the results that are unequivocally of archaeological origin, but there are some where an archaeological explanation is considered the most likely cause.

6.26 In the northern part of parcel C4, along the eastern margin there is a group of strong linear positive trends, **C_A,** that form a small rectangular anomaly which appears to continue beyond the survey margin. This is interpreted as a possible enclosure or similar feature of uncertain date, with possible extensions to the north.

6.27 In the centre of parcel C8 there are a pair of orthogonal positive linear anomalies characteristic of ditches of some sort. This pair, **C_B**, occur in relative isolation so it is not possible to suggest a further date or function for them, but they appear to be boundary ditches of some sort. A curvilinear positive anomaly to their west may relate to the boundary or may be a separate feature.

6.28 East of these anomalies in parcel C9, there are a series of weaker rectilinear and curvilinear trends, **C_C,** which may be a further continuation of the boundary system or which may be unrelated; the anomalies are too ephemeral and discontinuous to suggest a more robust interpretation for them.

6.29 In parcel C14, south of an anomaly interpreted as a former pond (see below), there is a curved arc of discrete strongly enhanced anomalies, **C_D**. These have been interpreted as being of possible archaeological interest, though they may instead be related to the former pond or to natural variations.

6.30 In parcel C3 in the west of the survey block, there is a stronger positive rectilinear anomaly similar in character to those noted at C_B. These may be from a similar partially detected (or partially surviving) enclosure of uncertain date.

6.31 There are further isolated linear trends which are also of possible archaeological interest, such as those in parcel C_10, marked **C_E**.

Historical Features

6.32 Numerous former ponds (possibly originating as marl pits) are depicted throughout the central block of the survey area on the 1st Edition Ordnance Survey maps. These are clearly visible in the survey results as two slightly different types of anomalies. In the western part of the survey block, the former ponds seem to have organised filling material that is producing a strong magnetic anomaly but with little mixing of dipoles, and the anomalies conform fairly closely to the depicted extent of the ponds. These are marked as **C_F** in the interpretation drawings. In the centre and east of the survey block, the anomalies in the locations of the former ponds are tightly grouped clusters of dipolar anomalies, suggesting a jumbled fill of fired or otherwise magnetic materials, which often spreads further out than the outline of the mapped feature, and typically with a small halo of disturbance around them. These are marked **C_G** on the interpretation maps. The difference in magnetic character of the anomalies associated with the ponds suggests different methods or materials were used to fill them in when they were given back over to arable cultivation. The former ponds also seem to be a terminal point for some of the linear trends of unclear origin within the survey area, suggesting they may relate to drainage.

6.33 In parcel C3 a linear trend is visible in the same location as a mapped former field boundary, **C_H** There is also a possible short section of a former boundary in parcel C4, marked **C_i**.

Unclear Origins

6.34 Throughout the central survey block there are discrete anomalies and linear trends which cannot be more robustly interpreted due to the noisy character of the results. These are equally likely to arise from human activity in the recent or archaeological past, or from natural variations in the subsurface or the green waste material.

6.35 Some of these anomalies are however worth specific discussion. Firstly, a group of strong positive linear trends, **C _J** in the south of parcel C16. These are possibly field drains, but the local noise makes it difficult to be certain and it is also possible these are further undated ditches or similar features.

6.36 Secondly, in a group of parcels in the south east of the central survey block, there are a series of similar clusters of strong dipolar anomalies in small rectangular configurations, marked as **C_K** in the interpretation. These clusters stand out in their local surroundings and have a common ‘E’ shape to their collective dipolar anomalies. These may relate to small unmapped agricultural structures such as animal shelters or feeders, or to natural variations of some sort.

Agricultural

6.37 Only a few parcels within the central block show evidence of the widely spaced linear trends or anomalies associated with ridge and furrow cultivation, parcel C14 in the south east, and parcels C2 and C3 in the south west. In all three cases the anomalies are weaker trends visible because the background noise in these parcels is lower allowing weaker anomalies to be discerned. The rest of the survey area shows the typical tightly spaced linear trends that relate to modern cultivation; again these have been drawn in an indicative rather than exhaustive manner.

Non – Archaeology

6.38 Patches of moderately more enhanced background values in parcels C3, C6 and C9, marked **C_L** are attributed to natural variations in the background geology resulting in a more enhanced topsoil and thus a generally strong response to human activity.

6.39 A service crosses parcels C1 - C4, marked **C_M,** and is of the same character as **W_M,** discussed above. This service has only a very small halo and has not interfered with the interpretation of nearby

anomalies. The expected magnetic disturbances are also present along field margins and originates from modern ferrous infrastructure in the boundaries or adjacent structures.

Eastern Block

6.40 The eastern survey block is the area most affected by the spreading of green waste and other modern agricultural sources of topsoil noise. Data in this area was collected in early winter 2024 after the maize was harvested, as the crop was too tall to survey alongside the central and western blocks in the summer period. Deep ruts and churned soil meant it was not possible to use the ATV at all, and only parts of the area were suitable for survey with the handcart, so most of the area was collected using handheld equipment on grids, as outlined in section 5 above. This heavy mixing and working of the topsoil combined with the use of green waste as a soil improver has resulted in a very noisy magnetic background throughout most of the survey parcels. There are small patches where the green waste does not seem to be present, but these are too small to give a good impression of the 'natural' magnetic background in this area. Parcels E4 and E5 are less impacted by this material and instead have a lightly speckled appearance related to natural variations in the sub surface. Despite this, strong anomalies are visible through the blanketing effect of the noise in some of the survey areas and some of these can be matched to known features depicted on historic maps, whereas others may be of archaeological interest. However, in this part of the survey area as whole, the interpretation of the results is of lower confidence, as weaker anomalies are likely to have been masked completely by the noise.

Archaeology, possible archaeology.

6.41 There are no anomalies in this area which are unequivocally archaeological in origin, though there are a number where archaeological features are the most likely cause. These are concentrated in E1, and largely consist of positive anomalies and trends that are visible through the noisy background.

6.42 In the centre of parcel E1, there is a circular anomaly consisting of intermittent strongly positive discrete anomalies, **E_A**. This overall has the morphology of a ring ditch of approximately 15m in diameter, which suggests it is more likely to relate to a barrow than to settlement. Close to this there is a short intermittent linear anomaly running north-south, **E_B**, which is also of possible archaeological interest, though any relationship to the potential ring ditch is unclear. West of these two anomalies, there is a band of strongly enhanced material bisecting the survey area and running north-south, **E_C**. This looks like what could be expected from a ploughed-out former boundary, but no boundary is depicted here on available maps, and so the feature responsible may be of archaeological interest.

6.43 Further linear trends, **E_D** discernible in the noise within parcel E1 have also been marked as being of possible archaeological interest, though they may also relate to random variations in the noise, to more recent agricultural processes or to natural variations in the underlying material. They do not form a clear pattern that can be interpreted as to function or date.

6.44 Similar curving linear trends are visible in parcel E5, forming two large curved arcs, **E_F**. They are close to a discrete large strong positive anomaly, **E_E** interpreted as a potential large pit. There are no further anomalies identified as being of likely archaeological interest in this survey block, but as always it is possible that some of the anomalies of 'unclear' origin may in fact arise from archaeological features, as discussed below.

Historical Features

6.45 As with the central area, the eastern area has a number of former ponds, likely marl pits, depicted on the 1st Edition Ordnance Survey maps. Where one of these been covered by the survey, the expected

dipolar response from the infilling material can be seen in the survey results. This is marked **E_G** in the interpretation drawings

6.46 Former paths or tracks are also visible as areas of stronger disturbance in the survey results, along the northern edge of parcel E3, marked **E_H**. The start and end of a trackway or path that used to cross E5 are also visible as slightly noisier areas at the margins of the field, though the main area of the field does not have a visible corresponding anomaly. These are also marked **E_H**.

6.47 Three linear trends are visible in parcel E1, marked **E_i** which all correspond to the location of boundaries depicted on the available historic maps. No further anomalies clearly associated with historical features have been recognised in the results.

Unclear Origins

6.48 There are numerous linear trends and discrete anomalies or spreads of noisier results present in the data from the eastern survey block. Some are noteworthy and have been assigned numbers and are discussed below.

6.49 An intermittent positive linear anomaly is visible in the southern part of parcel E6, **E_J**. This may be a former boundary not depicted on historical maps, or it may be a result of more recent agricultural practices, or a field drain or similar.

6.50 In line with a linear trend related to a former boundary in the eastern part of parcel E1, there are two discrete negative anomalies, **E_K**. These are unusual in that they do not appear to be dipolar; they have no positive component. They may be pockets of unenhanced material appearing as negatives against the strong background. Their association with the former boundary may be coincidental, or it may be that these anomalies arise from the process of removing the boundary feature in some way.

6.51 In area E5, close to the anomalies of possible archaeological interest, there is a grouping of strong dipolar anomalies that are not consistent with ferrous material **E_L**. These anomalies are possibly consistent with small scale extraction of marls, or the processing of them, but they may also simply be strongly enhanced parts of the green waste or the underlying geology.

6.52 A noisier zone of disturbance, **E_M** follows the eastern edge of parcel E3. Recent maps show a farm track or similar in this location, and it is likely that the enhanced noise in this area relates to that, but it is also possible that earlier features are responsible for the changes in magnetic character here, as this enhancement is not constrained to the field margin, protruding into the field area in places.

Agricultural

6.53 There are weak widely spaced linear trends in E1 and E4 that are characteristic of ridge and furrow cultivation. Elsewhere in the eastern survey block, more closely spaced linear trends associated with more recent cultivation are prevalent, and only a representative sample have been drawn.

6.54 In the central part of parcel E3, linear trends consistent with field drains have been identified.

Non – Archaeology

6.55 Banding typical of natural variations is present in parcel E4, and linear trends in E6 appear to be similar.

6.56 Areas of magnetic disturbance are present as expected at the margins of the field related to the presence of ferrous material in the boundaries or associated structures. These disturbances have not negatively impacted the survey interpretation other than in their immediate location where they may mask weaker anomalies.

7 Conclusion

7.1 The survey results have allowed the identification of several anomalies of archaeological interest, all of which occur in reasonably discrete areas within the survey boundaries. The first of these is in the east and north of the western survey block, where an oval enclosure with internal features has been identified on a local high spur overlooking Black Brook and the course of Wat's Dyke to the east of the survey area. North and west of this probable enclosure there are linear anomalies consistent with boundaries or field systems of undetermined date. Their relationship to the enclosure is unclear.

7.2 In the central survey area, there is no clear focus of possible archaeological activity, but there are isolated groups of anomalies suggestive of fragments of field systems or enclosures. By contrast in the eastern survey block, there is a clear focus of activity in the north of the survey block, with a possible ring ditch and a series of rectilinear boundary features suggestive of a field system.

7.3 These anomalies have been identified despite the varying levels of magnetic noise within the survey area, which generally speaking worsens from west to east. However, in all of the areas, as well as the possible archaeology, anomalies consistent with features depicted on historical maps have been identified, along with ploughing trends and drains, as well as natural variations. This collectively suggests that were further substantial archaeological remains present within the survey area, they would have been detected. It is also likely that weaker and more ephemeral anomalies from shallow or weakly magnetically enhanced archaeological features have not been recognised within the results, and this risk increases from west to east across the survey area.

7.4 The survey results have also identified areas with clear evidence of ridge and furrow cultivation, which may help understand the local land use during the medieval period. The ridge and furrow cultivation seems to be concentrated in the west, though this may be a result of differential survival due to more recent land use, as the western area is generally used more for pasture than for arable in more recent times. Marl extraction is well attested the form of multiple infilled ponds, particularly in the central survey block.

7.5 In assessing the results of the geophysical survey against the specific aims set out in Section 4:

- The survey has succeeded in locating, recording and characterising surviving sub-surface remains within the Site, though more remains may be present that are not suitable for detection using magnetic methods;
- The survey has resulted in a comprehensive report and archive.

8 Statement of Indemnity

8.1 Although the results and interpretation detailed in this report have been produced as accurately as possible, it should be noted that the conclusions offered are a subjective assessment of collected datasets.

8.2 The success of a geophysical survey in identifying archaeological remains can be heavily influenced by several factors, including geology, seasonality, field conditions and the properties of the features being detected. Therefore, the geophysical interpretation may only reveal certain archaeological features and not produce a complete plan of all the archaeological remains within a survey area.

9 Archive Deposition

9.1 In accordance with professional standard practice an online OASIS database record will be completed for submission to the HER and Archaeological Data Service (ADS) (Appendix 2).

9.2 One digital and hard copy of the report and data will be submitted to the relevant Historic Environment Record (HER) at the Client's discretion.

9.3 A digital copy of the report and data will also be submitted to the ADS at the Client's discretion.

10 Bibliography

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*denotes a reference that occurs in Appendix 2 rather than the main body of this report.

11 Plates

Plate 1: Unsurveyable portions of parcel W_1 during the summer of 2024

Plate 2: Parcel C_7 during survey in the summer of 2024.

Plate 3: Deep ruts in parcel E_6 during the autumn of 2024

12 Figures

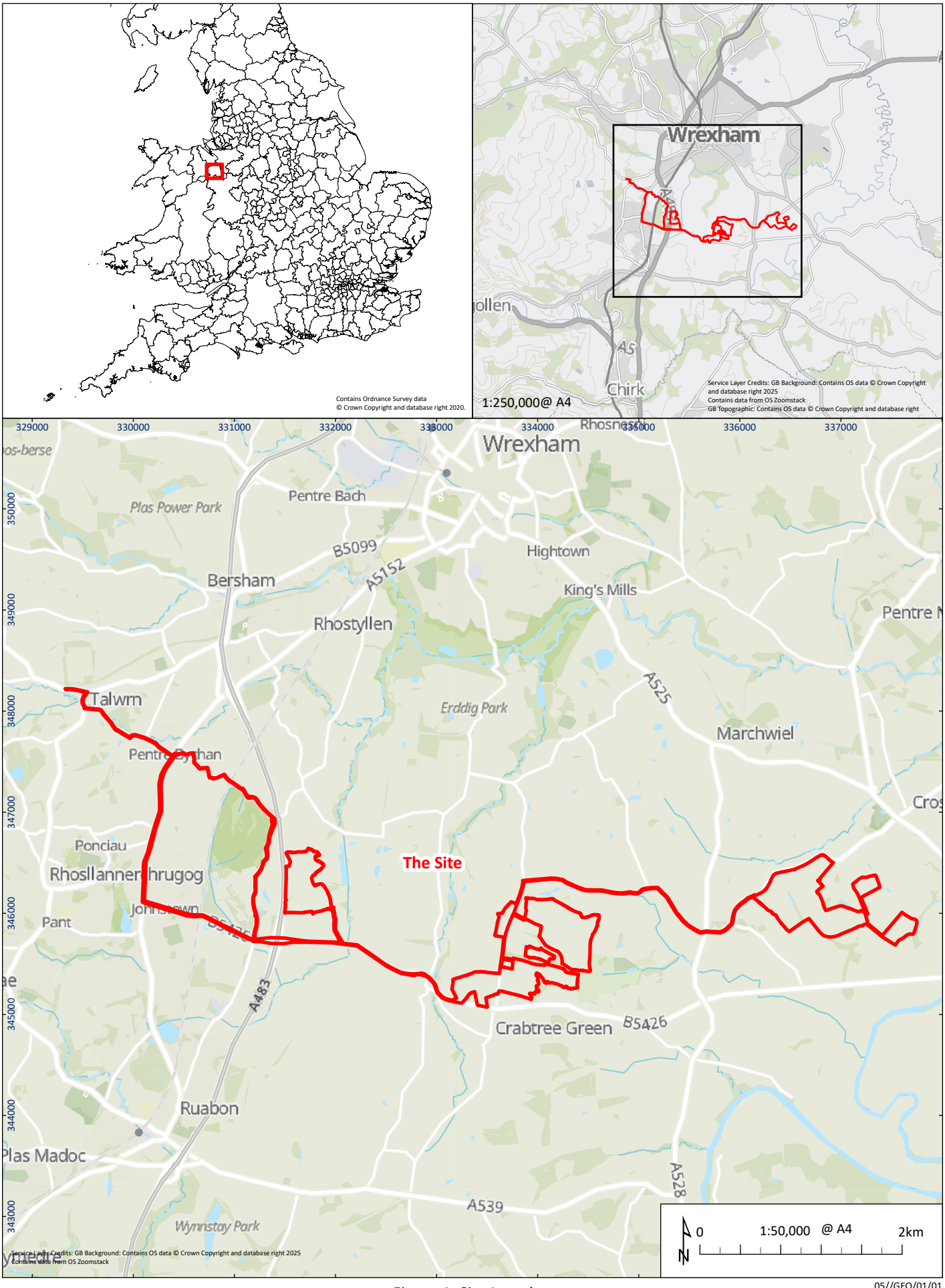

Figure 1: Site Location

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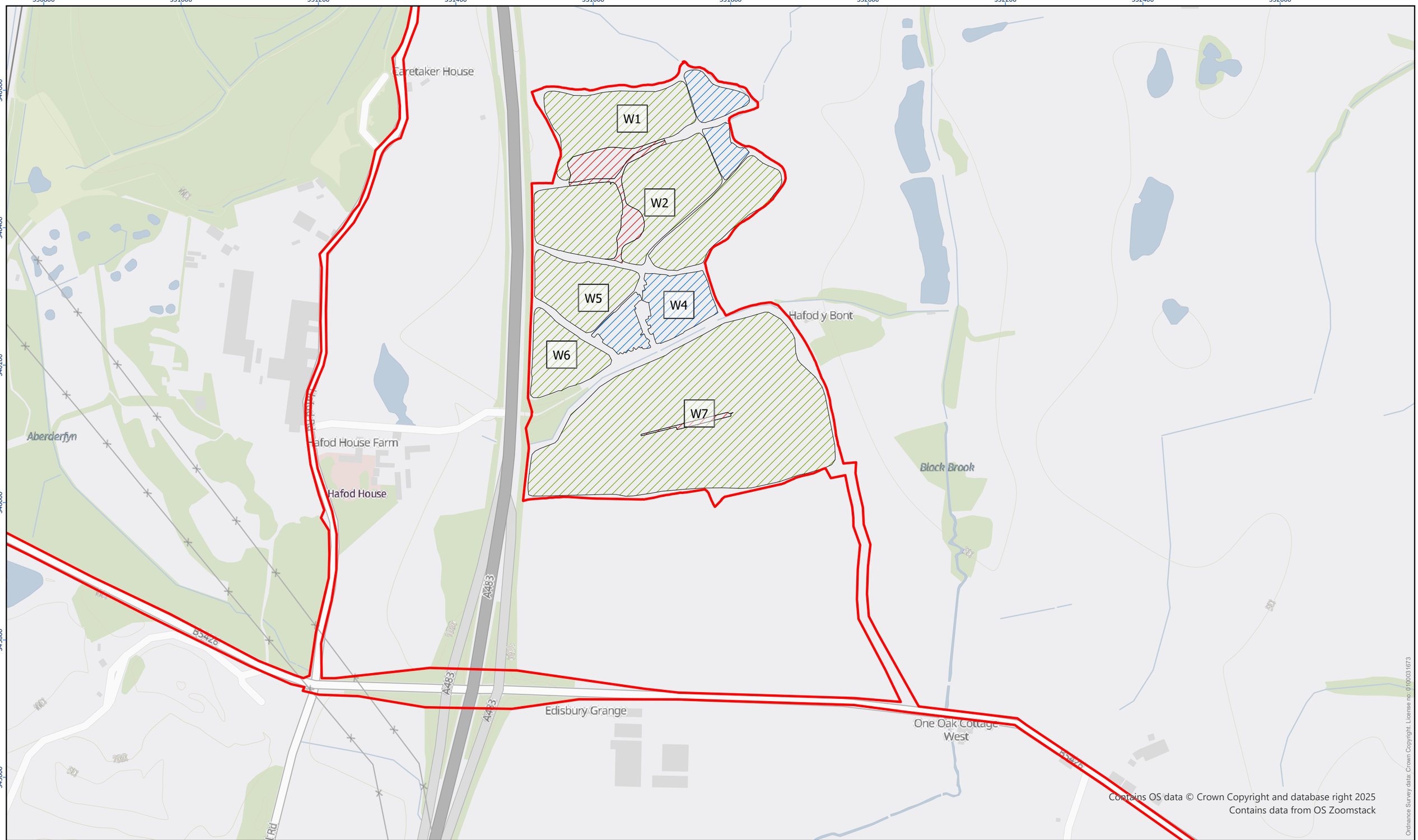

Survey Areas

Figure 2.0

- Sensys Cart
- Bartington Cart
- Unsuitable

N

0 90m

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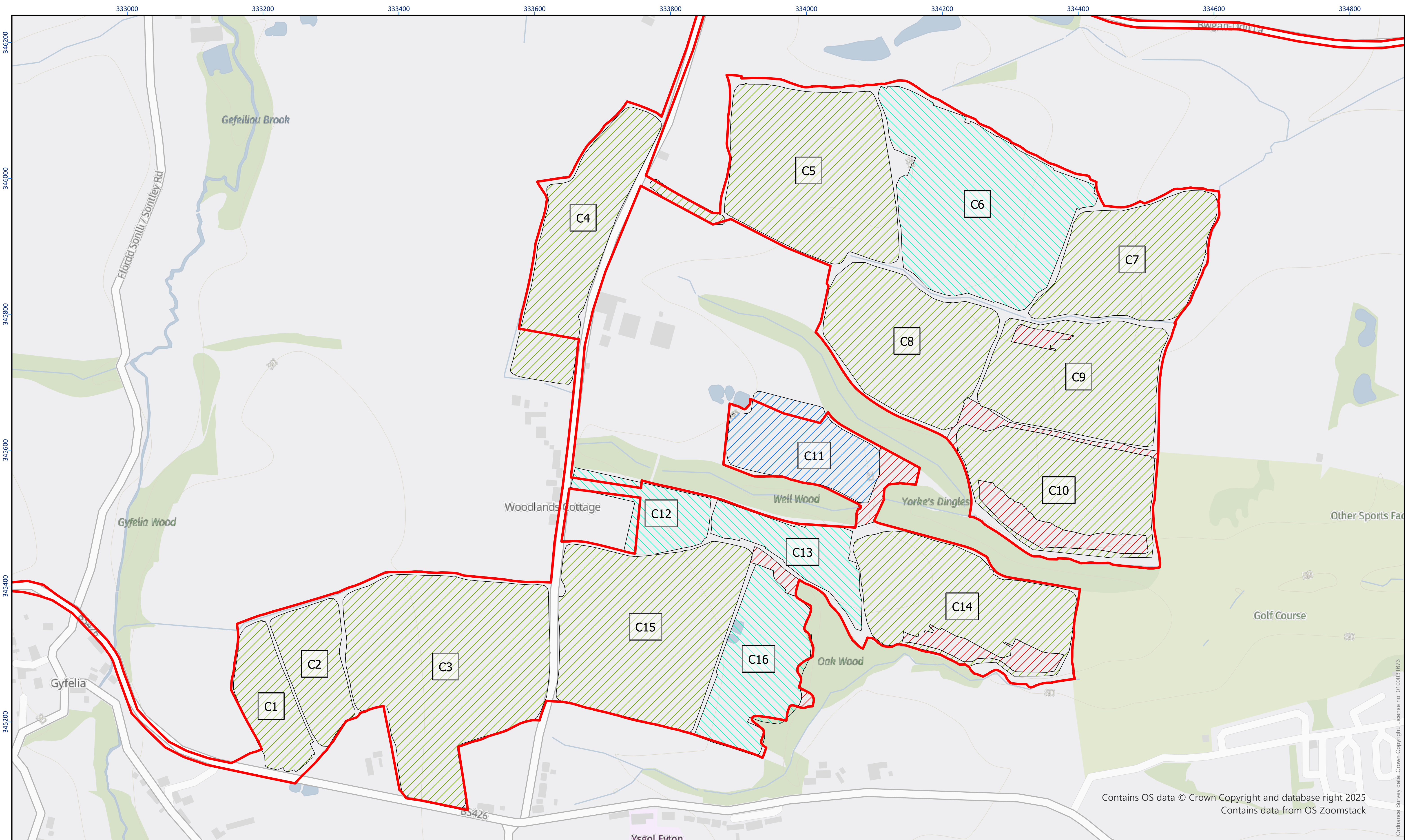
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

