Harthill Community Geophysics, Rotherham, South Yorkshire

Detailed Gradiometer Survey Report

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wessexarchaeology

Portway House
Old Sarum Park
Salisbury
Wiltshire
SP4 6EB

www.wessexarch.co.uk

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Fieldwork directed by	Matt Tooke
Project management by	Milica Rajic
Document compiled by	Alexander Schmidt
Contributions from	Patricia Voke and Nicholas Crabb
Graphics by	Alexander Schmidt

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Summary

A detailed gradiometer survey was conducted over three areas of land adjacent to Hard Lane, to the north of Harthill, Rotherham. The project was commissioned by the Harthill and Woodall Archaeology Group with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features.

The site comprises arable fields located north of the village of Harthill, South Yorkshire, covering a combined total area of 6.1 ha. The geophysical survey of Area 1 and 3 was undertaken on 2 and 3 March 2020 and has identified a dense concentration of anomalies of archaeological interest, predominantly comprising ditch features that are likely associated with enclosures. Area 2 was surveyed 1 April 2021 and also contains anomalies, potentially archaeological but mostly modern and geological in nature.

In Area 1 a possible enclosure and several boundary features have been identified as well as several circular anomalies that could indicate round houses or other settlement activity. In addition, evidence of ridge and furrow cultivation has also been identified. The limited size of the area has slightly hampered more detailed interpretation, but it is likely that it may relate to a wider distribution of archaeological remains in the vicinity.

Area 2 contains several possible ditch-features, one of which may be a continuation of the same features identified in Area 1. It is not possible to more confidently interpret these anomalies as other origins cannot be ruled out. A former field boundary and ridge and furrow have also been detected in Area 2.

Area 3 is more complex with several phases of activity noted. Two distinct, adjoining double ring-ditch features have been identified as well as two single ring-ditch features that could indicate round barrows. The interconnected ring ditches in the south of the area could relate to a slightly irregular barrow monument or a sub-circular enclosure. However, the single ditched examples to the north are perhaps more likely associated with round barrows. These could all date to the Bronze Age and these monuments may form part of a barrow cemetery or funerary complex of significant archaeological interest.

In addition to these, a probable field system has also been identified in Area 3. This is comprised of an interconnected network of ditch-features forming land divisions. Several recti-linear enclosures have also been identified on a corresponding alignment. Such anomalies could date to the Iron Age or Romano-British period but as they appear to respect the position of the probable round barrow, an earlier date may also be feasible. However, several of these linear anomalies correspond to former field boundaries recorded on 1854 OS mapping. Moreover, on the same alignment, numerous parallel trends have been detected that indicate ridge and furrow cultivation.

The remaining anomalies throughout both areas are thought to be modern. These pertain largely to agricultural activity including ploughing and field drains.

Acknowledgements

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The fieldwork was undertaken by Matt Tooke and Amy Dunn. Alexander Schmidt processed and interpreted the geophysical data, wrote the report and prepared the illustrations. The geophysical work was quality controlled by Patricia Voke and Nicholas Crabb. The project was managed on behalf of Wessex Archaeology by Milica Rajic.

Harthill Community Geophysics, Rotherham, South Yorkshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Harthill and Woodall Archaeology Group to carry out a geophysical survey over three areas at land east of Hard Lane, Harthill. Area 1 is located directly east of Hard Lane (centred on NGR 449420 381740), Area 2 is located to the east of the road that runs south of Kiveton Community Woodland (centred on NGR 449025 381800), and Area 3 is east of Hard Lane, near Manor Road (centred on NGR 450060 382160; **Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken by the Harthill and Woodall Archaeology Group.

1.2 Scope of document

1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

1.3 The site

1.3.1 The site is located between the north of the village of Harthill and south of Kiveton, 10 km north-west of Worksop, in the county of South Yorkshire.

1.3.2 The survey comprises three targeted areas of land, where cropmarks had previously been observed. Area 1 consists of 1 ha of agricultural land, currently utilised for pasture. It is bound by hedgerow field boundaries on all sides with Hard Lane to the west and further agricultural land to the north, east, and south.

1.3.3 Area 2 consists of 3.2 ha of agricultural land, bounded by open agricultural land to the north, east, and south. The western edge is bordered by the Bridge Brook Dike with the Kiveton Community Woodland beyond.