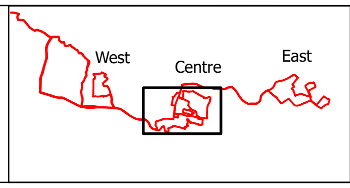


Survey Areas

Figure

2.1

Sensys Cart	Bartington 601-2
Bartington Cart	Unsuitable



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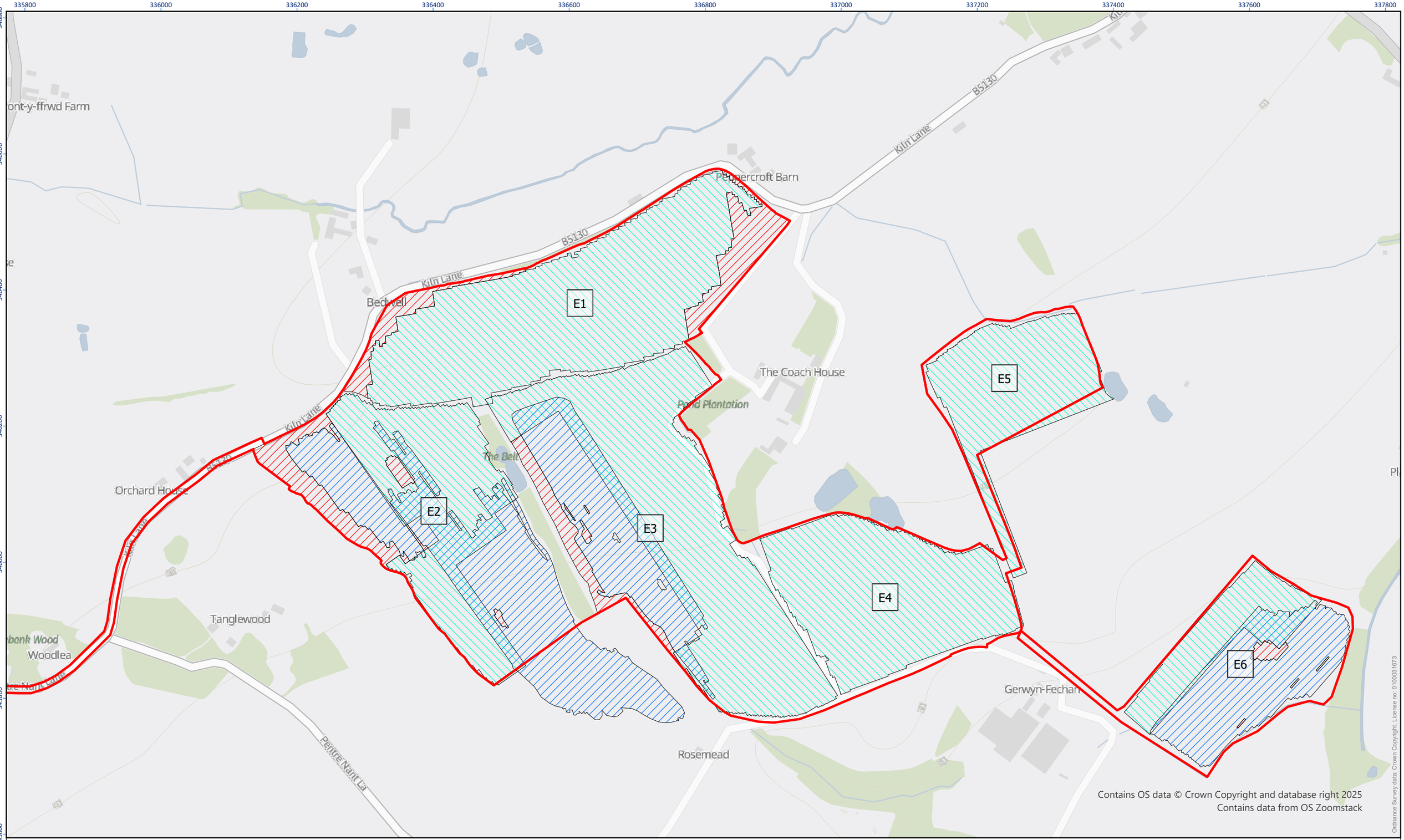
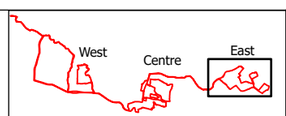
AOC Archaeology Group



Survey Areas

Figure 2.2

- Bartington Cart
- Bartington 601-2
- Unsuitable



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Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Survey Results - West

Figure 3.0

2nT

-1nT

West Centre East

N

0 90m

Scale: 1:5,000 @ A3

Drawing Number: 05/40759/GEO/3.0/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Survey Results - Centre

Figure 3.1

2nT
-1nT

West Centre East

N

0 90m

Scale: 1:5,000 @ A3

Drawing Number: 05/40759/GEO/3.1/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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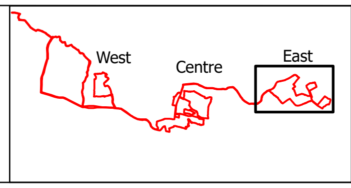
Greyscale Plot of Processed Survey Results - East

Figure 3.2

2nT
-1nT



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Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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330800 331000 331200 331400 331600 331800 332000 332200 332400 332600

346600 346400 346200 346000 345800 345600

W_1 W_1 W_2 W_2 W_2 W_2 W_5 W_4 W_5 W_4 W_7

Caretaker House
Hafod y Bont
Hafod Rd
Hafod House Farm
Hafod House
Aberderfyn
Black Brook
A483
A483
A483
B5426
B5426
Edisbury Grange
One Oak Cottage West

Interpretation Overview - West

Figure 4.2

Anomaly (Probable Archaeology)
Spread (Probable Archaeology)
Anomaly (Possible Archaeology)
Anomaly (Unclear Origin)
Spread (Unclear Origin)
Anomaly (Geology/Natural)
Spread (Geology/Natural)
Spread (Magnetic Disturbance)
Anomaly (Ferrous/Iron Spike)
Disturbance from overhead service

Anomaly_Type
Linear Trend (Probable Archaeology)
Linear Trend (Possible Archaeology)
Linear Trend (Historic Feature)
Linear Trend (Unclear Origin)
Linear Trend (Agricultural, Ploughing)
Linear Trend (Agricultural, Ridge and Furrow)
Linear Trend (Service)

West Centre East

N
0 90m
Scale: 1:5,000 @ A3

Drawing Number: 05/40759/GEO/4.2/02	
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Checked by: SO	Date: 05/02/2025
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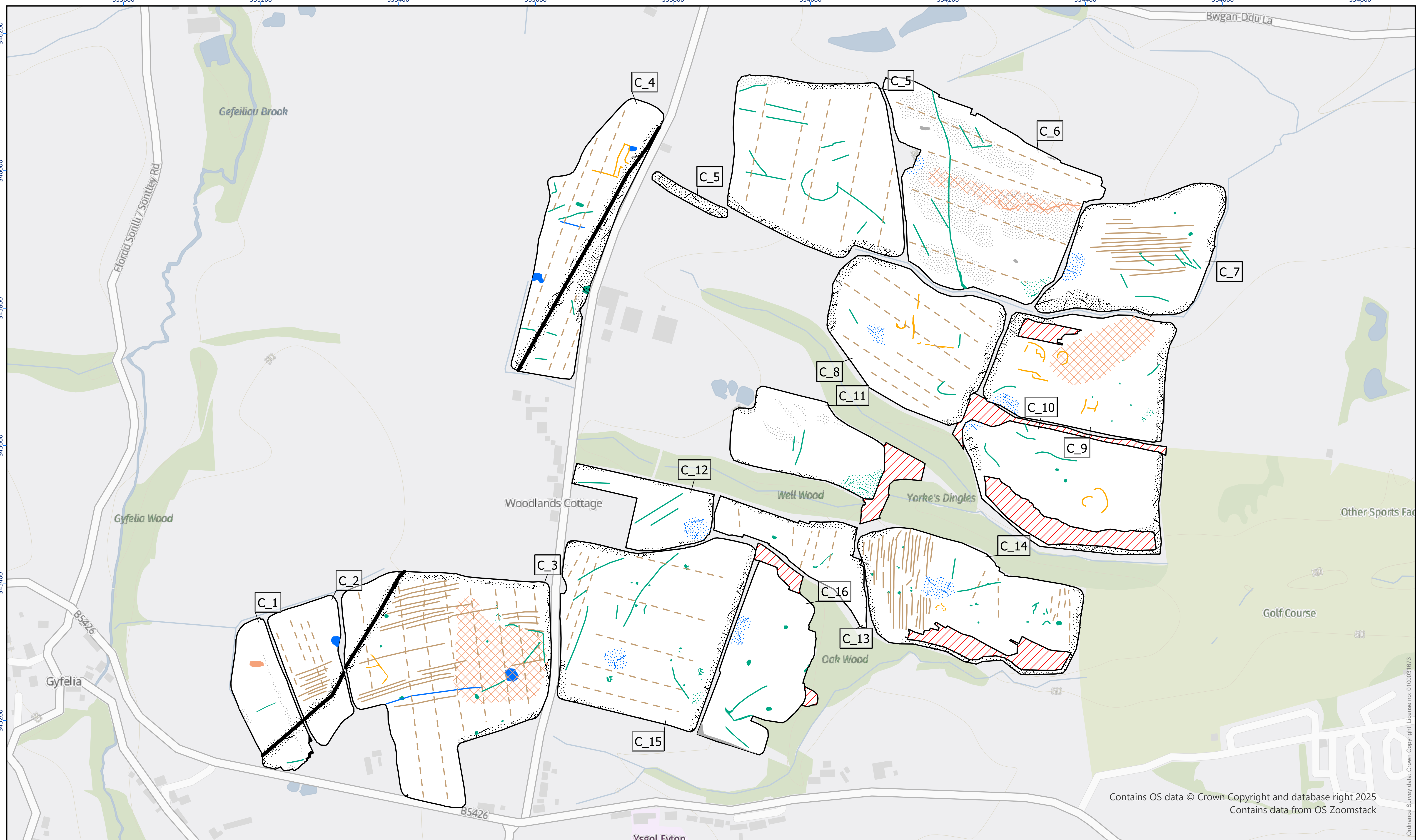

Interpretation Overview - Centre

Figure 4.1

Anomaly_Type

- Anomaly (Possible Archaeology)
- Anomaly (Historic Feature)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Anomaly (Geology/Natural)
- Spread (Geology/Natural)
- Anomaly (Magnetic Disturbance)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Geology/Natural)
- Linear Trend (Service)

West | Centre | East

N

0 — 90m

Scale: 1:5,000 @ A3

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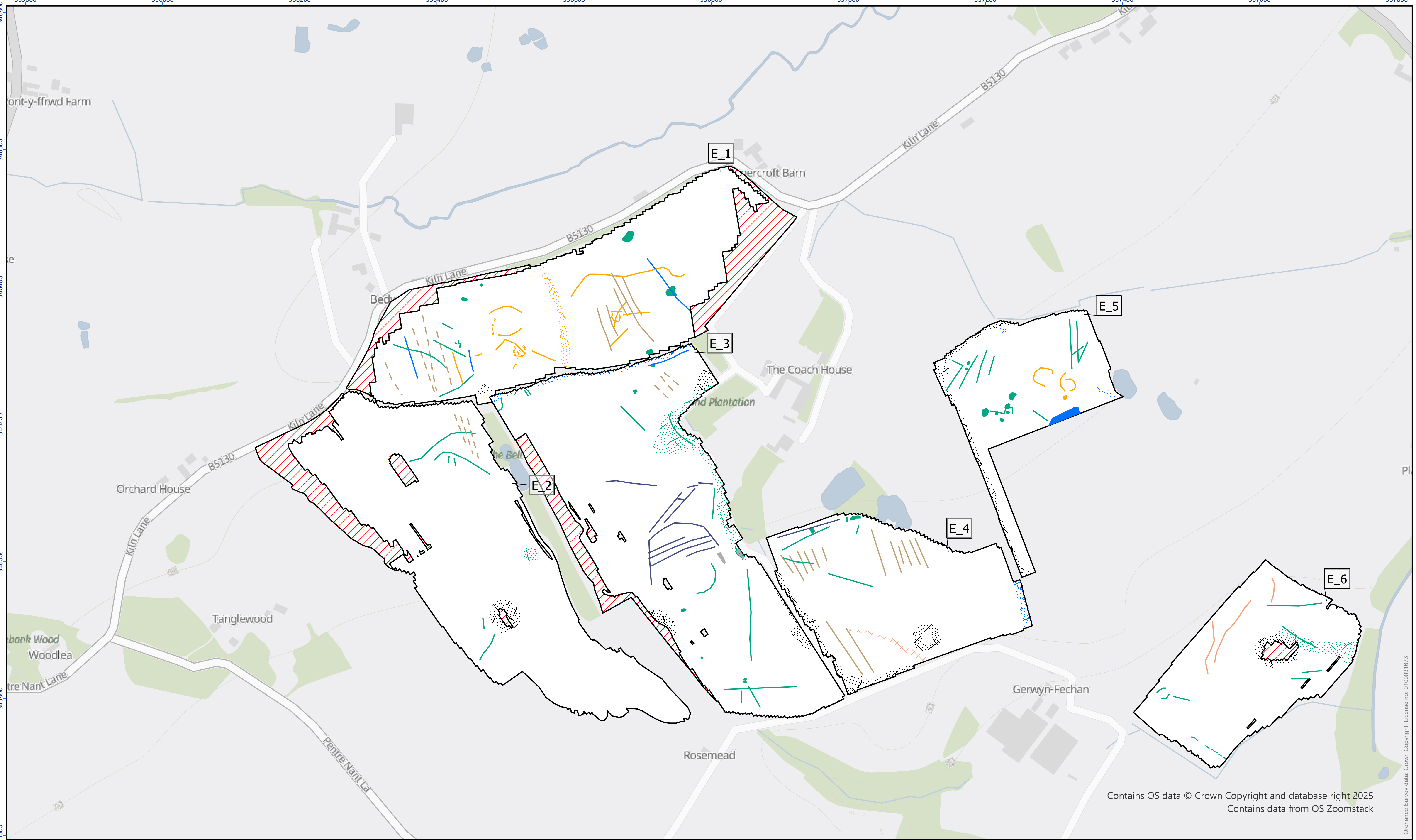

Interpretation Overview - East

Figure 4.2

Anomaly (Possible Archaeology)
Spread (Possible Archaeology)
Anomaly (Historic Feature)
Spread (Historic Feature)
Anomaly (Unclear Origin)
Spread (Unclear Origin)
Spread (Geology/Natural)
Spread (Magnetic Disturbance)
Anomaly (Ferrous/Iron Spike)

Anomaly_Type
Linear Trend (Possible Archaeology)
Linear Trend (Historic Feature)
Linear Trend (Unclear Origin)
Linear Trend (Agricultural, Ploughing)
Linear Trend (Agricultural, Ridge and Furrow)
Linear Trend (Drainage)
Linear Trend (Geology/Natural)

West Centre East

N
0 90m
Scale: 1:5,000 @ A3

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Checked by: SO	Date: 05/02/2025
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346700 346650 346600 346550 346500 346450 346400 346350

A483

W_1 W_1 W_2 W_2 W_2 W_5 W_4

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.0

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.0/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.1

2nT
-1nT

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.1/02	
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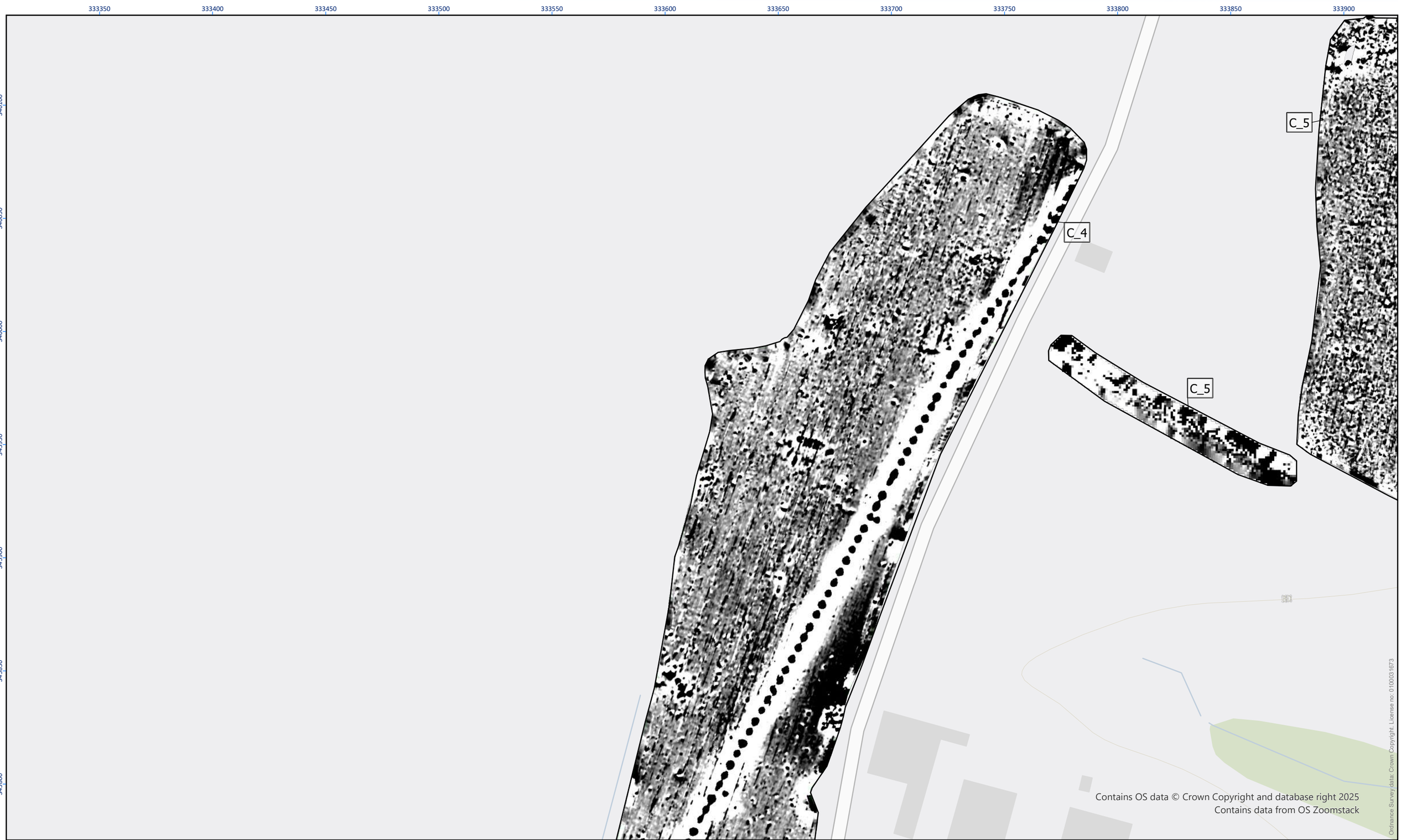

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.2

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.2/02	
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Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

333800 333850 333900 333950 334000 334050 334100 334150 334200 334250 334300 334350

346150 346100 346050 346000 345950 345900 345850

C_4 C_5 C_5 C_6 C_7 C_8

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.3

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.3/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

334200 334250 334300 334350 334400 334450 334500 334550 334600 334650 334700 334750 334800

346100 346050 346000 345950 345900 345850 345800 345750

C_6

C_7

C_8

C_9

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.4

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.4/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

333750 333800 333850 333900 333950 334000 334050 334100 334150 334200 334250 334300

345850 345800 345750 345700 345650 345600 345550

C_5 C_8 C_6 C_9 C_10 C_11 C_12 C_13

Well Wood

Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.5

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.5/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.6

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.6/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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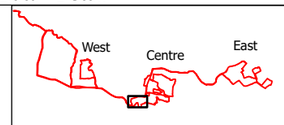
Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.7

2nT
-1nT



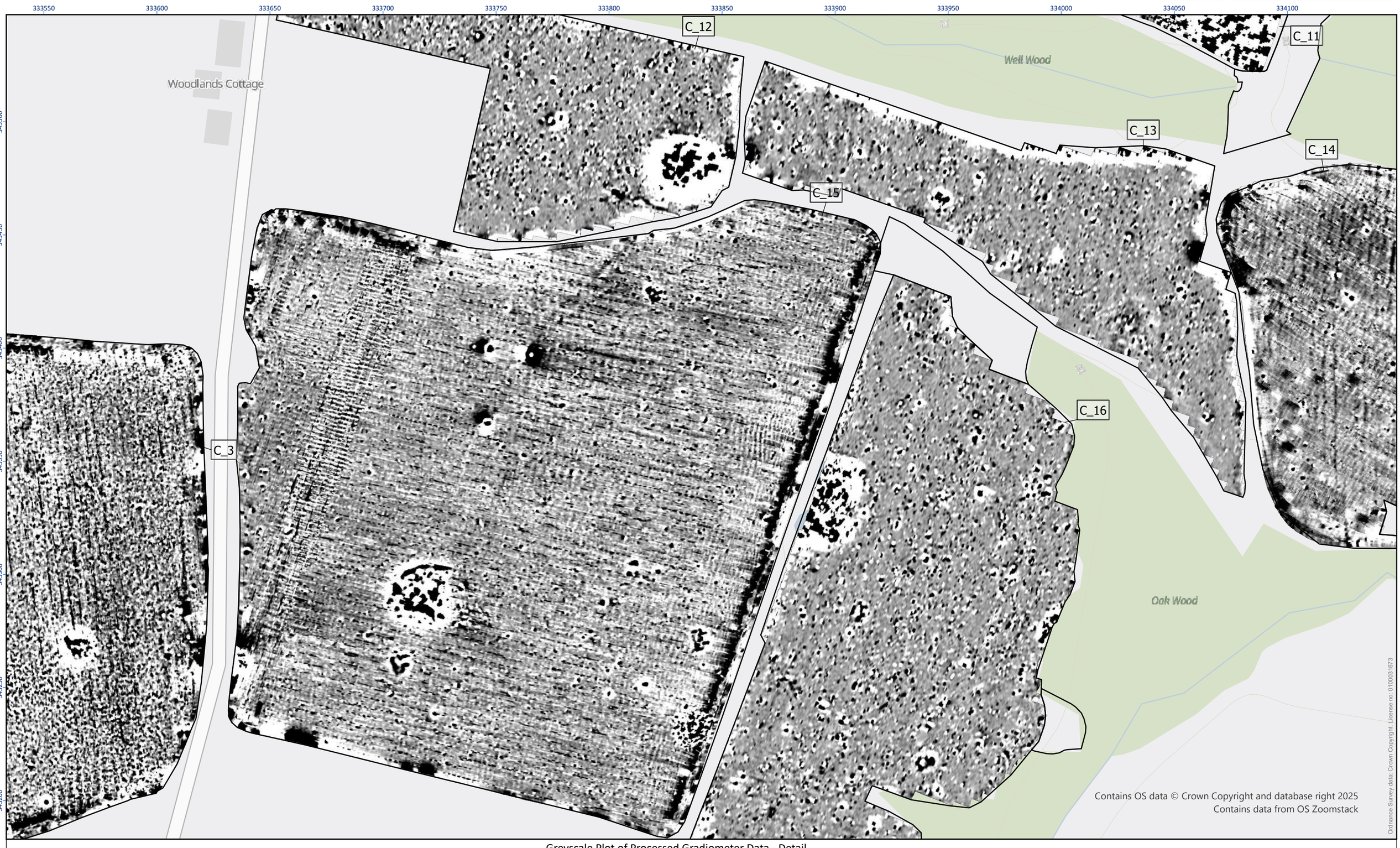
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.7/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.8

2nT
-1nT

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.8/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.9

2nT
-1nT

West Centre East

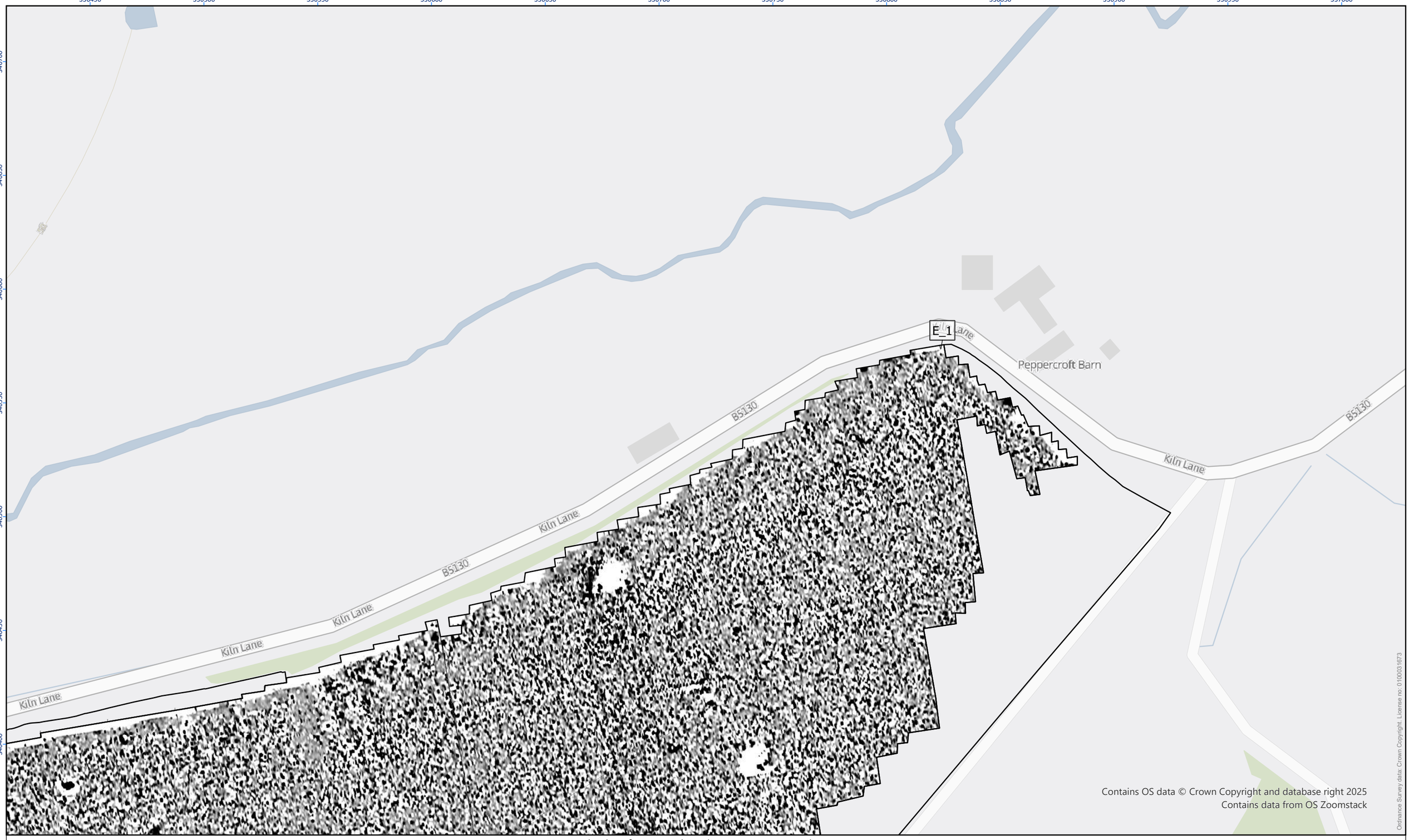
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.9/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.10

2nT
-1nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.10/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.11

2nT
-1nT

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.11/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.12

2nT

-1nT

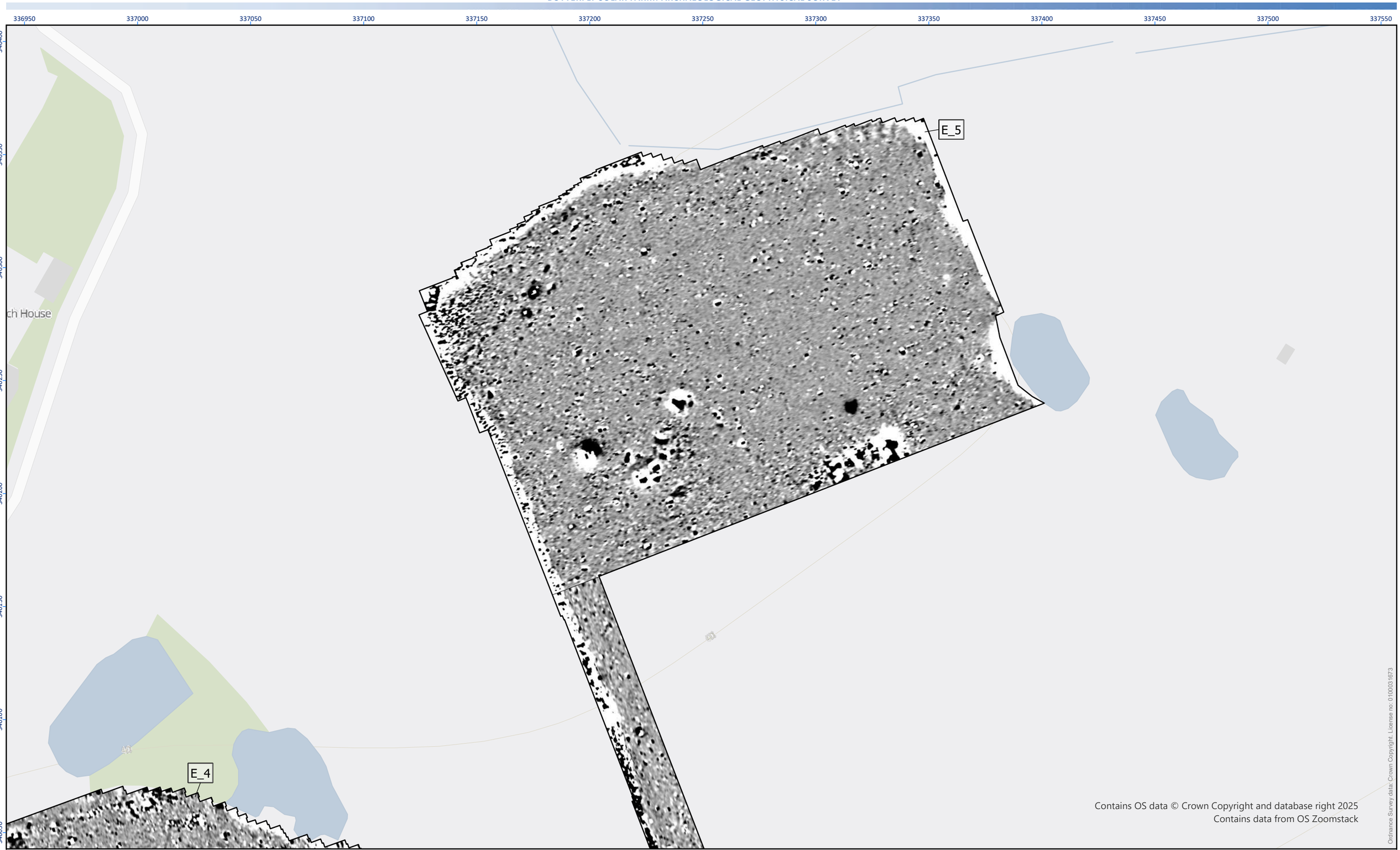
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.12/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.13

2nT
-1nT

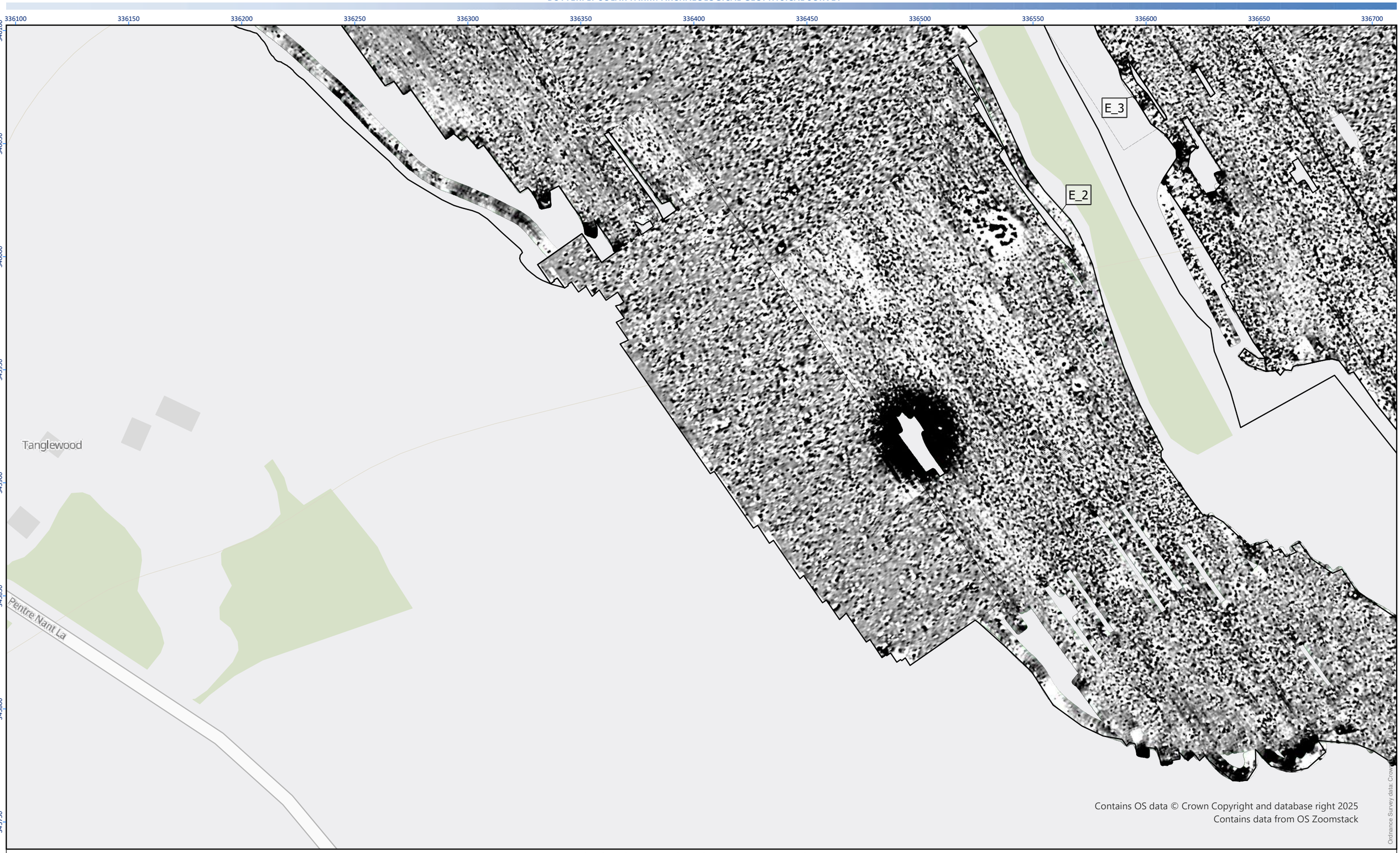
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.13/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.14

2nT
-1nT

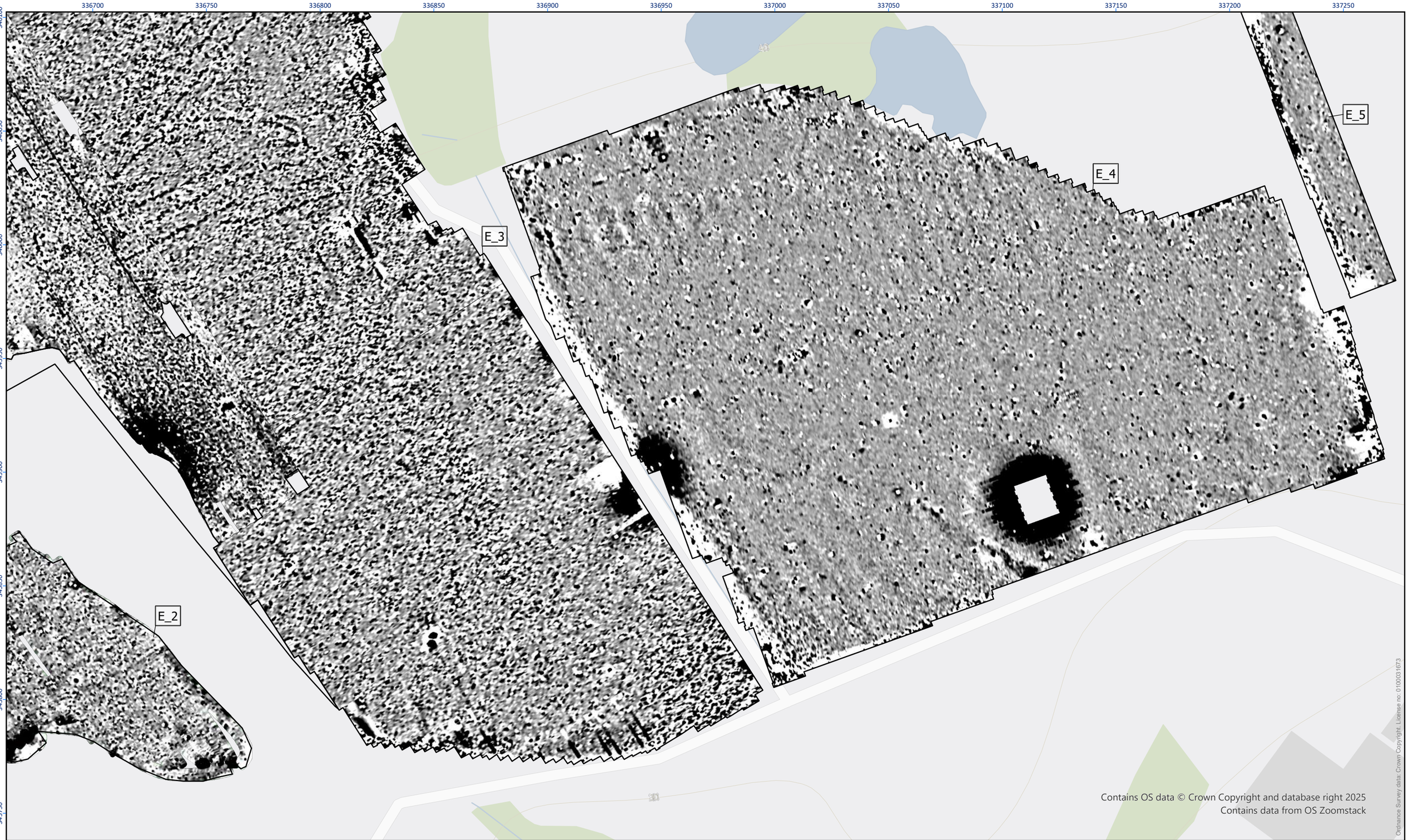
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.14/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.15

2nT
-1nT

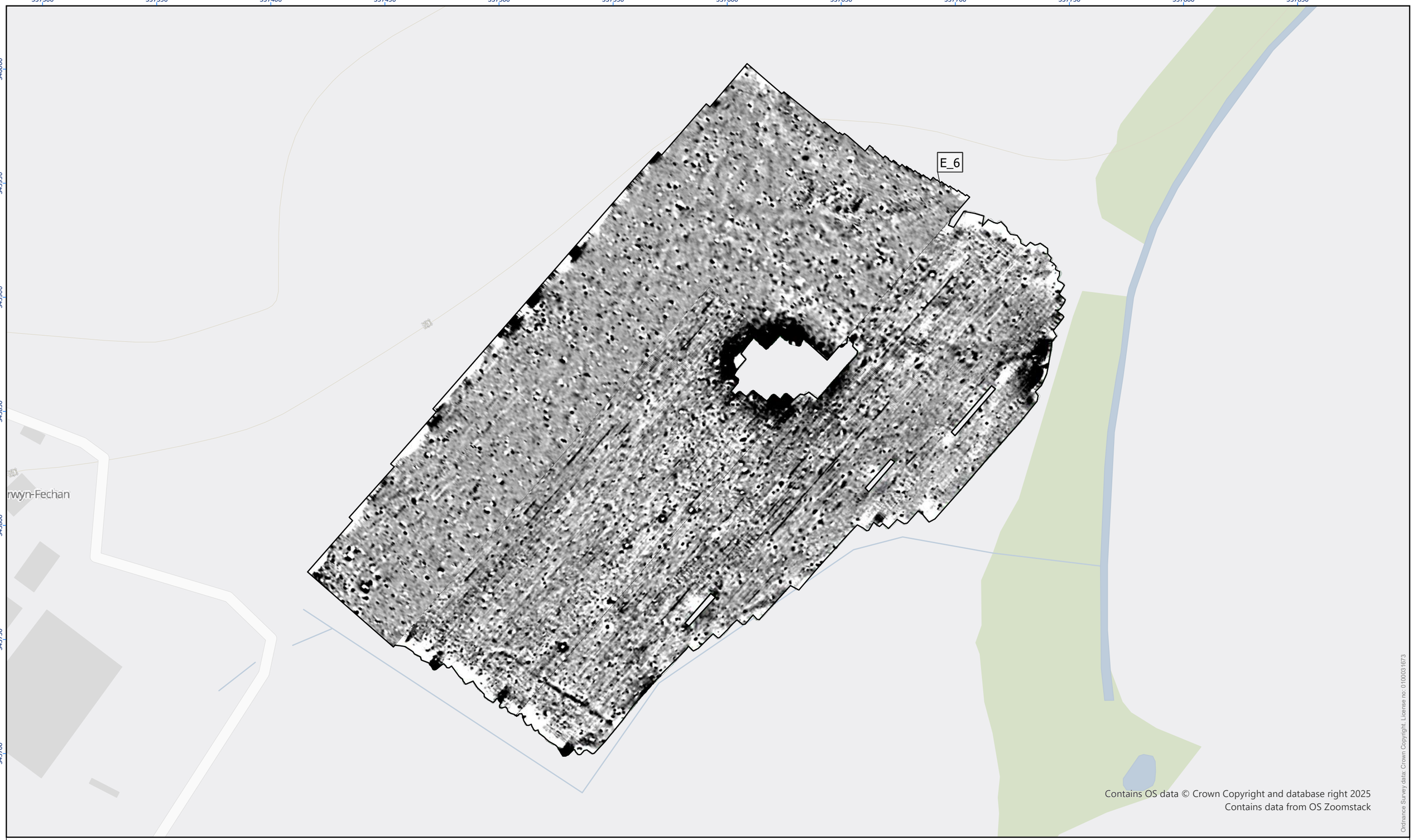
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.15/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Greyscale Plot of Processed Gradiometer Data - Detail

Figure 5.16

2nT
-1nT

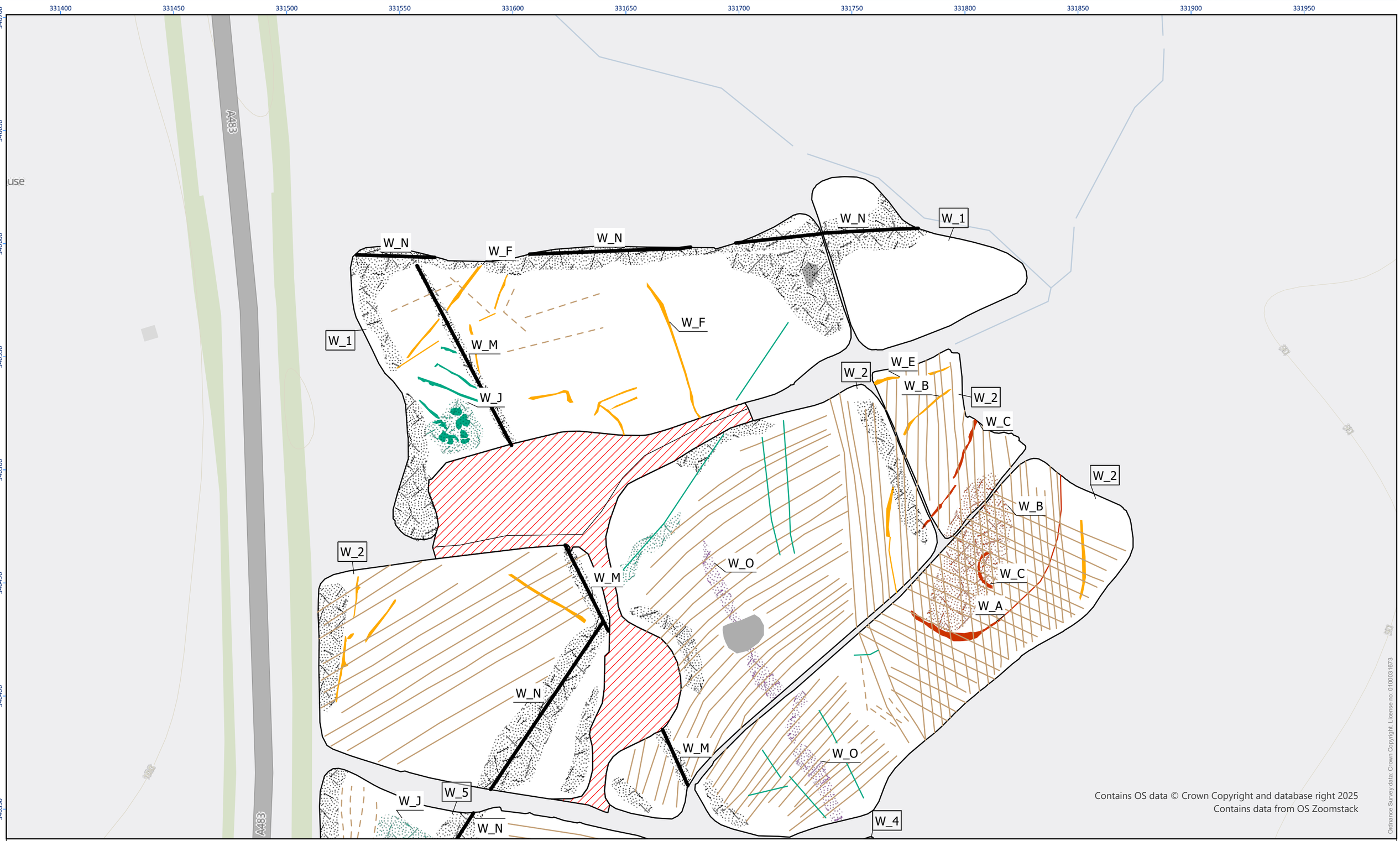
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/5.16/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

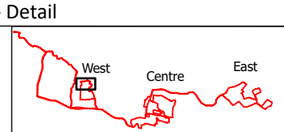
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.0

- Anomaly (Probable Archaeology)
- Spread (Probable Archaeology)
- Anomaly (Possible Archaeology)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Disturbance from overhead service
- Linear Trend (Probable Archaeology)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Service)



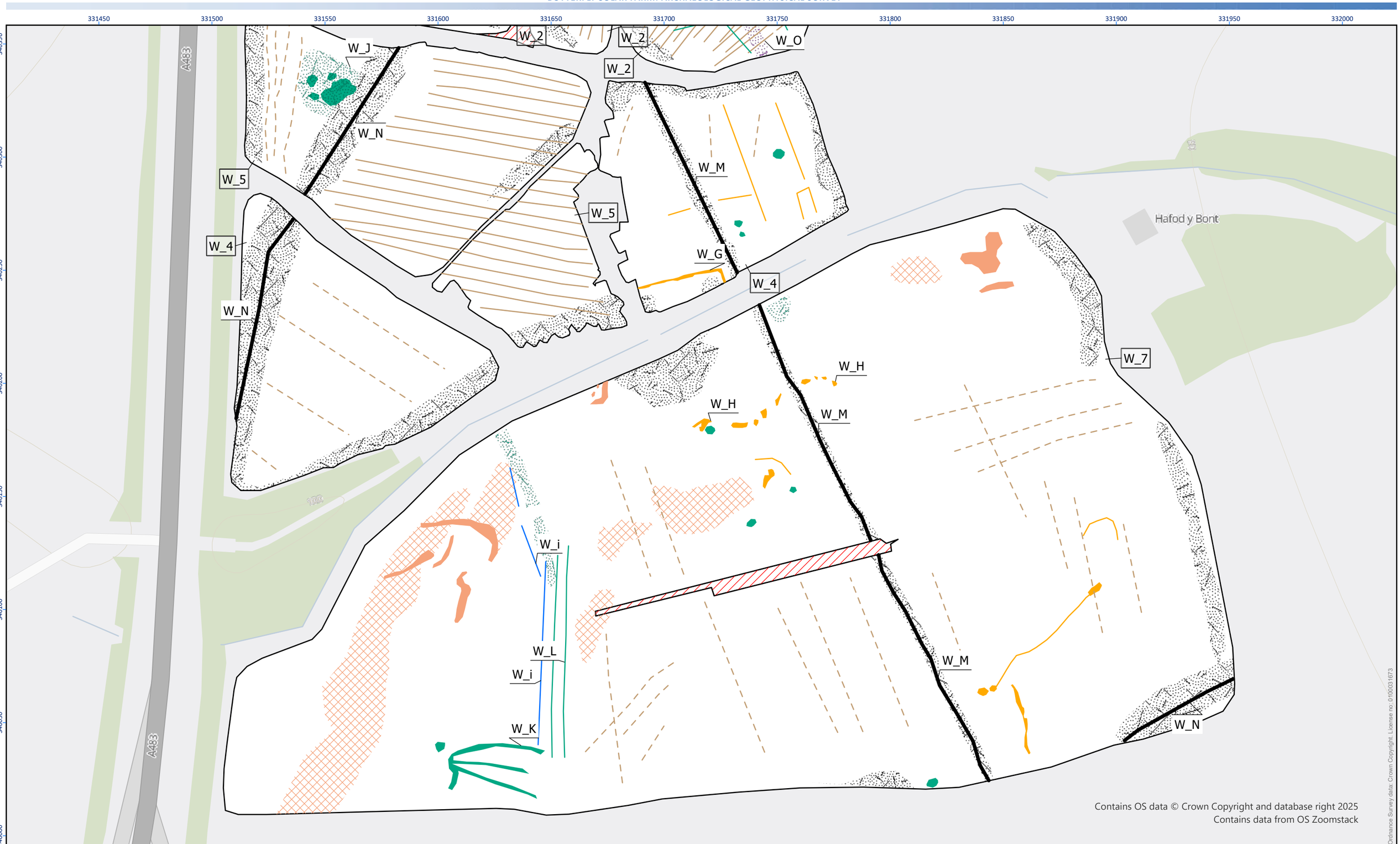
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.0/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

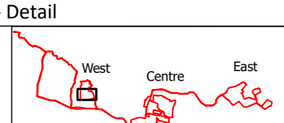
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.1

- Anomaly (Possible Archaeology)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Anomaly (Geology/Natural)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Disturbance from overhead service
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Service)



N

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Scale: 1:1,500 @ A3

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Created by: KA	Date: 05/02/2025
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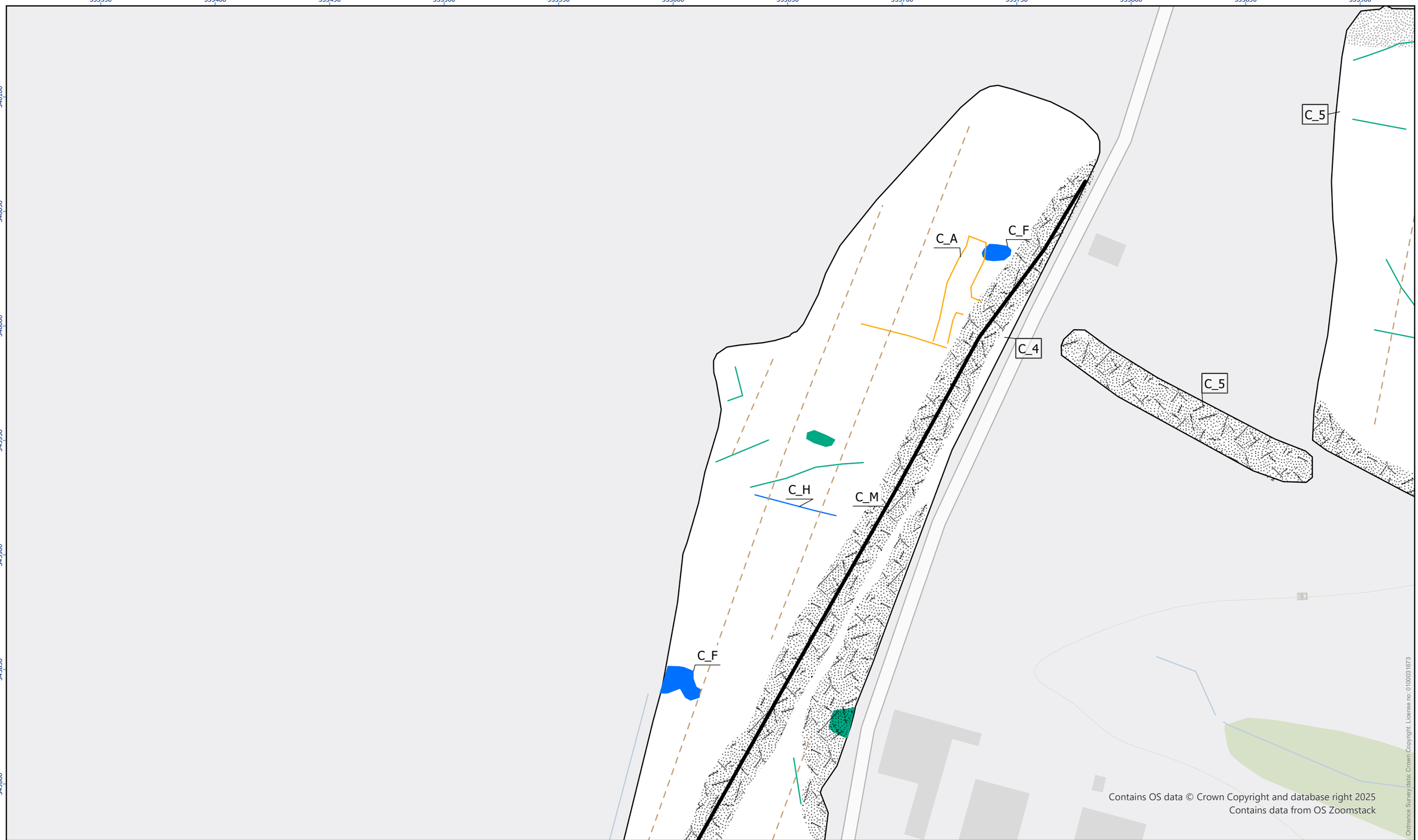
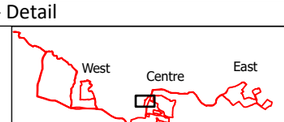


Interpretation of Survey Results - Detail

Figure 6.2

- Anomaly (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Magnetic Disturbance)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Service)



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Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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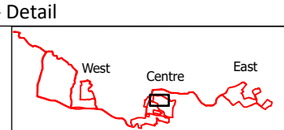
Interpretation of Survey Results - Detail

Figure 6.3

- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Geology/Natural)
- Linear Trend (Service)



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0 30m

Scale: 1:1,500 @ A3

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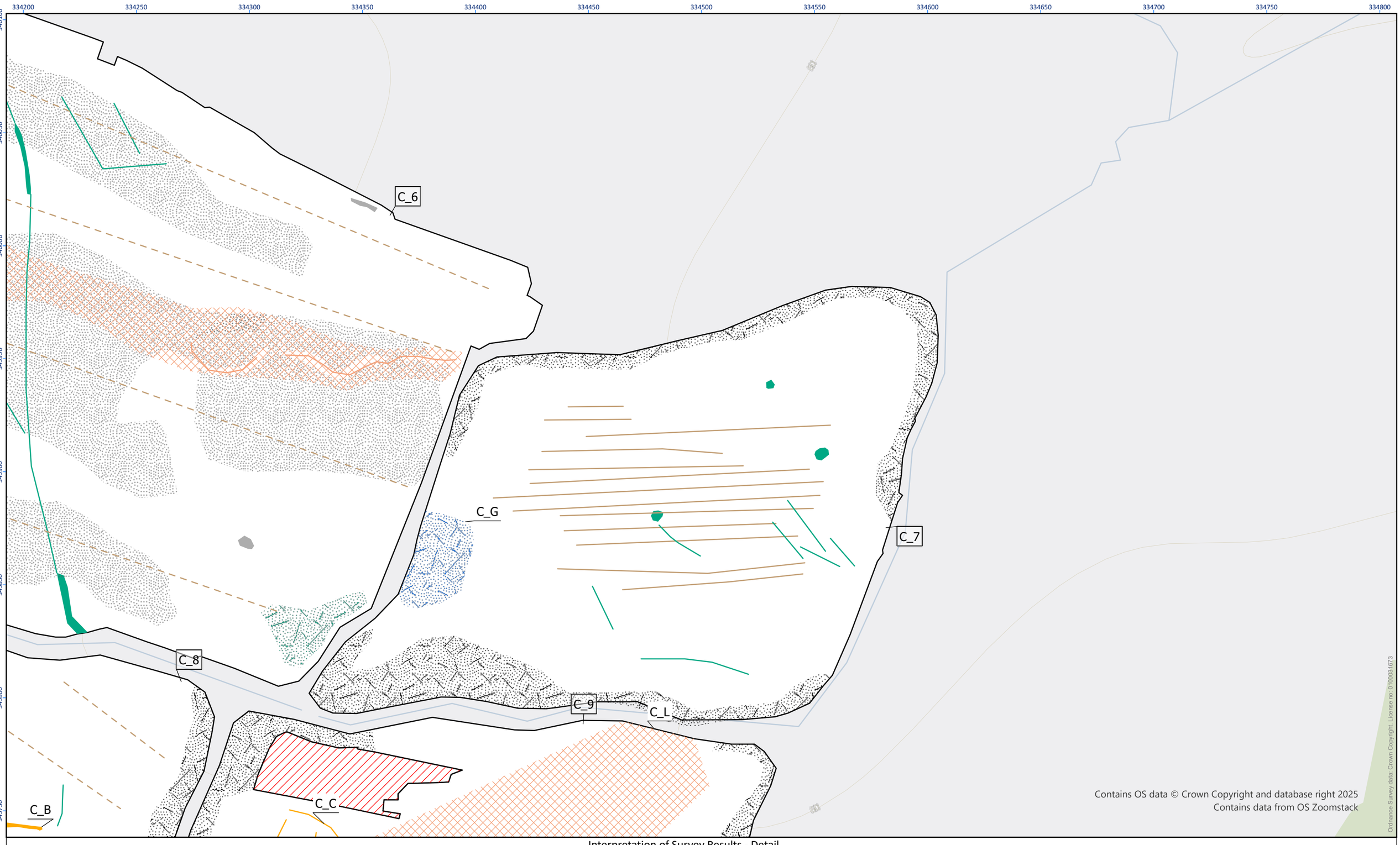
Approved by: JL	Date: 05/02/2025

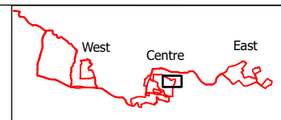
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.4

- Anomaly (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Geology/Natural)



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Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.4/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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333750 333800 333850 333900 333950 334000 334050 334100 334150 334200 334250 334300

345850 345800 345750 345700 345650 345600 345550

C_5 C_8 C_6 C_B C_G C_9 C_C C_G C_G C_11 C_10 C_i C_12 C_13

Well Wood

Interpretation of Survey Results - Detail

Figure 6.5

- Anomaly (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.5/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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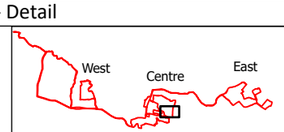
Interpretation of Survey Results - Detail

Figure 6.6

- Anomaly (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)



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0 30m

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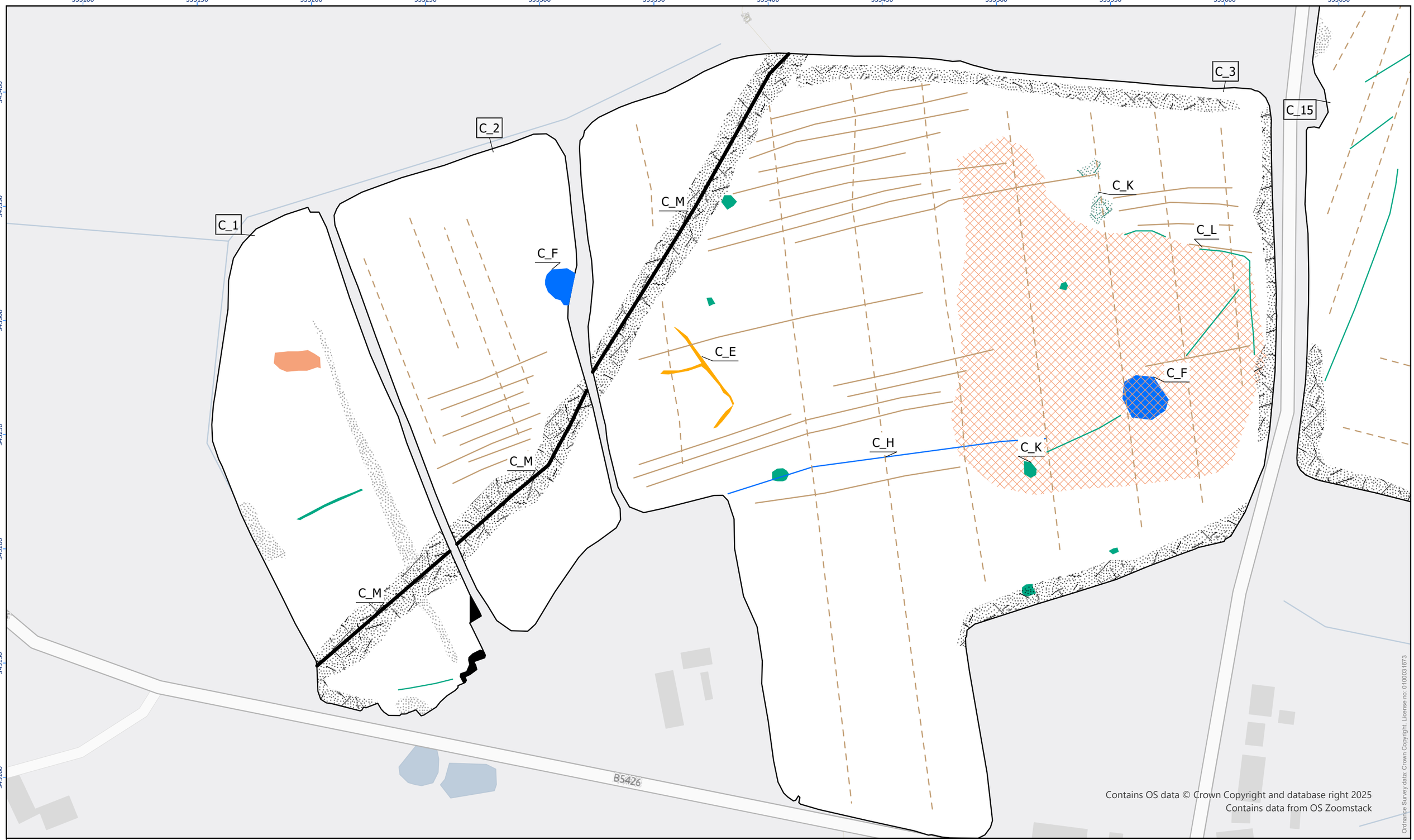
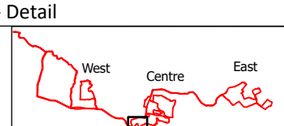
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.7

- Anomaly (Possible Archaeology)
- Anomaly (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Anomaly (Geology/Natural)
- Spread (Geology/Natural)
- Anomaly (Magnetic Disturbance)
- Spread (Magnetic Disturbance)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Service)



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.7/02	
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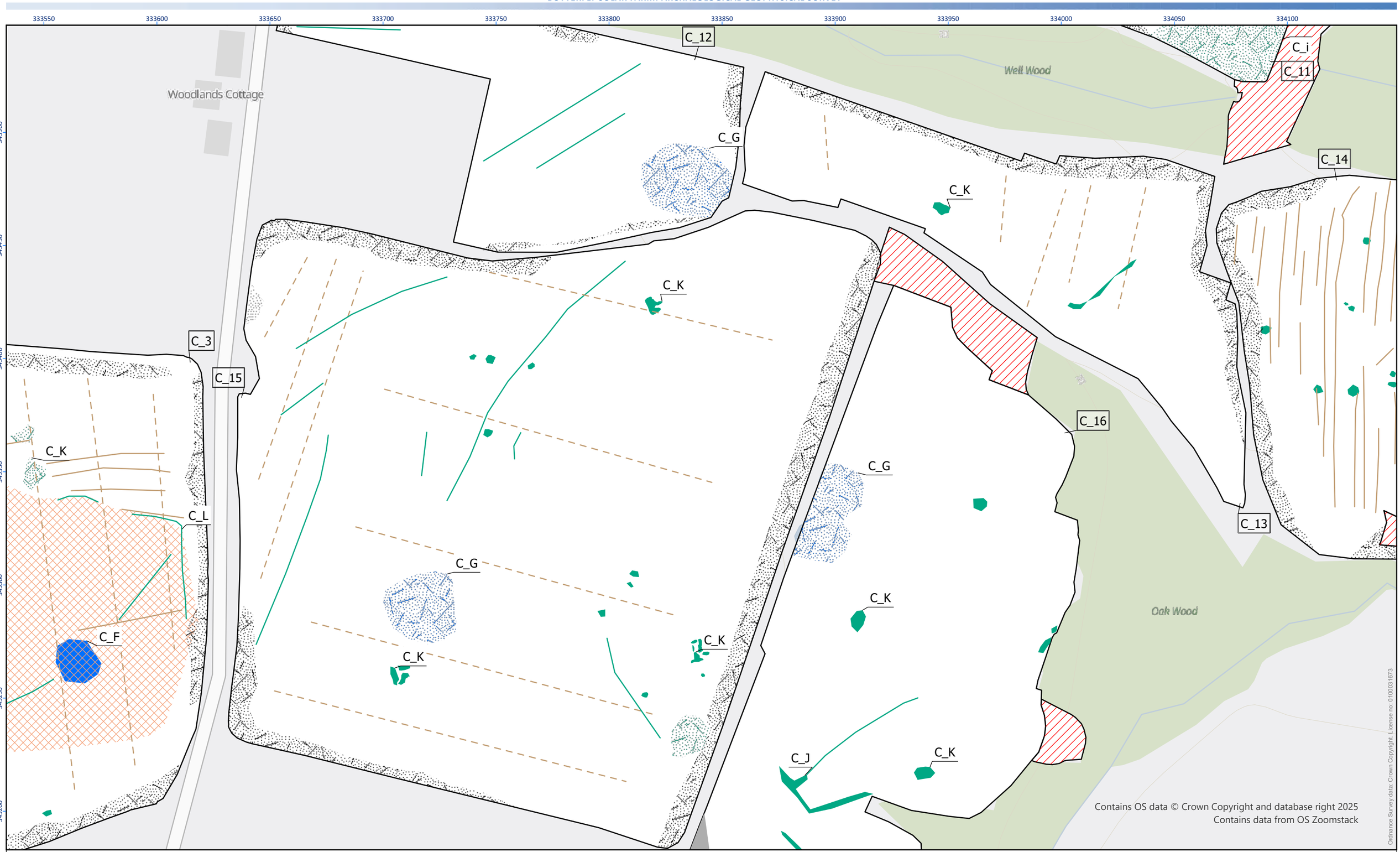
Approved by: JL	Date: 05/02/2025

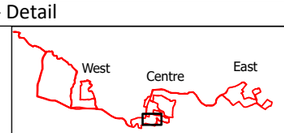
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.8

- Anomaly (Historic Feature)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Spread (Ferrous/Iron Spike)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.8/02	
Created by: KA	Date: 05/02/2025
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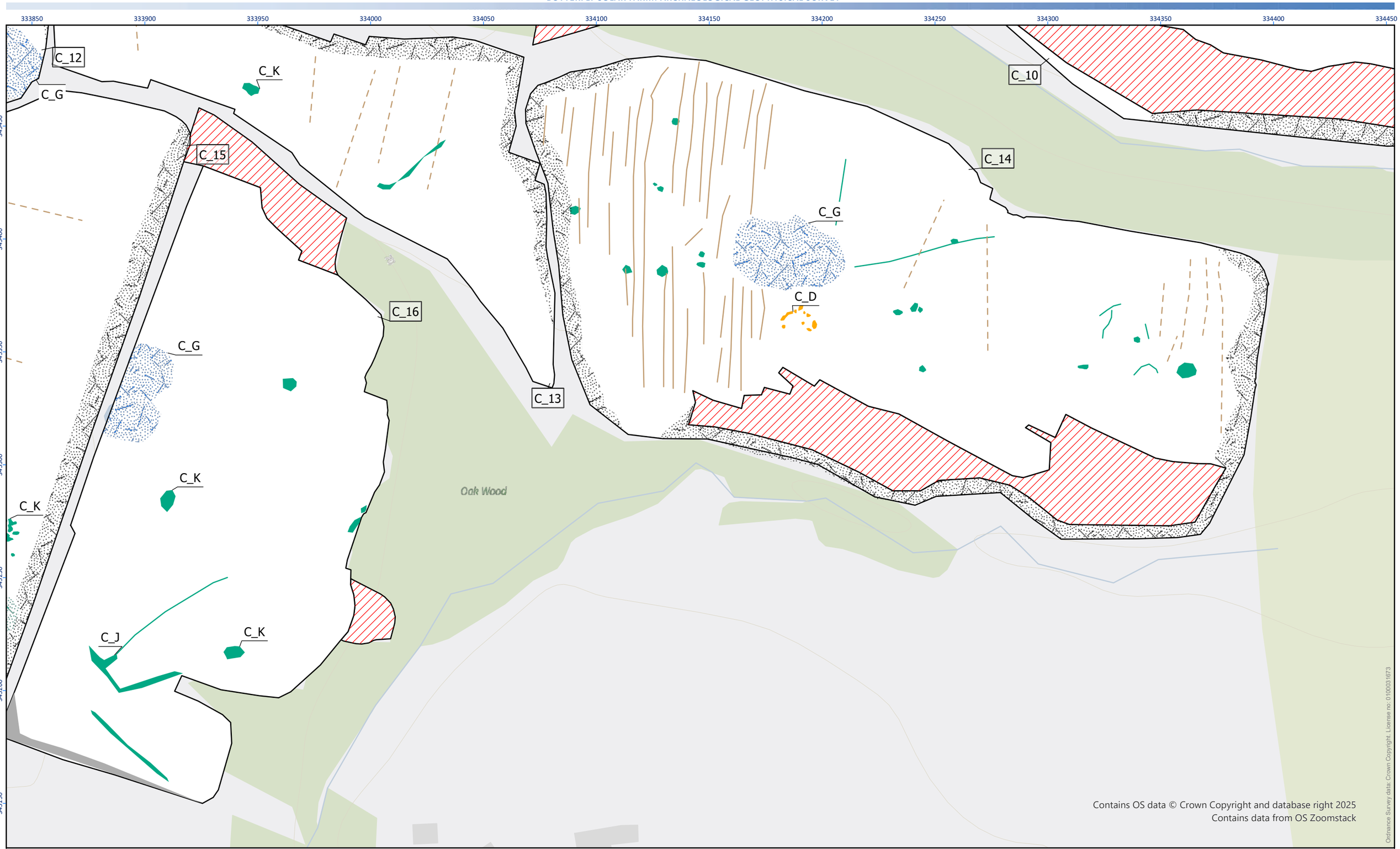
Approved by: JL	Date: 05/02/2025

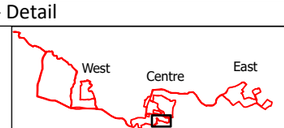
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.9

- Anomaly (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.9/02	
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Approved by: JL	Date: 05/02/2025

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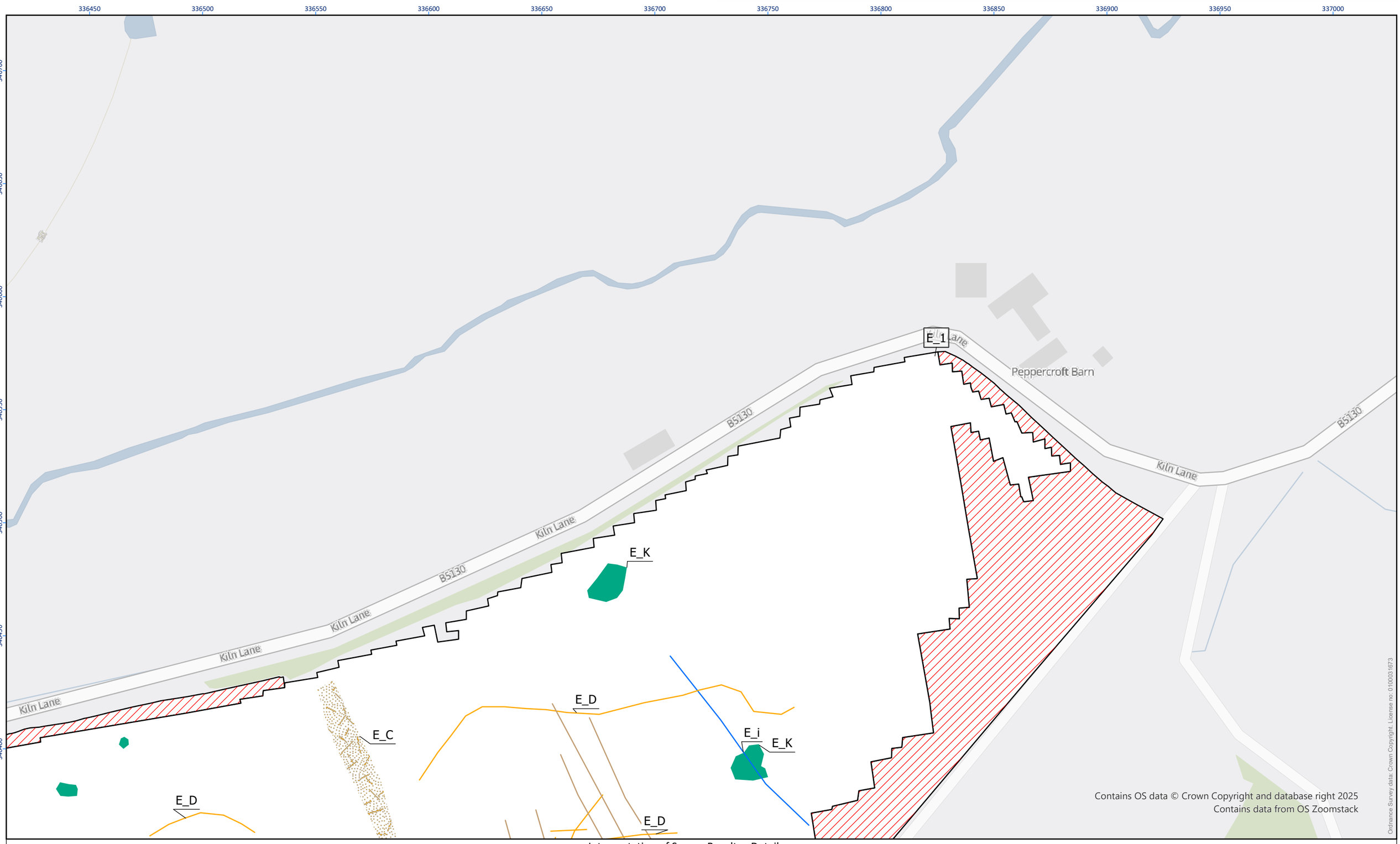


Interpretation of Survey Results - Detail

Figure 6.10

- Spread (Possible Archaeology)
- Anomaly (Unclear Origin)
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Agricultural, Ridge and Furrow)

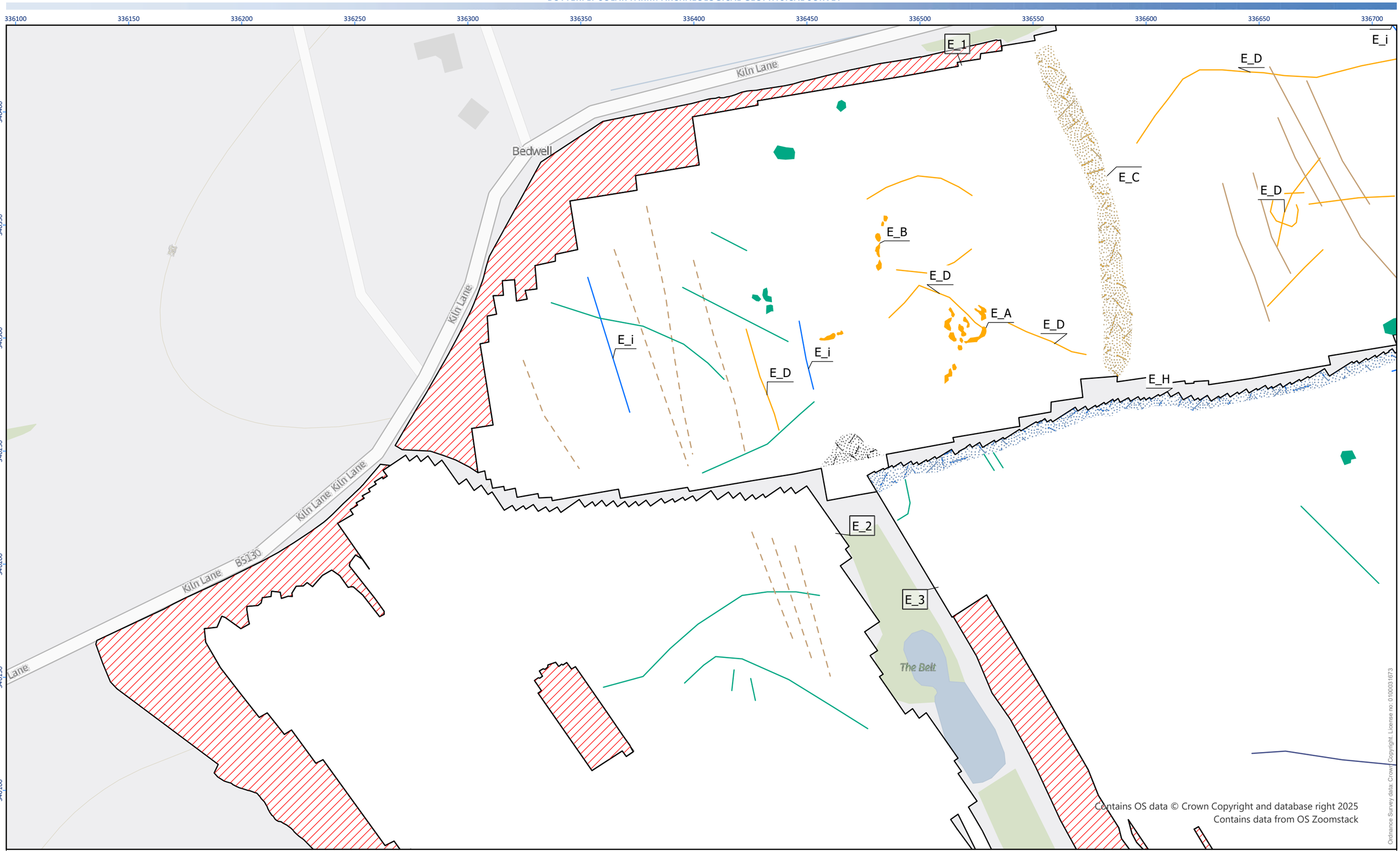
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.10/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

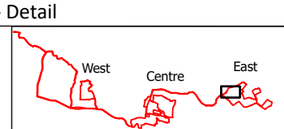
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.11

- Anomaly (Possible Archaeology)
- Spread (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Magnetic Disturbance)
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Drainage)



N

0 30m

Scale: 1:1,500 @ A3

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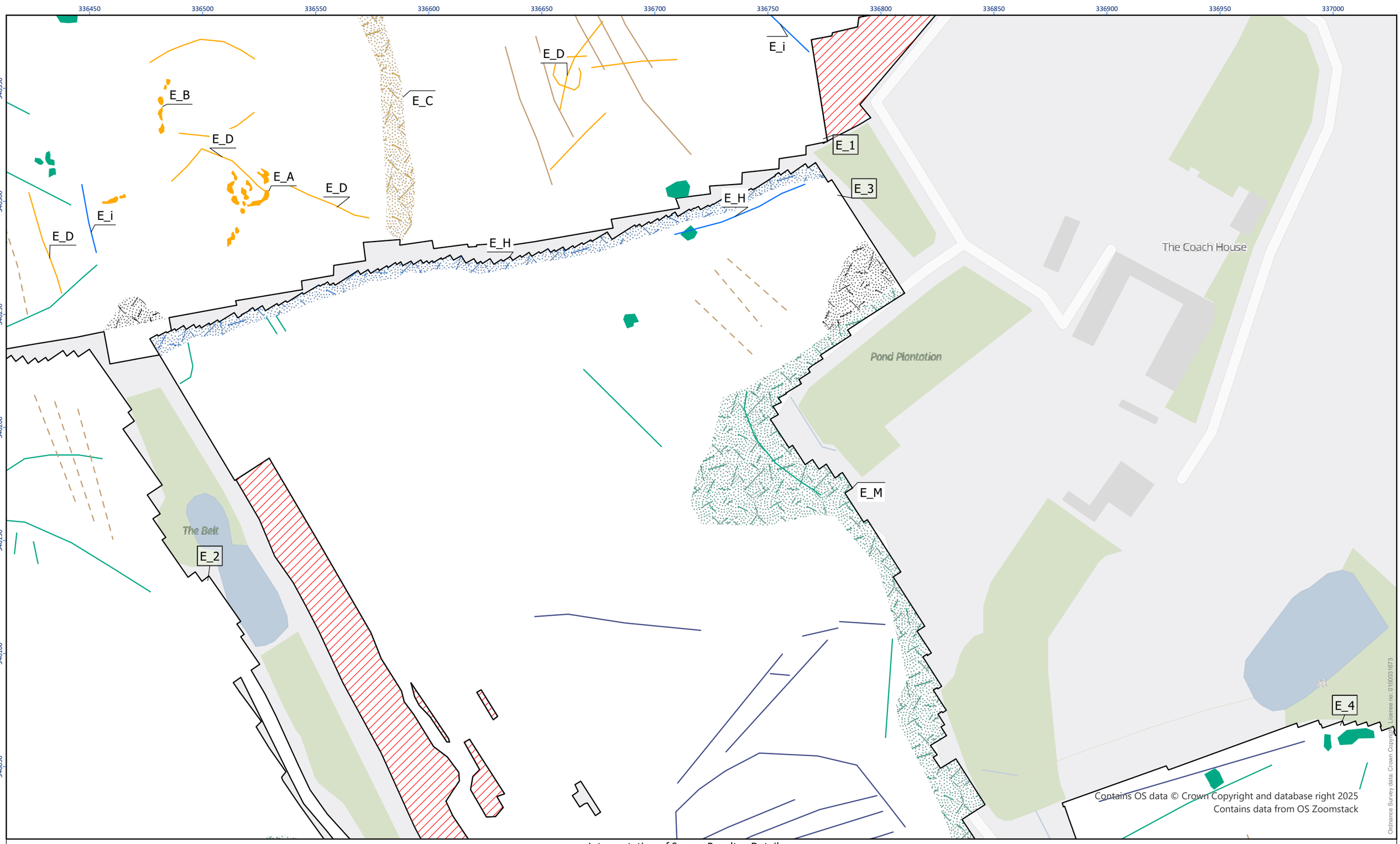
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.12

- Anomaly (Possible Archaeology)
- Spread (Possible Archaeology)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Linear Trend (Possible Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ploughing)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Drainage)

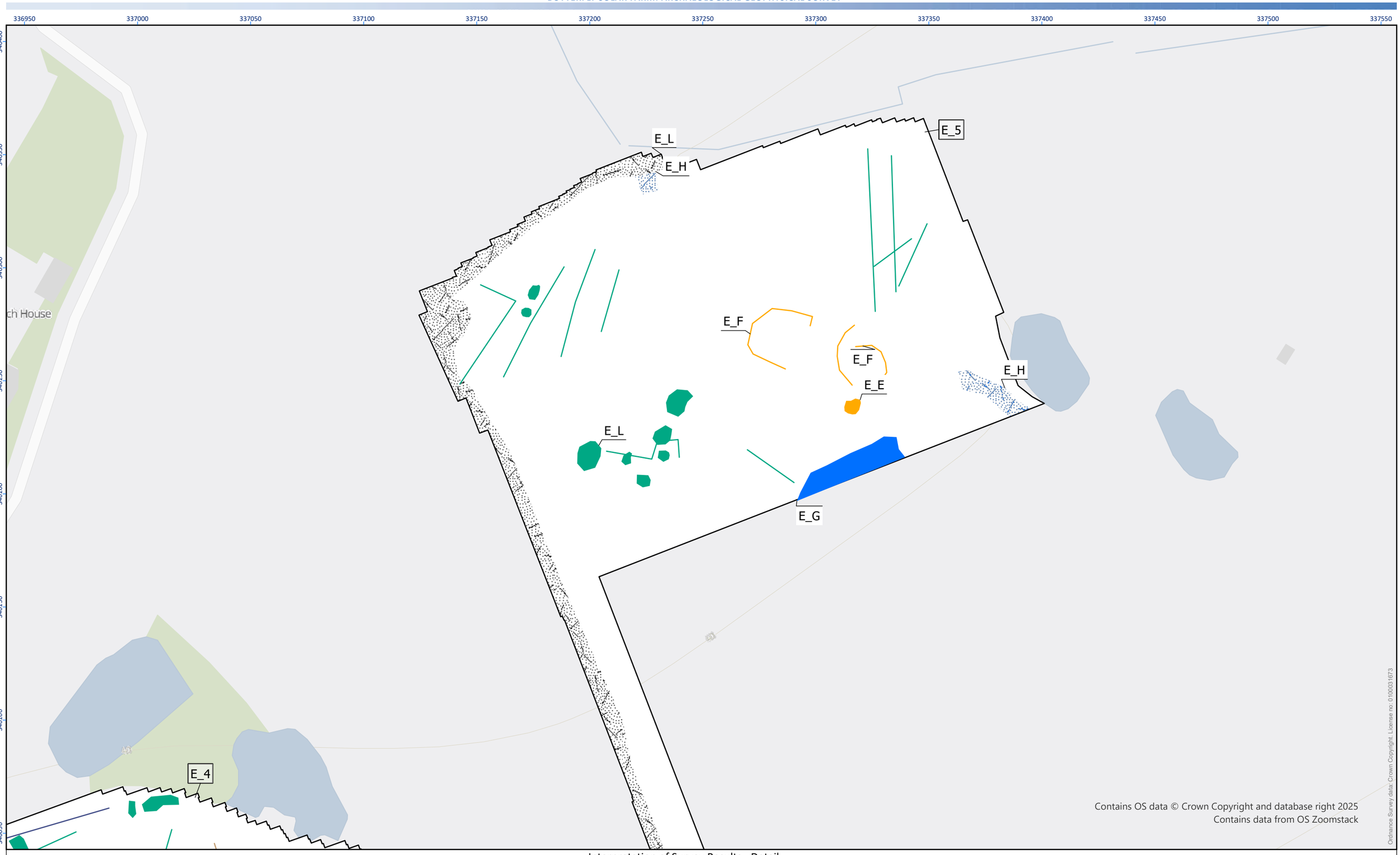
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.12/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

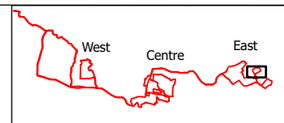
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.13

- Anomaly (Possible Archaeology)
- Anomaly (Historic Feature)
- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Magnetic Disturbance)
- Linear Trend (Possible Archaeology)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Drainage)



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Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.13/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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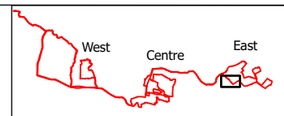
Interpretation of Survey Results - Detail

Figure 6.14

Spread (Unclear Origin)
Spread (Magnetic Disturbance)
Linear Trend (Unclear Origin)
Linear Trend (Drainage)



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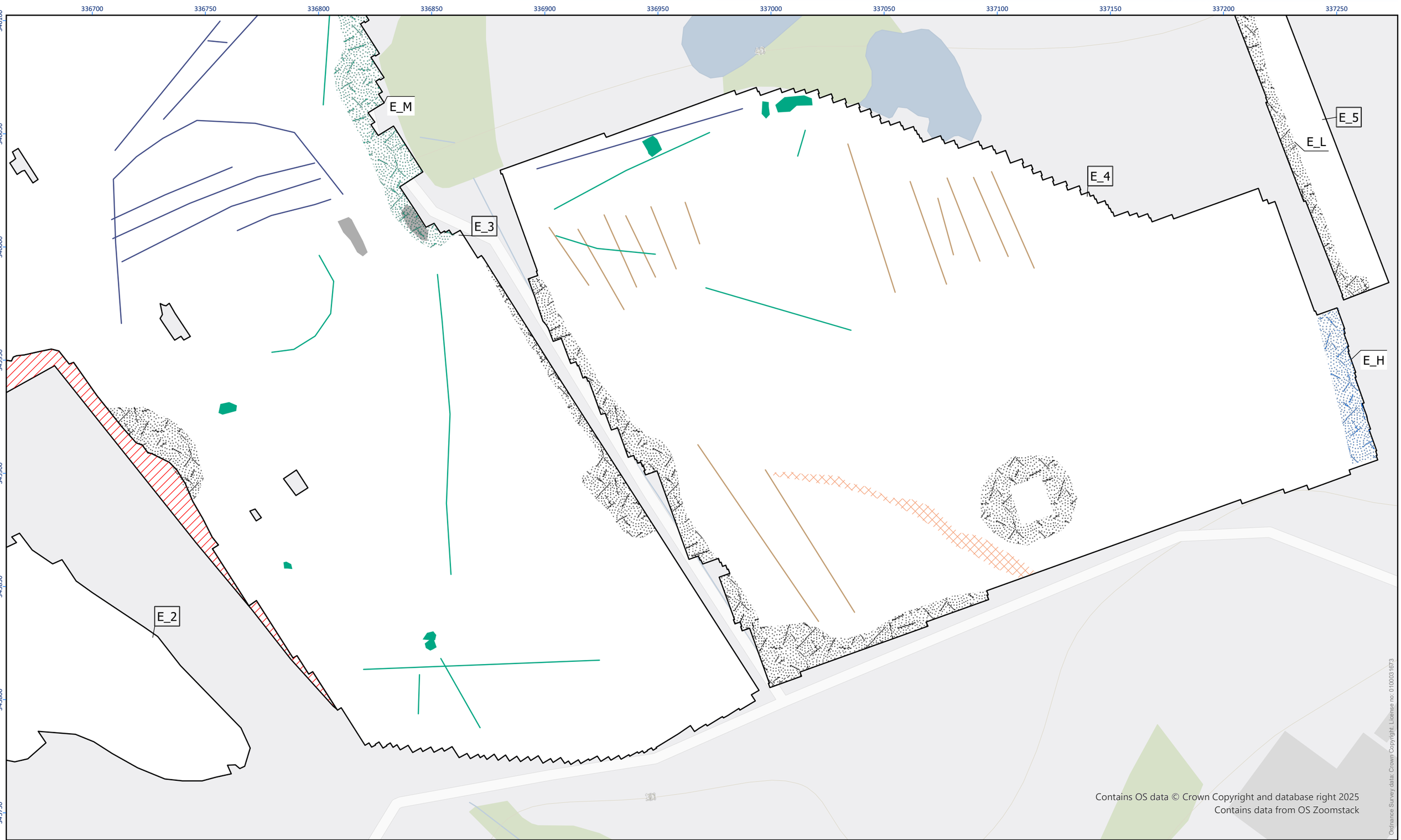
Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.14/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

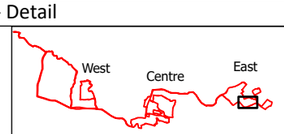
AOC Archaeology Group



Interpretation of Survey Results - Detail

Figure 6.15

- Spread (Historic Feature)
- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Geology/Natural)
- Spread (Magnetic Disturbance)
- Anomaly (Ferrous/Iron Spike)
- Linear Trend (Unclear Origin)
- Linear Trend (Agricultural, Ridge and Furrow)
- Linear Trend (Drainage)



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.15/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

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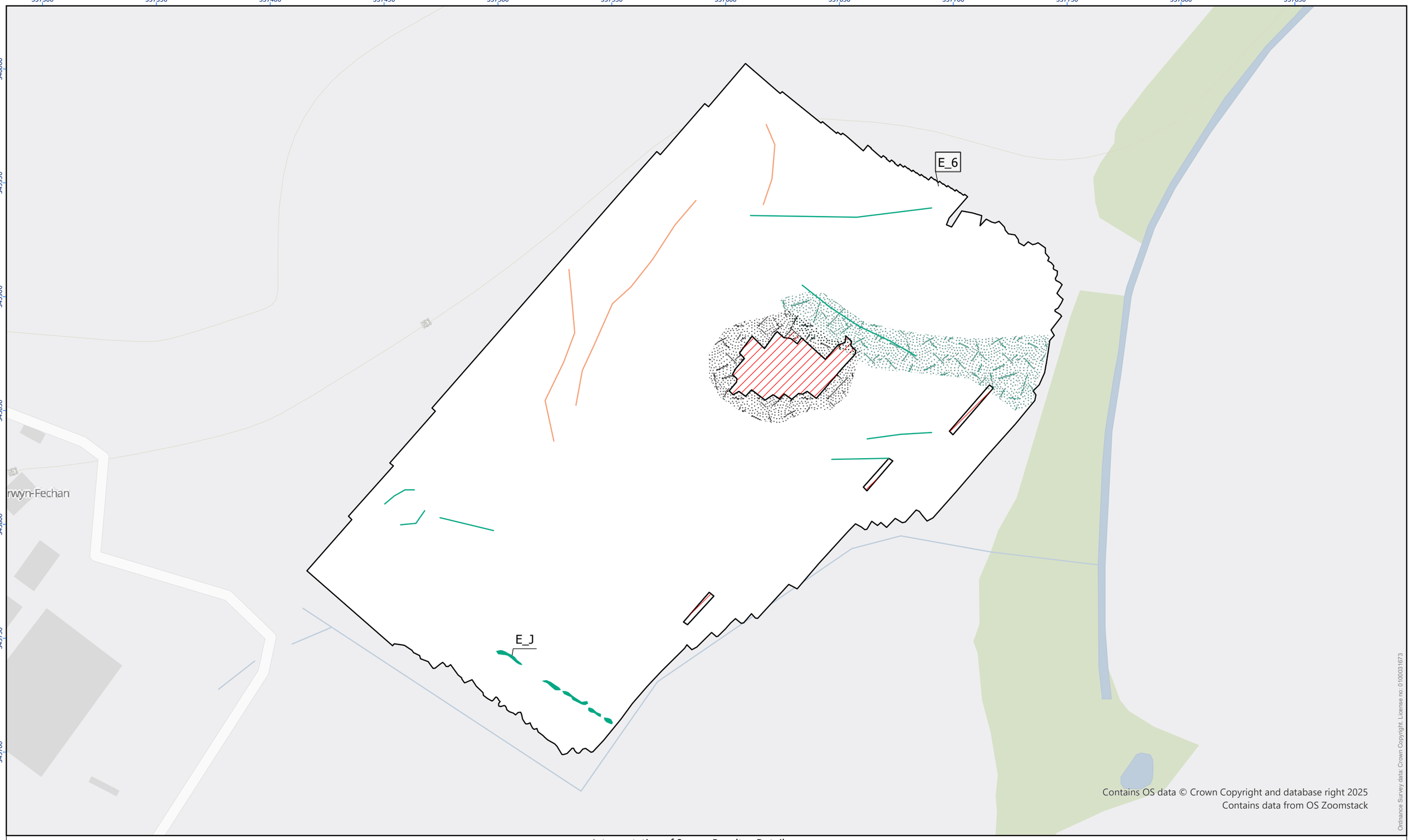
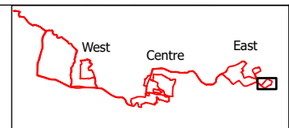
346000 345950 345900 345850 345800 345750 345700



Interpretation of Survey Results - Detail

Figure 6.16

- Anomaly (Unclear Origin)
- Spread (Unclear Origin)
- Spread (Magnetic Disturbance)
- Linear Trend (Unclear Origin)
- Linear Trend (Geology/Natural)



N

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Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/6.16/02	
Created by: KA	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

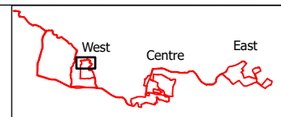
AOC Archaeology Group

Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.0

50nT

50nT



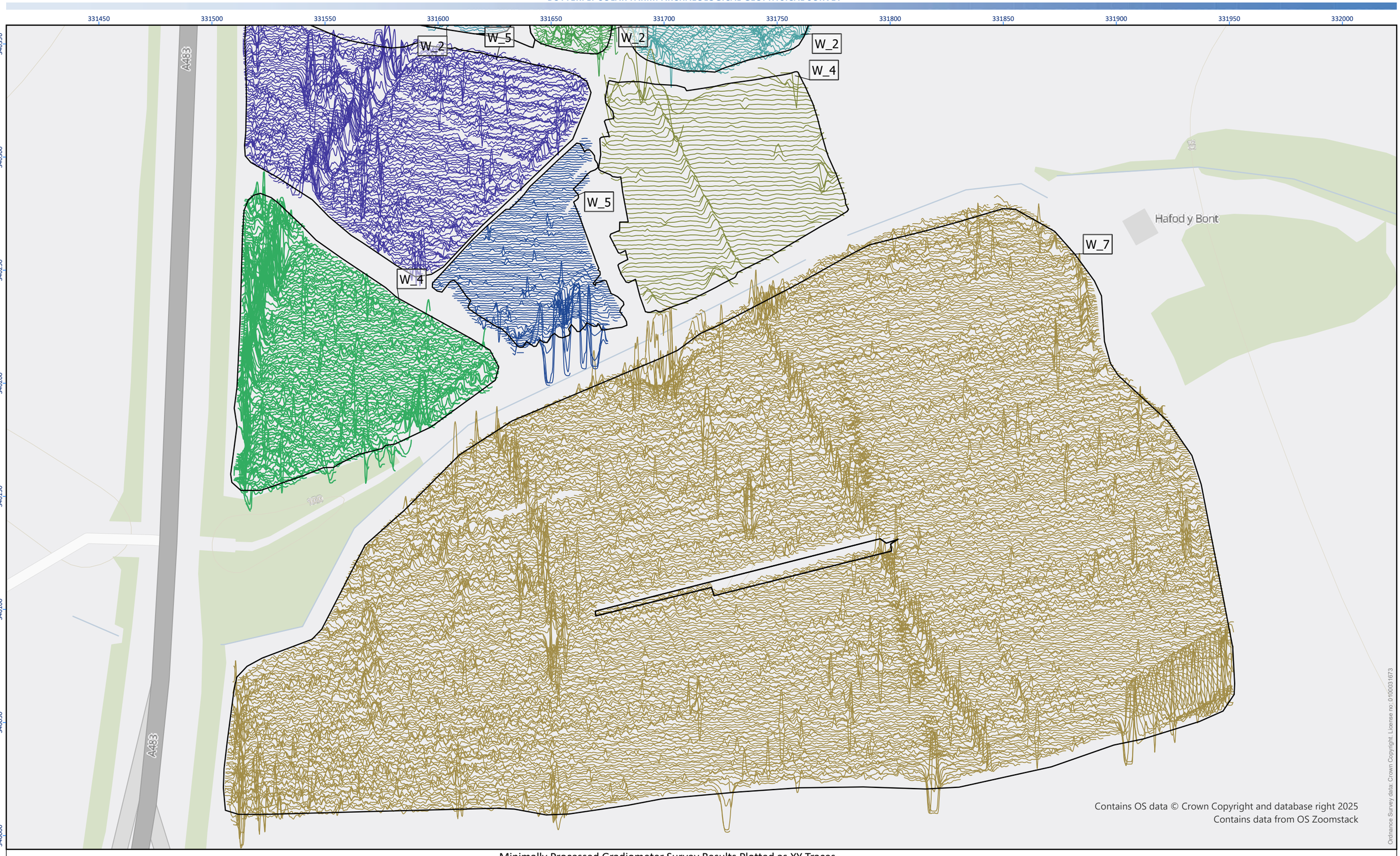
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.0/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

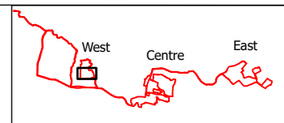


Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.1

50nT

50nT



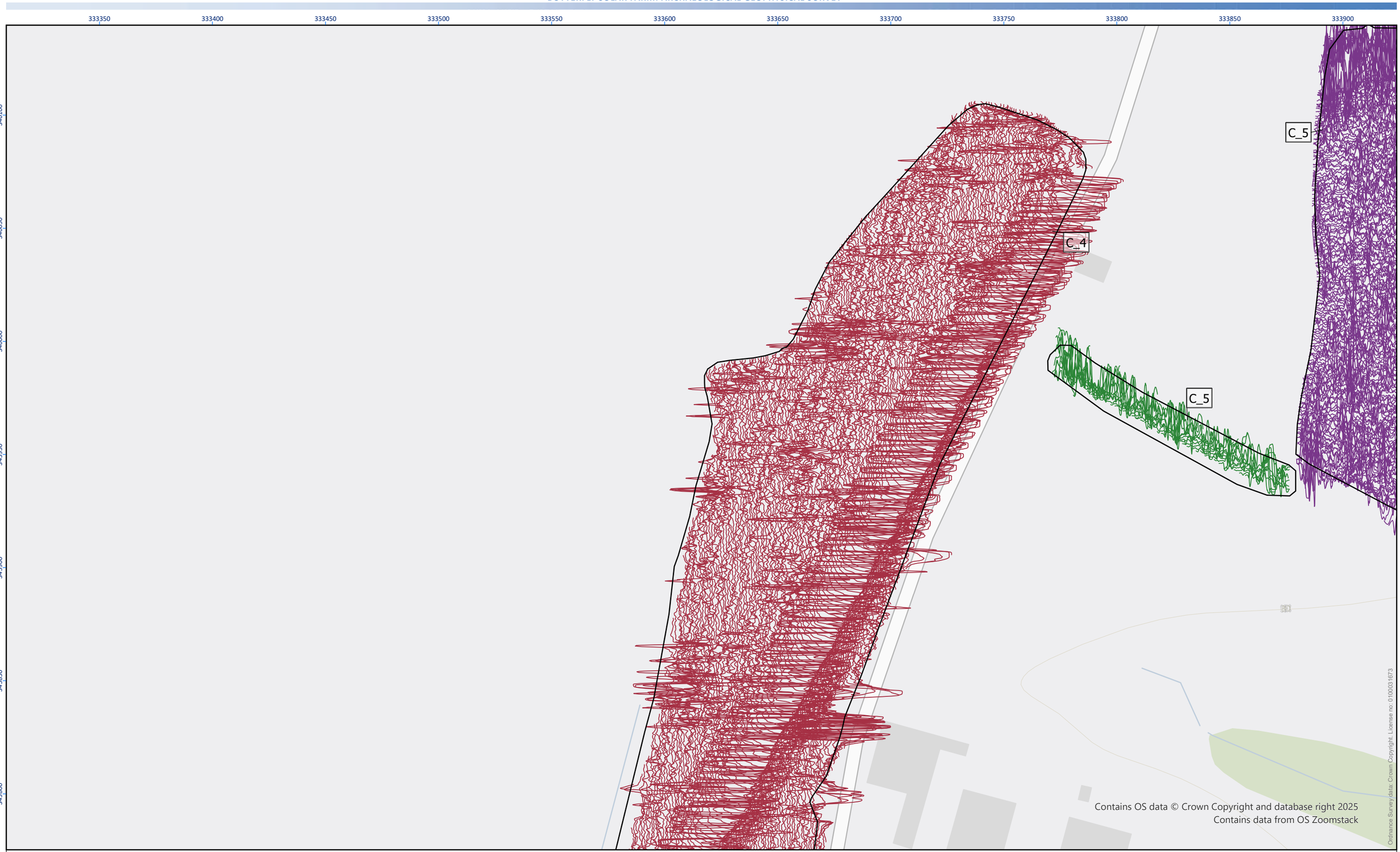
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.1/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.2

50nT

50nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.2/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

333800 333850 333900 333950 334000 334050 334100 334150 334200 334250 334300 334350

346150 346100 346050 346000 345950 345900 345850

C_4 C_5 C_5 C_6 C_7 C_8

Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.3

50nT
50nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.3/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

334200 334250 334300 334350 334400 334450 334500 334550 334600 334650 334700 334750 334800

346100 346050 346000 345950 345900 345850 345800 345750

C_6 C_7 C_8 C_9

Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.4

50nT
50nT

West Centre East

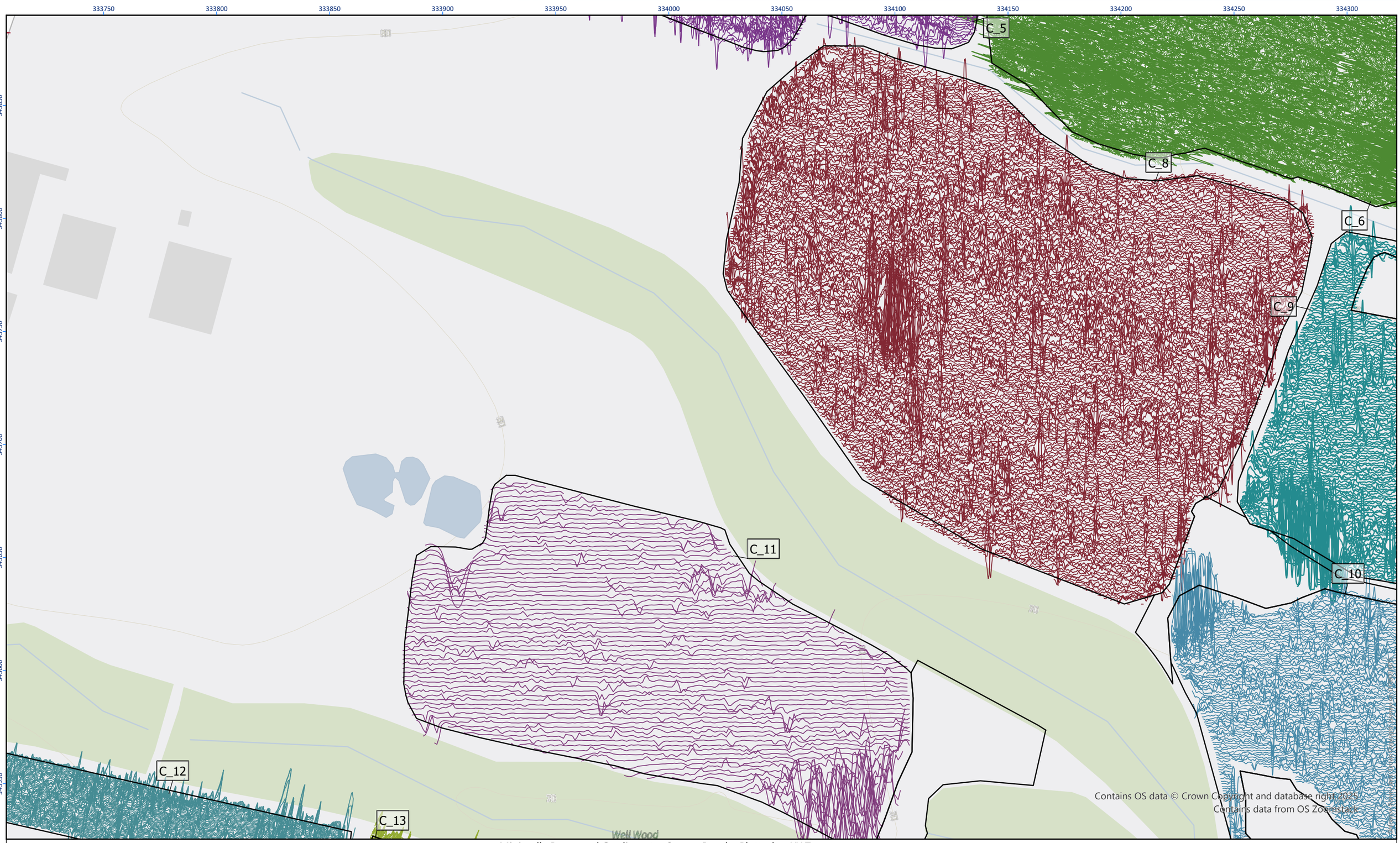
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.4/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.5

50nT

50nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

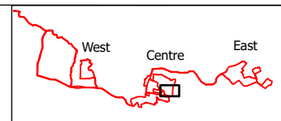
Drawing Number: 05/40759/GEO/7.5/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.6

50nT
50nT



N
0
30m
Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.6/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

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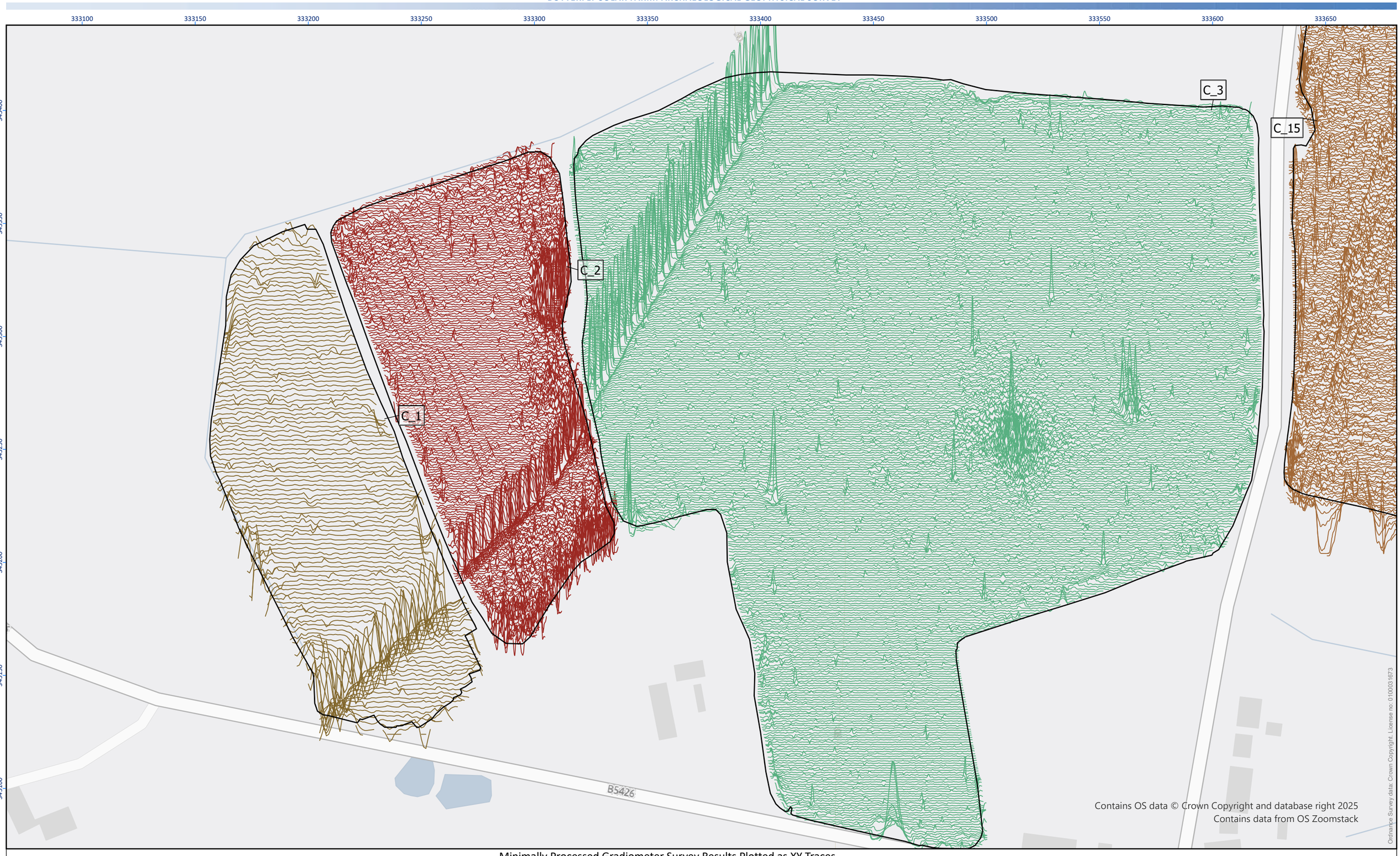


Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.7

50nT

50nT

West Centre East

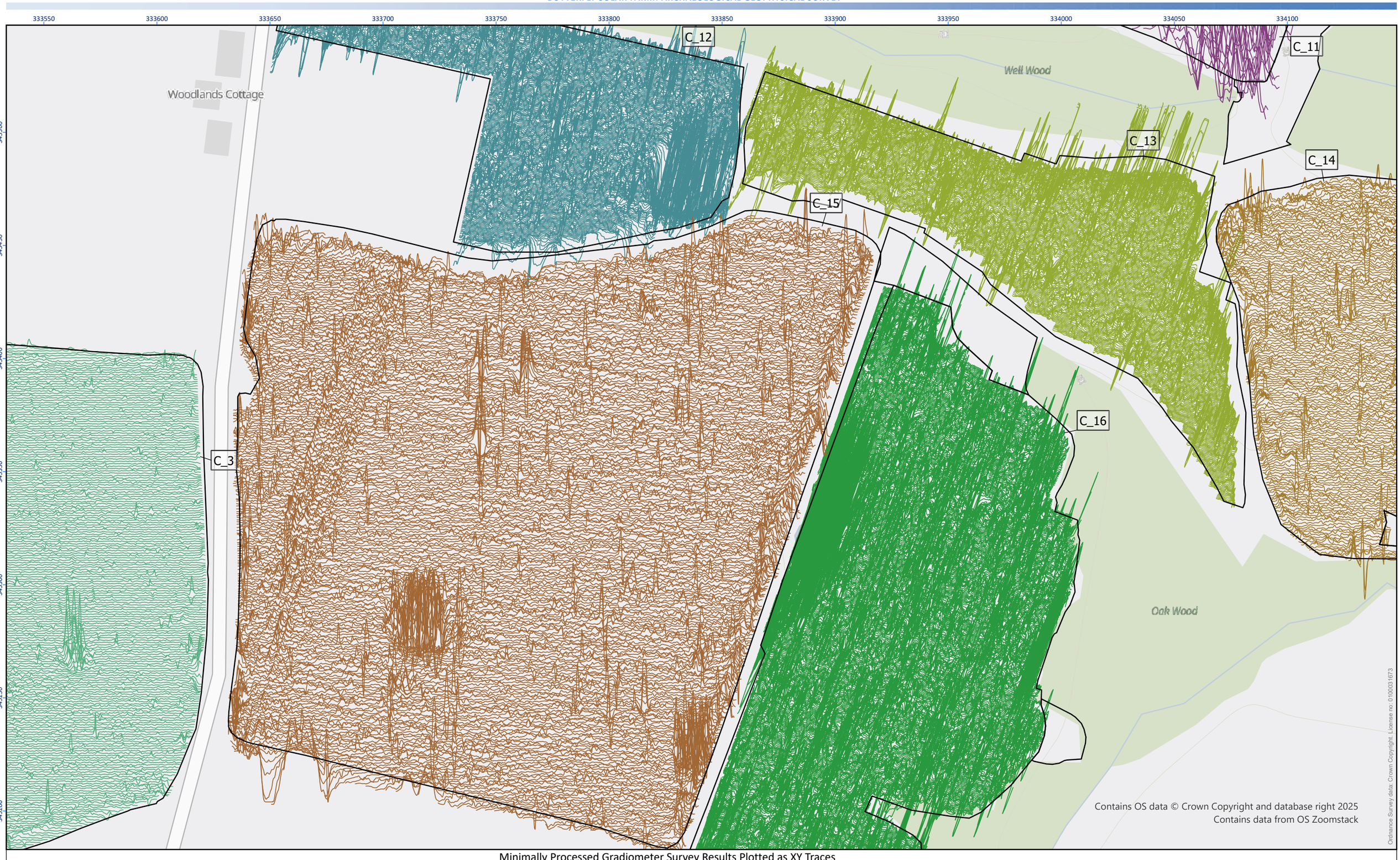
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.7/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.8

50nT

50nT

West Centre East

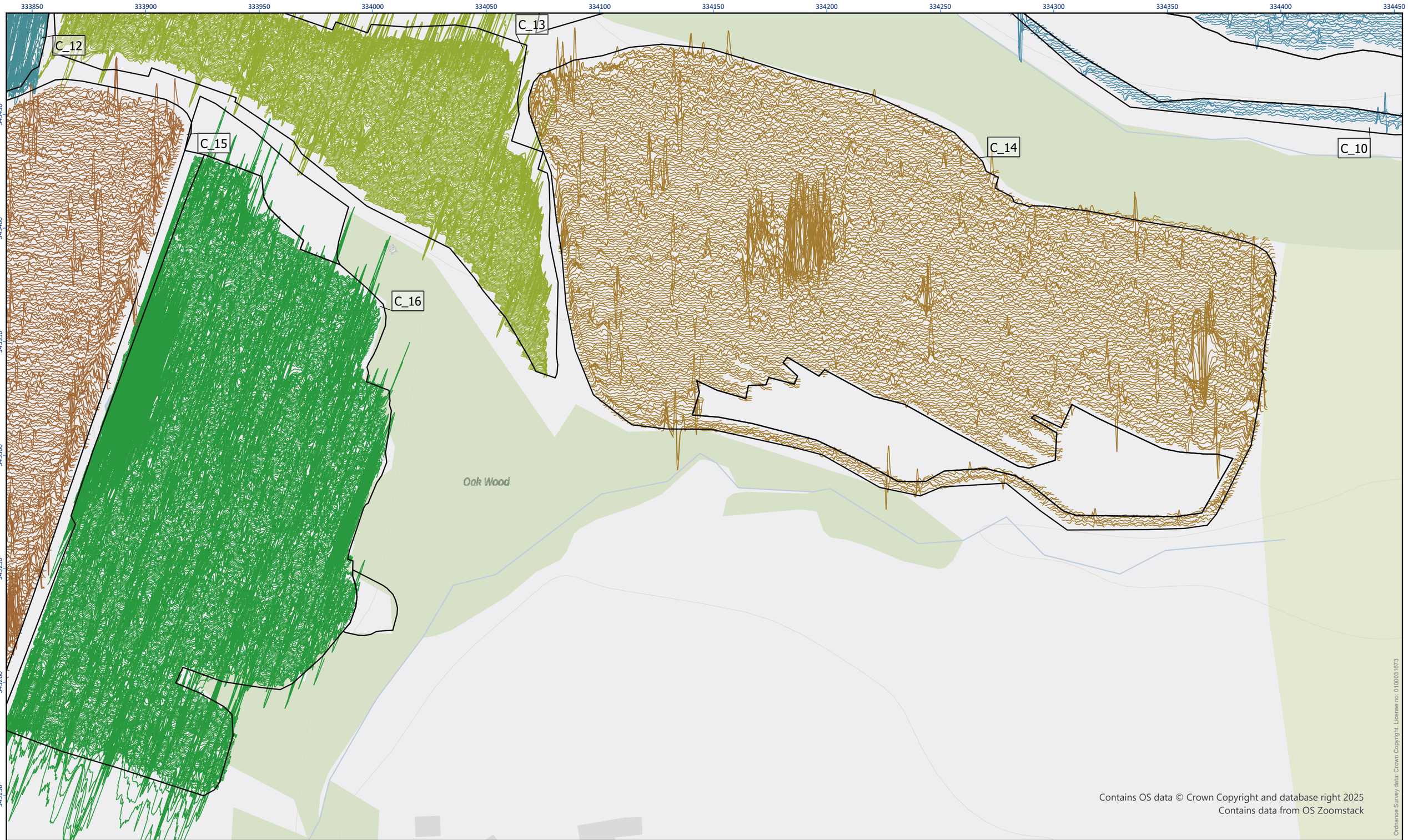
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.8/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

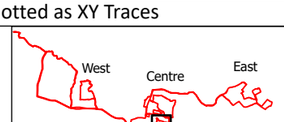
AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.9

50nT
50nT



N

0 30m

Scale: 1:1,500 @ A3

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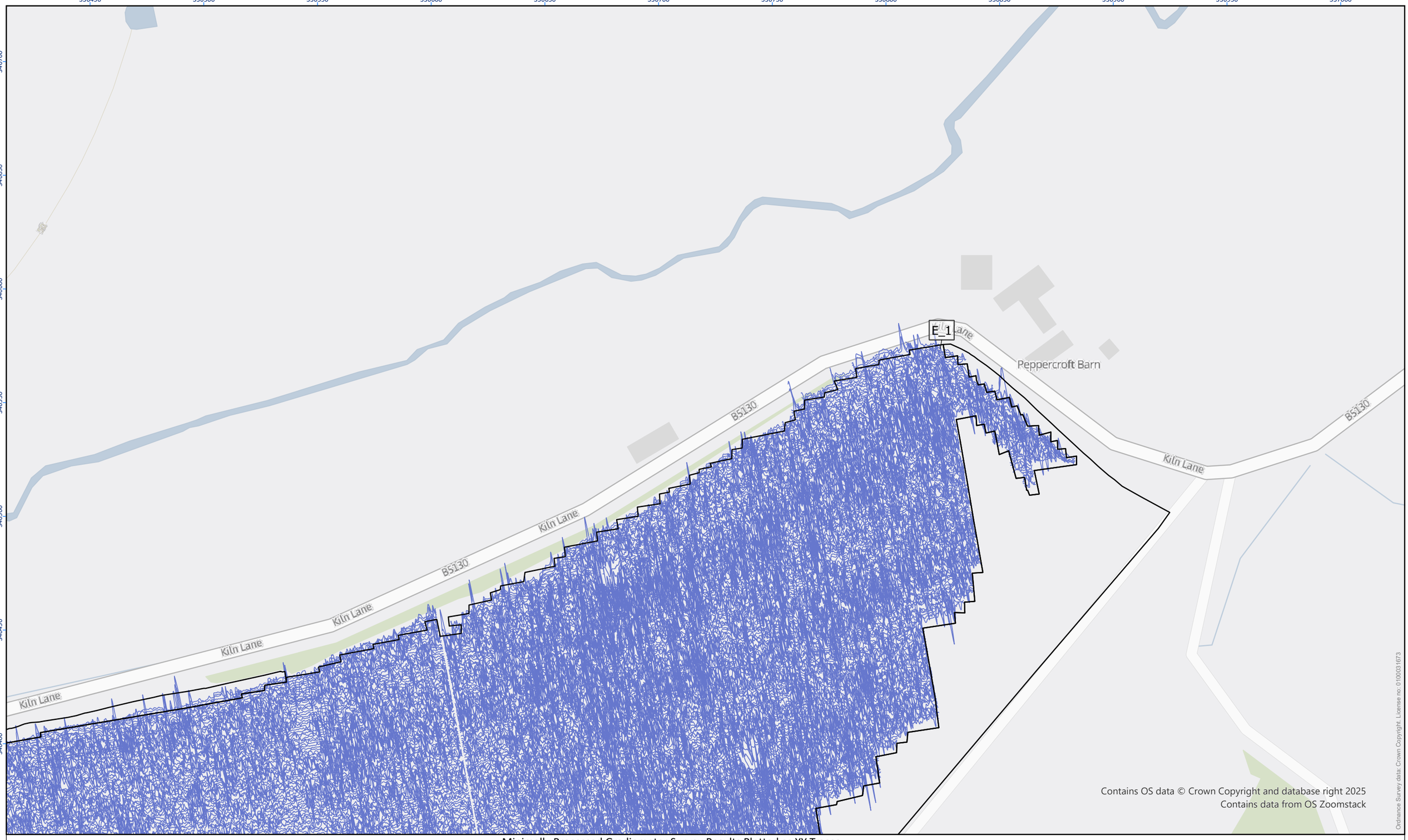
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.10

50nT

50nT

West Centre East

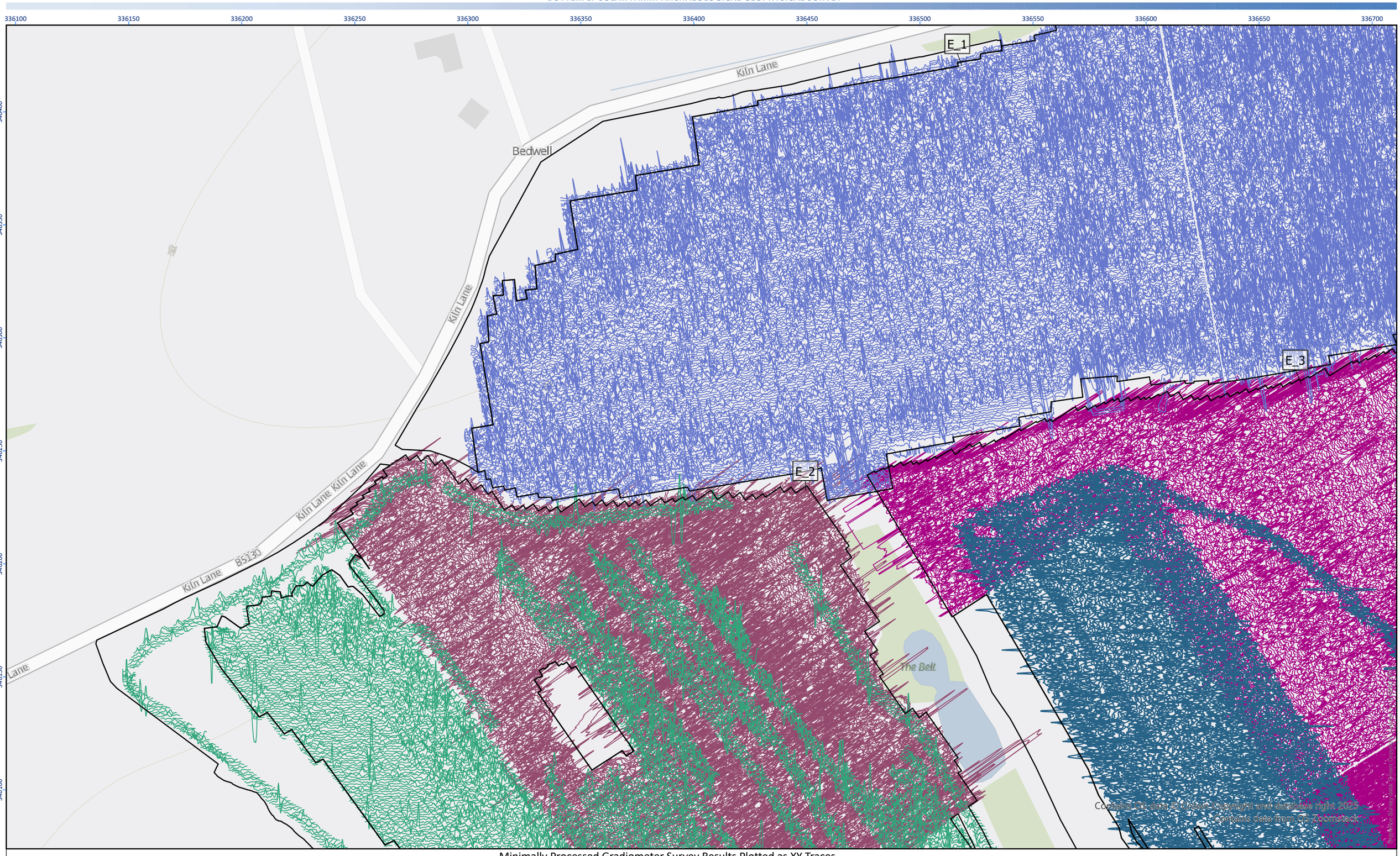
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.10/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

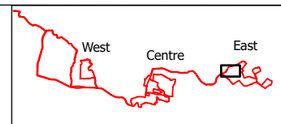


Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.11

50nT

50nT



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.11/01	
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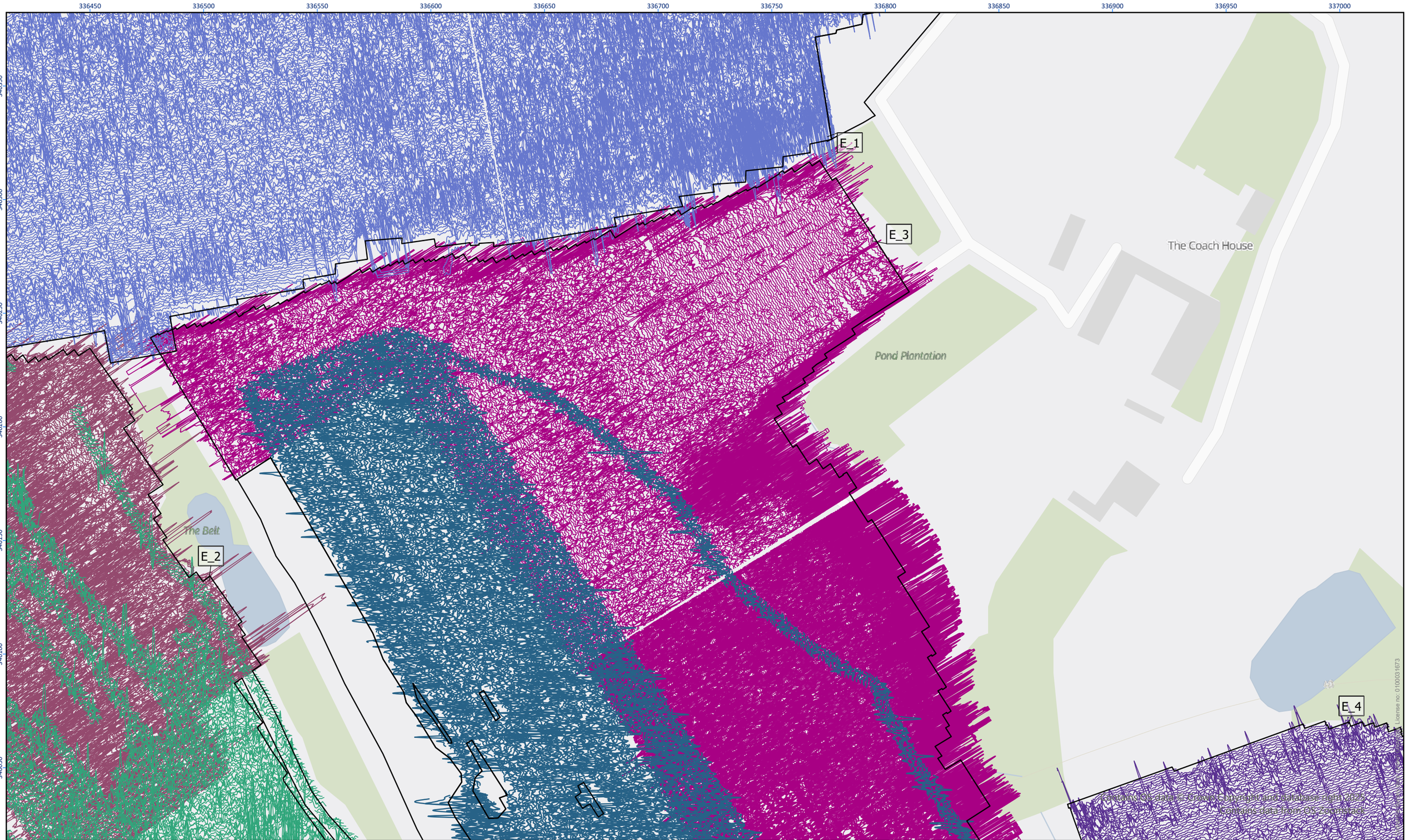
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

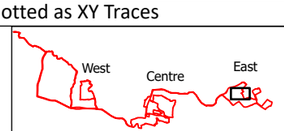


Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.12

50nT

50nT



N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.12/01	
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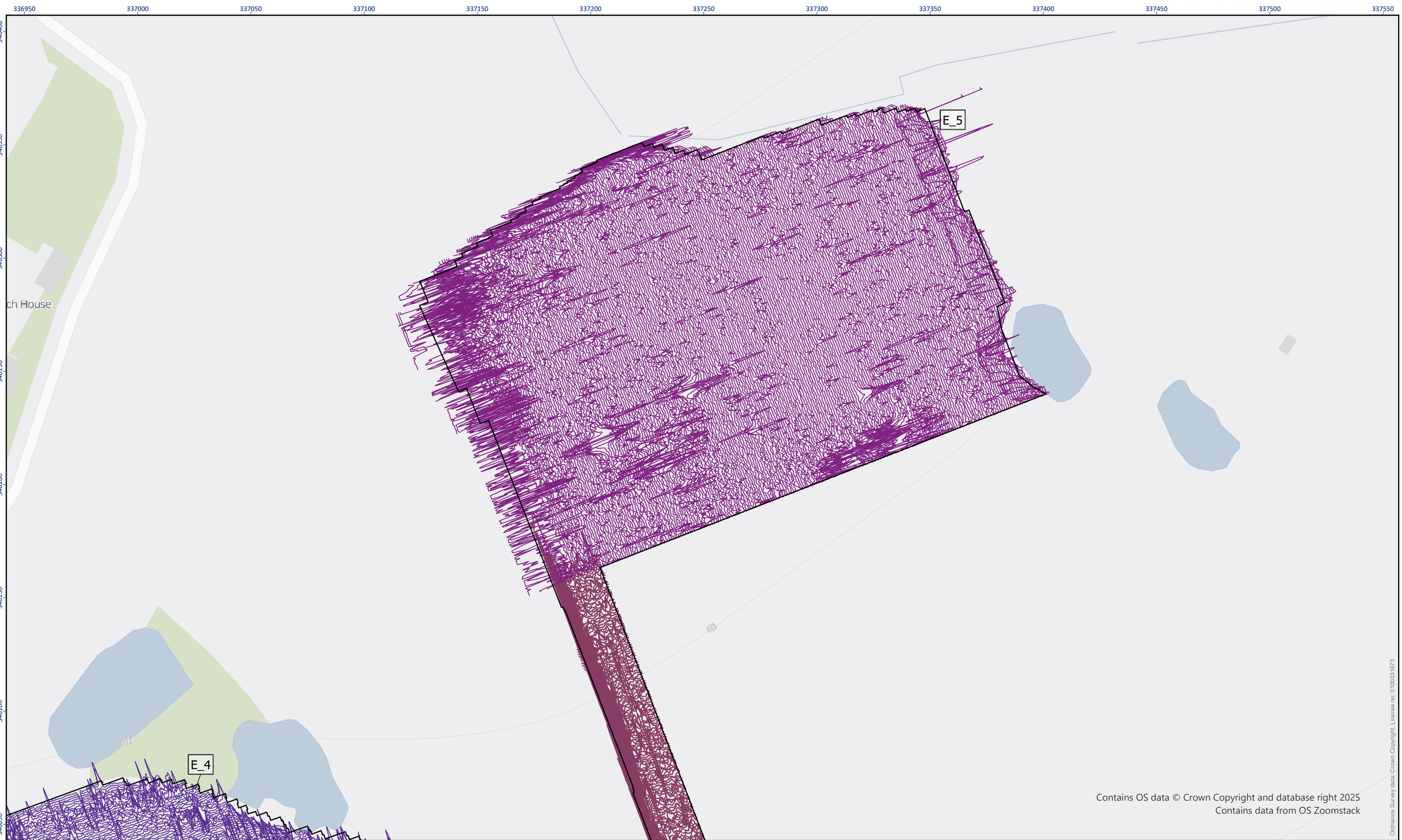
Approved by: JL	Date: 05/02/2025

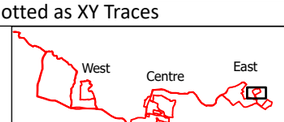
AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.13

50nT
50nT



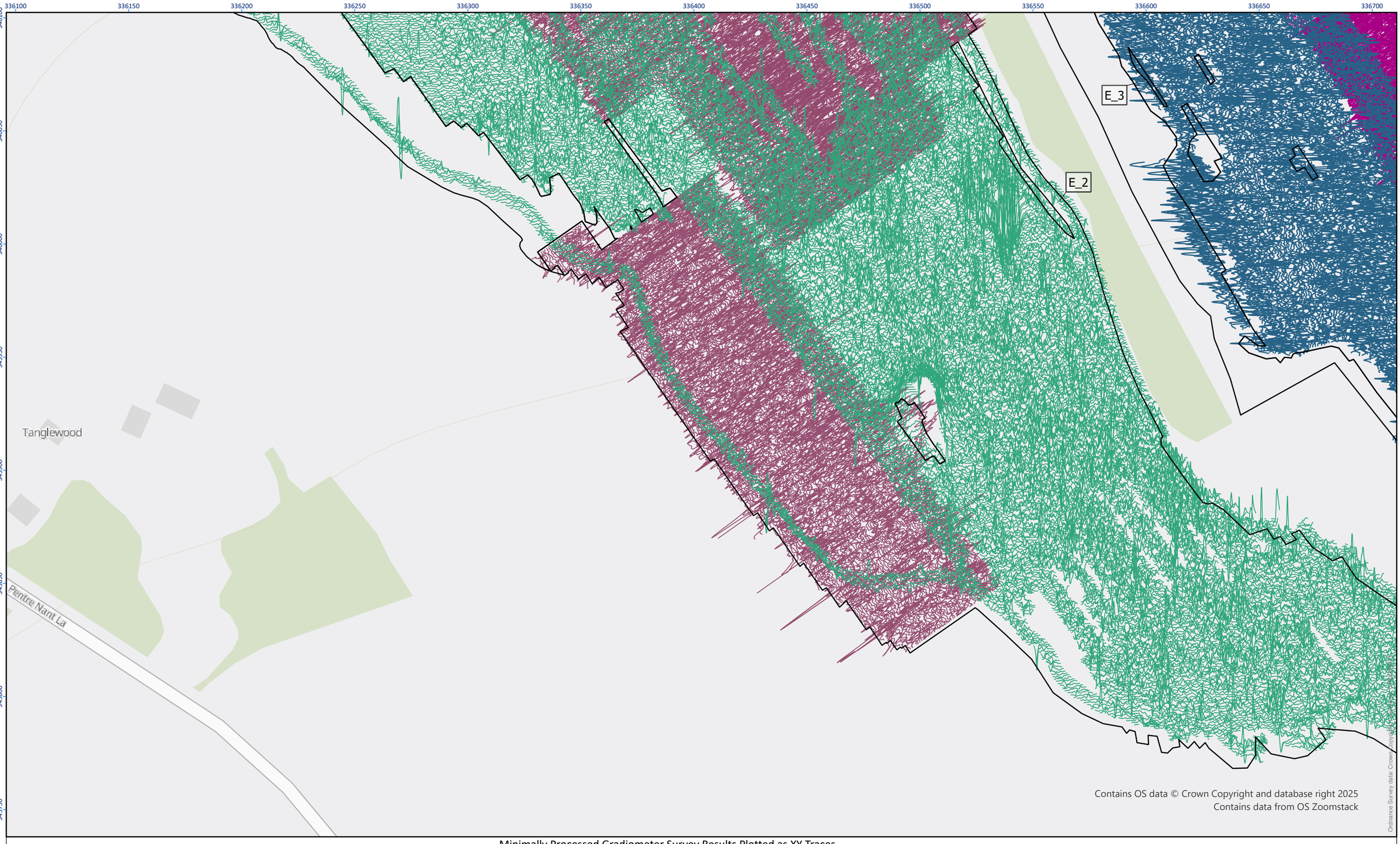
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.13/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.14

50nT

50nT

West Centre East

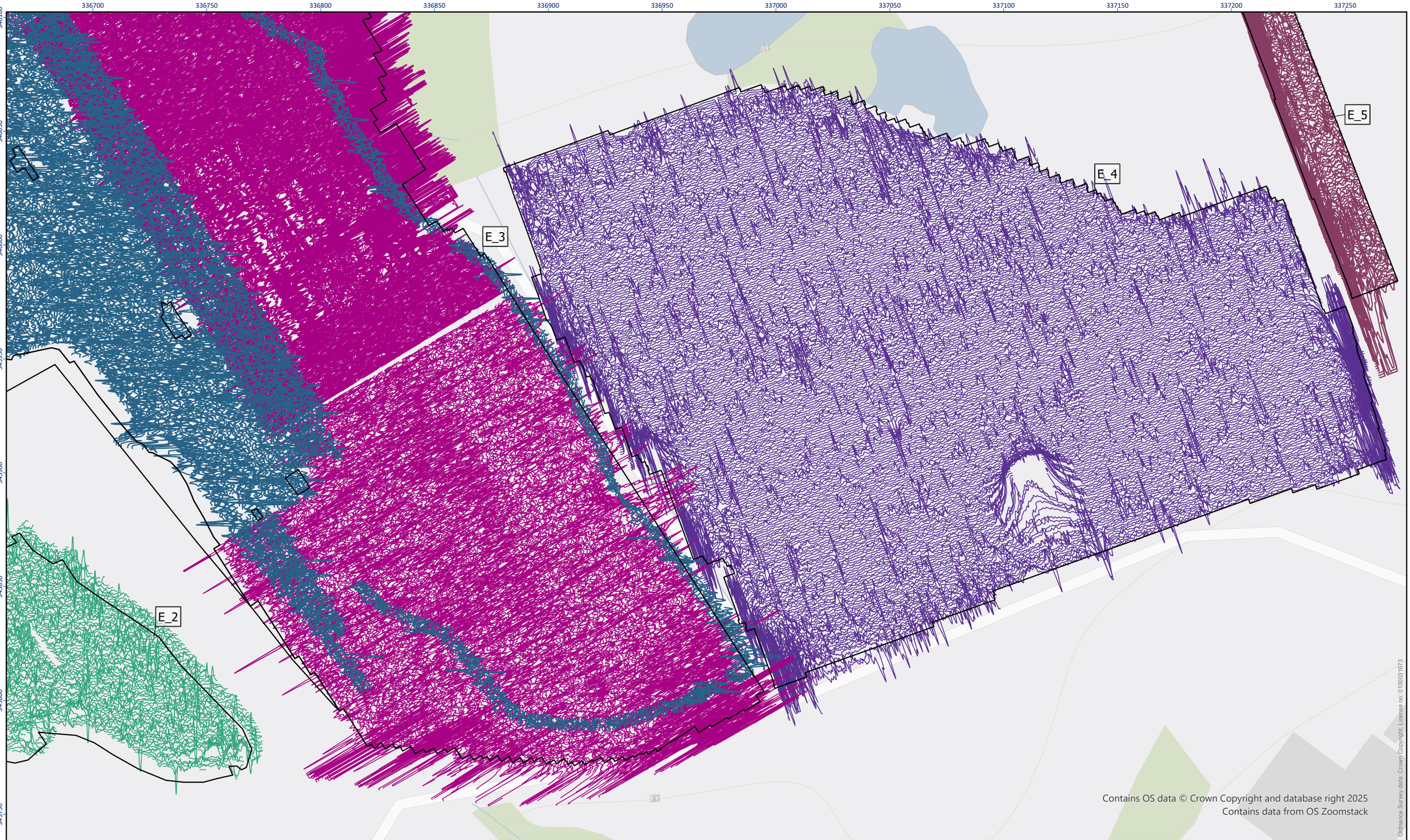
N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.14/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.15

50nT

50nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

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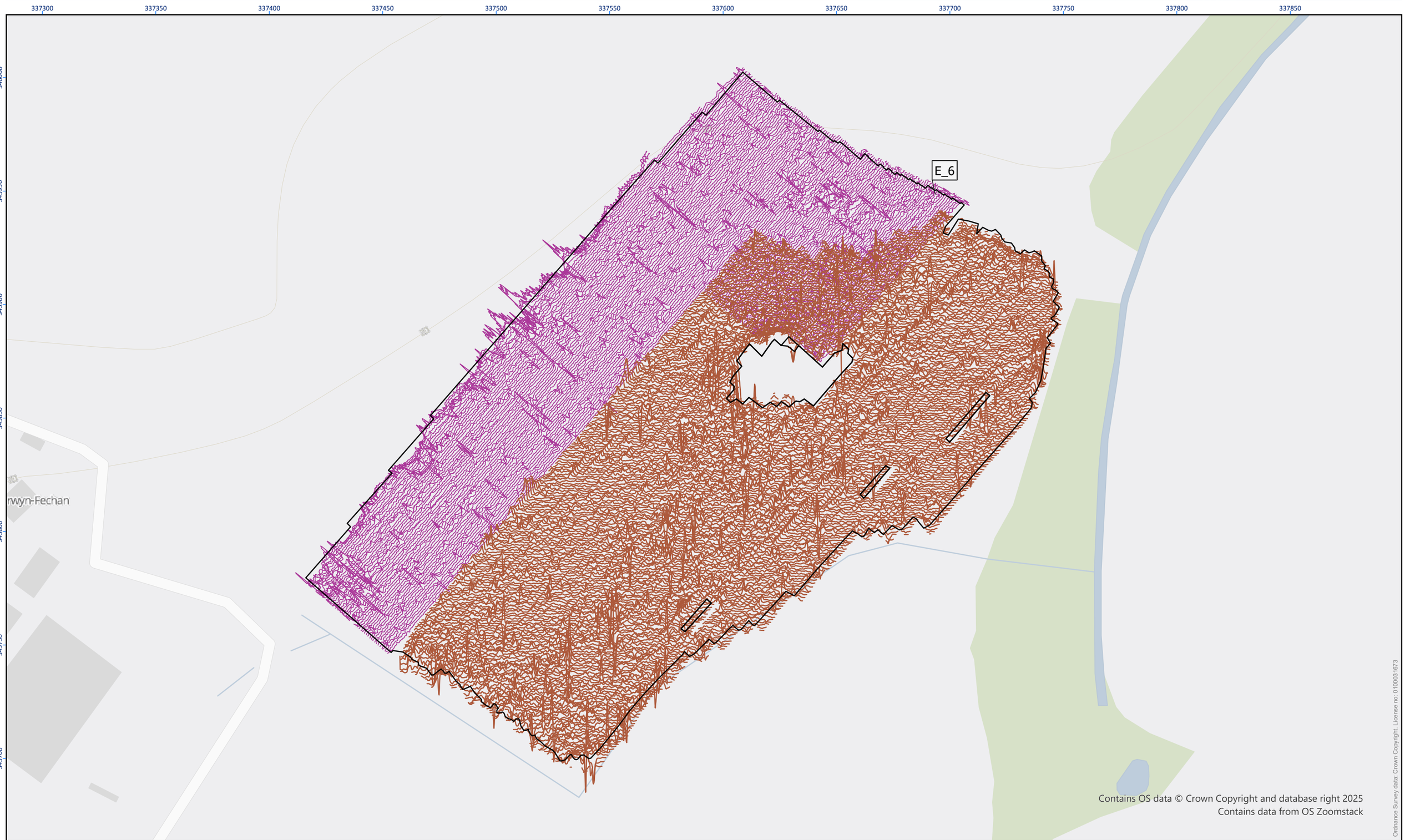
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group



Minimally Processed Gradiometer Survey Results Plotted as XY Traces

Figure 7.16

50nT
50nT

West Centre East

N

0 30m

Scale: 1:1,500 @ A3

Drawing Number: 05/40759/GEO/7.16/01	
Created by: KA/RL	Date: 05/02/2025
Checked by: SO	Date: 05/02/2025
Approved by: JL	Date: 05/02/2025

AOC Archaeology Group

Appendix 1: Survey Metadata

Oasis ID: aocarcha1-526997

Field	Description
Surveying company	AOC Archaeology Group
Data collection staff	Rob Legg, Kinnie Wade, Baeli Ferm, Megan Gathercole, Reed Haywood, Dan Shiel
Client	AXIS
Site name	Butterfly Solar Farm
County	Wrexham County Borough
NGR	SJ 33963 45632
Land use/field condition	Mixture of arable and pasture
Duration	July 2024 to November 2024
Weather	Varied
Survey type	Gradiometer Survey
Instrumentation	Gradiometer survey: Trimble GXOR system, Bartington Grad 601-2 Bartington cart survey: Bartington Non-Magnetic Cart, two Bartington Grad 601-2, Trimble R10 GNSS System Sensys cart survey: Sensys MXPDA cart, four FGM650/3 sensors, Trimble R10 GNSS System
Area covered	134.8ha
Download software	Grad601 PC Software v313 / MLGrad601 / DLMGPS v4.01-10, Geoserver v1.00-02 / Geoplot v4.0
Processing software	Geoplot v3.0 / v4.0 / Geomar, MultiGrad601 and TerraSurveyor / MAGNETO® / Geoplot v4.0
Visualisation software	ArcGIS Pro
Geology	Mudstone of the Etruria formation, mudstone, sandstone and conglomerate of the Salop formation underlie the central survey area and the west of the eastern survey area. Sandstone of the Kinnerton Sandstone formation underlies the east of the eastern survey area. Overlain by superficial deposits of diamicton of Devensian till, except for sand and gravel deposits in the southern half of the western survey area (BGS, 2025)
Soils	loamy and clayey, which are slowly permeable, seasonally wet and slightly acid but base-rich (Soilscapes, 2025)
Scheduled Monuments	NO
Known archaeology within survey area	No
Historical documentation/ mapping of survey area	Yes
Report title	Butterfly Solar Farm: Archaeological Geophysical Survey
Project number	40759
Report author	Kayt Armstrong and Rob Legg
Quality Checked by	Susan Ovenden

Appendix 2: Archaeological Prospection Techniques, Instrumentation and Software Utilised

Gradiometer Survey

Gradiometer surveys measure small changes in the earth's magnetic field. Archaeological materials and activity can be detected by identifying changes to the magnetic values caused by the presence of weakly magnetised iron oxides in the soil (Aspinall *et al*. 2008: 23; Sharma 1997: 105). Human habitation often causes alterations to the magnetic properties of the soils and sediments present in the area (Aspinall *et al*. 2008: 21). There are two physical transformations that produce a significant contrast between the magnetic properties of archaeological features and the surrounding soil: the enhancement of magnetic susceptibility and thermoremanent magnetization (Aspinall *et al*. 2008: 21; Heron and Gaffney 1987: 72).

Ditches and pits can often be detected through gradiometer survey as the topsoil within and around settlements typically has a greater magnetisation than the subsoil, due to human activity. This enhanced material accumulates in cut features such as ditches and pits. Areas of burning or materials which have been subjected to heat commonly also have high magnetic signatures, such as hearths, kilns, fired clay and mudbricks (Clark 1996: 65; Lowe and Fogel 2010: 24).

It should be noted that negative anomalies can also be useful for characterising archaeological features. If the buried remains are composed of a material with a lower magnetisation compared to the surrounding soil, the feature in question will display a negative signature. For example, stone-built structures composed of sedimentary rocks that are less magnetic than the surrounding soils can appear as negative features within the dataset if the local soils and sediments are at all magnetised.

Ferrous objects – i.e. iron and its alloys - are strongly magnetic and are typically detected as high-value peaks in gradiometer survey data; small (in spatial terms) spikes are generally assumed to derive from ferrous material of recent origin (e.g. stray bits of farm equipment) in the topsoil, though archaeological sources cannot be ruled out. Broader dipolar anomalies and those with diagnostic characteristics of form will be assigned to other classifications based on their character, which might include archaeology, burning, modern ferrous or uncertain.

Although gradiometer surveys have been successfully carried out in all areas of the United Kingdom, the effectiveness of the technique is lessened in areas with complex geology, particularly where igneous and metamorphic bedrock is present or there are layers of alluvium or till between the surface and the layers of interest. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Gradiometer Survey Instrumentation and Software

AOC Archaeology's gradiometer surveys are carried out using Bartington Grad601-2 magnetic gradiometers. The Grad601-2 is a high-stability fluxgate magnetic gradient sensor, which uses a 1m sensor separation. The detection resolution is from 0.03 nT/m to 0.1nT/m, depending on the sensor parameters selected, making the Grad601-2 an ideal instrument for prospective survey of large areas as well as detailed surveys of known archaeology. The instrument stores the data collected on an on-board data-logger, which is then downloaded as a series of survey grids for processing.

Following the survey, gradiometer data is downloaded from the instrument using Grad601 PC Software v313. Survey grids are then assembled into composites and enhanced using a range of processing techniques using Geoscan Geoplot v3.0 / v4.0 (see Appendix 3 for a summary of the processes used in Geoplot to create final data plots).

Bartington Non-Magnetic Cart Instrumentation and Software

AOC Archaeology's cart-based surveys are carried out using a Bartington Non-Magnetic Cart. The cart enables multiple traverses of data to be collected at the same time, increasing the speed at which surveys may be carried out and offers the benefits of reduced random measurement noise and rapid area coverage (Schmidt *et al.* 2015, 60-62; David *et al*. 2008, 21).

The cart uses a configuration of four Grad-01-1000L sensors mounted upon a carbon fibre frame along with two DL601 dataloggers and one BC601 battery cassette. The sensors are normally positioned at 1m intervals on a horizontal bar, with the datalogger taking readings every 12.5cm along each traverse, though this can be altered to increase / reduce resolution if required. The data is georeferenced via a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS which streams data throughout survey and allows the data to be recorded relative to a WGS1984 UTM coordinate system.

The gradiometer data is collected through Geomar MLGrad601 software on a laptop in real-time during the survey. The data is downloaded and converted into a .xyz file in Geomar MultiGrad601 before being processed along with the GPS data in TerraSurveyor v3.0.34.10 (see Appendix 3 for a summary of the processes used in Geoplot to create final data plots).

Sensys MAGNETO® MXPDA Non-Magnetic Cart Instrumentation and Software

AOC Archaeology's cart-based surveys are carried out using a Sensys MAGNETO® MXPDA push-cart magnetometer system. The cart enables multiple traverses of data to be collected at the same time, increasing the speed at which surveys may be carried out and offers the benefits of reduced random measurement noise and rapid area coverage (Schmidt *et al.* 2015, 60-62; David *et al*. 2008, 21).

The cart uses a configuration of five FGM650/3 fluxgate gradiometer sensors mounted upon a frame along with data logging equipment and batteries. The sensors are normally positioned at 0.5m intervals along a horizontal bar, with the data being collected in a constant stream through the data acquisition unit MXPDA. The data is georeferenced via a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS which streams data throughout survey and allows the data to be recorded relative to a WGS1984 UTM coordinate system. Whilst the cart is surveying, the data acquisition is visualised through a tablet PC which is mounted to the cart.

The data is downloaded via USB and converted using DLMGPS and Geoserver, before being processed (compensated) using MAGNETO® 3.0 software (see Appendix 3 for a summary of the processes used in MAGNETO® to create final data plots).

Appendix 3: Summary of Data Processing

Process	Effect
Clip	Limits data values to within a specified range
De-spike	Removes small spatial scale exceptionally high readings in the data. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground. In gradiometer survey, these can be caused by highly magnetic items such as buried modern ferrous objects.
De-stagger	Corrects a misalignment of data when the survey is conducted in a zig-zag traverse pattern.
Discard Overlap (TerraSurveyor)	Removes datapoints which occur too closely together and can cause digital artefacts in the data which are caused by the overlapping of parallel traverses.
Edge Match	Counteracts edge effects in grid composites by subtracting the difference between mean values in the two lines either side of the grid edge from one of the grids.
Filter (MAGNETO)	Much like a zero mean traverse, it resets the median value of each point to zero, in order to address the effect of striping in the data and counteract edge effects. In MAGNETO the individual values take into account the value of all uncorrected points within a certain distance to create its own median.
GPS Filter (MAGNETO)	Used to either remove or reduce the appearance of constant and reoccurring features that are not consistent with the GPS signal in use by the cart system.
High pass filter	Removes low-frequency, large spatial scale variance in order to remove background trends in the data, such as variations in geology.
Interpolate	Increases the resolution of a survey by interpolating new values between surveyed data points, creating a smoother overall effect.
Low Pass filter	Uses a Gaussian filter to remove high-frequency, small spatial scale variance, typically for smoothing the data.
Periodic Filter	Used to either remove or reduce the appearance of constant and reoccurring features that distort other anomalies, such as recent plough lines.
Remove Turns (TerraSurveyor)	Uses analysis of the direction of travel derived from the GNSS data to break continuous streams of data into individual traverses.
Zero Mean Grid	Resets the mean value of each grid to zero, in order to counteract grid edge discontinuities in composite assemblies.
Zero Mean Traverse	Resets the mean value of each traverse to zero, in order to address the effect of striping in the data and counteract edge effects.

Processing Steps

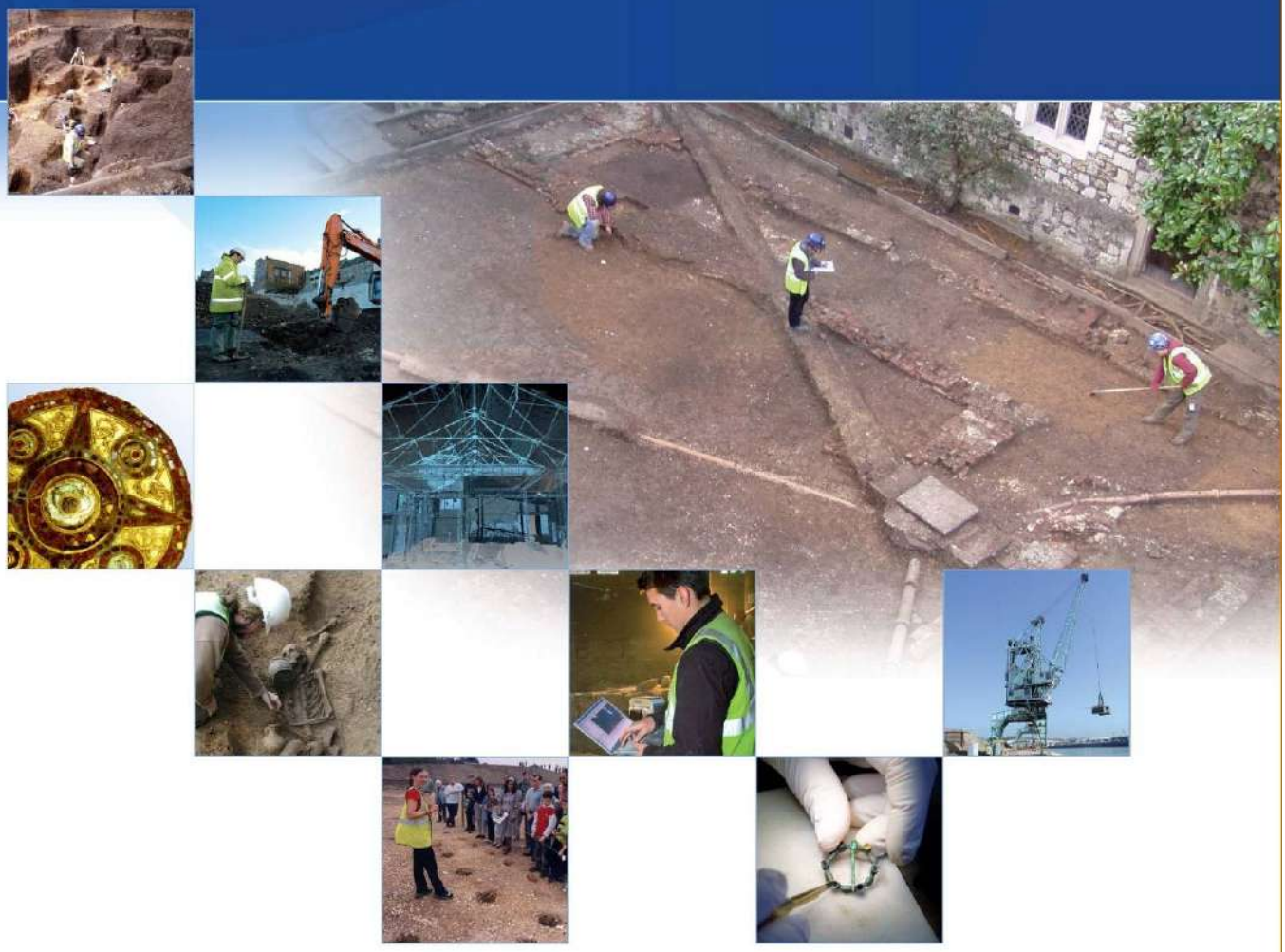
Gradiometer survey	
Process	**Extent**
Zero Mean Traverse	All LMS =on, threshold -5 to 5
De-spike	X=1 Y=1 Thr = 3 Repl = Mean
De-stagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Expand –SinX/X x2
Palette Scale	Grey08 Min= -1nT Max= 2nT

Bartington and SenSYS Cart survey	
Process	**Extent**
Base Settings	Interval 0.123m, Track Radius 1.06m
Remove Turns	Threshold Angle 90°, Cut Length 5m
Discard Overlap	Threshold Distance 0.4m, Minimum Track 5, Newest
Despike	Mean Diameter 3 Threshold 12
Destripe	Mean Traverse SD 1.5
High Pass Filter	Uniform (Median) 12
Clip	-30/30

Appendix 4: Technical Terminology

Type of Anomaly	Description of Type/Class and rationale for interpretation
Anomaly	Usually linear / curvilinear / rectilinear / discrete anomalies characterised by a sharp-edged increase or decrease in values compared to the magnetic background. Some interpretation classes may have more gradual transitions in magnetic character- this is used as part of the classification process.
Spread	Spreads of enhanced material refer to diffuse areas of altered magnetic character, which suggest a localised spread of material with a magnetic contrast within the topsoil or ploughzone or a generalised enhancement of the magnetic properties over a specific area. These anomalies do not have the high dipolar response characteristic of ferrous material anomaly unless specifically classified as a spread of ferrous debris.
Linear Trend	Linear trends are less distinct and are typically visible as linear patterning in the overall texture of the data. A common example of these is the striping effect caused by recent ploughing.

Class of Anomaly	Description
Probable Archaeology	Interpretation is supported by the presence of known archaeological remains or by other forms of evidence such as HER records, LiDAR data or cropmarks identified through aerial photography. OR the data contains diagnostic anomalies in terms of character or morphology which allow a secure interpretation. Anomalies typically have well defined edges with abrupt transitions indicative of cut features with magnetically enhanced fills, such as ditches. Discrete anomalies will be checked on XY traces for their magnetic character; discrete anomalies in this class likely to be cut features such as pits; anomalies indicating high temperature processes will alternatively classified as 'burned area' - see below. Ferrous material creates distinct 'spikes' and is classified as such.
Possible Archaeology	Anomalies are interpreted as likely to have an archaeological origin, though other explanations are also possible, but less likely. Anomalies typically have well defined edges with abrupt transitions indicative of cut features with magnetically enhanced fills, such as ditches. Discrete anomalies checked on XY traces; discrete anomalies in this class likely to be cut features such as pits; anomalies indicating high temperature processes classified as 'burned area' - see below.
Burned Area	An anomaly with a form on the XY trace plot that is characteristic of high temperature activity such as a kiln or hearth. Should be considered as possible archaeology and should be assigned an anomaly number if a more specific interpretation is possible based on the anomaly characteristics (for example, a clear kiln) so that this can be discussed in text.
Historical Features	Features observed on historical mapping that correspond with anomalies in the data. Linear anomalies caused by removed field boundaries often exhibit distinct characteristics related to the removal process. Areas of enhanced magnetism in this class could relate to former buildings, trackways, quarries or ponds and their nature should be clarified with the use of anomaly numbers and discussion in the results section.
Unclear Origin	These anomalies are (often) magnetically weak and discontinuous or isolated making their context difficult to ascertain. OR they are indistinct for other reasons such as magnetic disturbance in their vicinity. Anomalies in this category have no more likely explanation than another, so whilst an archaeological origin is possible, an agricultural, geological, or modern origin is also equally likely.
Agricultural	Anomalies associated with agricultural activity, either historical (unless shown on a map, then classed as a historical feature) or modern. Usually, this interpretation is arrived at due to on the ground observations of (for example) ploughing, access tracks and the like, or from observation of recent aerial images of the survey area. Recent ploughing is shown as a dashed line and Ridge and Furrow ploughing is shown as a solid line.
Ridge and Furrow / Rig and Furrow	A series of regular linear or slightly curvilinear anomalies which are broad and usually have diffuse edges, either composed of an increased or decreased magnetic response compared to background values. Wide regular spacing between the anomalies is consistent with that of a ridge and furrow / rig and furrow ploughing regime, and the regime may also have a degree of sinuosity characteristic of certain types of ridge and furrow cultivation. Often, multiple directions will be present, with distinct headlands in between. The pattern might follow the general landscape organisation, or it may radically differ from it, depending on the local sequence of inclosure. The anomalies often present as a positive 'ridge' anomaly adjacent to a negative 'furrow' anomaly.
Ploughing Trends	A series of regular linear anomalies or changes in the texture of the survey data, either composed of an increased or decreased magnetic response compared to background values. Anomalies seen parallel to field edges are representative of headlands caused by ploughing.
Drains	A series of magnetic linear anomalies (often with a characteristic alternating positive-negative pattern, which indicates a ceramic drain) of an indeterminate date, usually with a regular dendritic or herringbone patterning which reflects the topography of the survey area.
Geology / Natural	An area of enhanced magnetism that is composed of irregular (usually) weak increases or decreases in magnetic values, frequently with gradual transitions in character, compared with background readings. These are likely to indicate natural variations in soil composition or reflect variations in the bedrock or superficial geology. In areas where former water courses were present, paleochannels may present as distinct curving and banded or braided linear anomalies.
Service	Strong linear anomalies often composed of contrasting high positive and negative dipolar values, with a halo of magnetic disturbance extending from the causative body. Such anomalies are characteristic of below-ground services.
Magnetic Disturbance	A zone of strong magnetic response (usually alternating between positive and negative with abrupt transitions) that has been caused by modern infrastructure or ferrous material within or adjacent to the survey area, such as metallic boundary fencing, gateways. The magnetic haloes around services and changes in the background texture of the data resulting from overhead power lines also fall into this class. These haloes are strong enough to obscure other anomalies (including those of possible archaeological interest) in the area they affect.
Ferrous Anomalies / Ferrous (iron spikes) and ferrous or debris spreads	A response caused by ferrous materials on the ground surface or within the subsoil, which causes a strong but localised dipolar response in the data. These generally represent modern material often re-deposited during manuring, rubbish at field edges and spreads of debris or building material used to surface tracks or left behind following demolition. Distinct from magnetic disturbance, these anomalies relate to material at their spatial location, rather than an effect occurring at a distance from the material responsible.
Free Category for custom use	A category which may be employed to denote specifically identified anomalies related to known past activity within the area, for example those definitely associated with a former airfield, or mapped former mineral extraction.



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