1.3.4 Area 3 is the largest area, covering 4.1 ha of arable land further to the east of Hard Lane and west of Manor Roa. The area is bounded by open agricultural land on all sides.

1.3.5 Area 1 is on a slight south-east facing slope, falling from 110 m above Ordnance Datum (aOD) at the north-western edge to 107 m aOD at the south-eastern edge. Area 2 is on a slight north-west facing slope, falling from 103 m aOD at the south-eastern corner to 93 m at the north-western edge. Area 3 is atop of a small hill, at 102 – 103 m aOD throughout.

1.3.6 The solid geology across Area 1 and 3 comprises Mexborough Rock (Sandstone) with no overlying superficial deposits recorded (BGS 2021). Area 2 in underlain by Mudstone, Siltstone, and Sandstone of the Pennine Middle Coal Measures Formation, with superficial deposits of Alluvium recorded directly to the west of the area.

1.3.7 The soils underlying Area 1 are likely to consist of typical brown earths of the 451f (Rivington 1) association. For Area 2, they are likely cambic stagnogley soils 713a (Bardsey) association. Area 3 is likely to comprise with a mix of the paleo-stagnogley soils of the 712a (Dale) association (SSEW SE Sheet 3 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The following historical and archaeological background has been compiled using publicly available online resources, combined with the results of Wessex Archaeology's previous investigations in the area, and in-house resources. While not exhaustive the following is a summary of findings considered relevant to the interpretation of geophysical survey data.

2.2 Summary of the archaeological resource

2.2.1 There are no scheduled monuments or other designated heritage assets within the sites. One Grade I listed building is noted in Harthill – The Church of All Hallows (NHLE 1132709) and numerous further Grade II and II* listed buildings are noted in the surrounding landscape. These are largely attributed to 16th – 19th century dwellings and outbuildings in the neighbouring settlements of Harthill to the south, Woodall to the south-west, Wales to the north-west, and Thorpe Salvin to the south-east.

2.2.2 There are a small number of records pertaining to prehistoric period within vicinity of the site. This includes a possible cave or rock shelter at Red Hill near Kiveton Park, which may have been utilised during the Palaeolithic period. In addition, at Hunger Hill, to the north-east of Harthill, 1 km to the south-east of Area 1, rectilinear features that may be associated with a Bronze Age to Iron Age enclosure have been identified from aerial photographs.

2.2.3 750 m to the north-east of Area 3 is Packman Lane. This north – south aligned road follows the boundary between the parishes of Harthill and Thorpe Salvin for two miles between Kiveton Place in the north and Bondhay Common in the south. The road is an early communication line possibly of prehistoric origin (Hey 1979) and two excavations in fields south of Kiverton Park railway station, 900 m north-east of Area 3, revealed traces of cobbled road.

2.2.4 Packman Lane was formerly known as Ryknild Street until the 18th century (Hey 1979) and was thought to have been associated with the line of the Roman Ryknild Street, which extended between the Fosse Way and Templeborough near Rotherham. A projection of the alignment passes through Maltby and on to the Romano-British settlement at Edlington. However, no trace of Roman road has been officially identified with the only evidence related to the place name Rykenild (Garbett 1950), and this is therefore somewhat uncertain.

2.2.5 A cluster of Roman finds have been recovered by metal detectorists 3 km east of Area 3 to the north of Thorpe Salvin. The collection of finds was dated to the 1st to 2nd century AD. Concentrations of Roman finds have been recovered between Thorpe Salvin to the east of the survey areas and Chesterfield Canal to the south-west of the survey areas, which may be indicative of a nearby Roman settlement or cemetery.

2.2.6 The historical pattern of land division is noted to change with significant strip-field systems noted on the earliest available historical Ordnance Survey (OS) mapping (1854) compared to the modern pattern of land division. Area 1 is seemingly part of this strip field system of fields perpendicular to Hard Lane.

2.2.7 Extensive cropmarks are noted in Area 1 and 3 (Google Earth). Across Area 1, several linear features are noted, including one cropmark on a north – south alignment that appears to correspond to a former field boundary noted on historical OS mapping (1854). Area 3 contains several notable features including a double ring-feature to the south of the area.

An adjacent single ring-feature is noted on the north-west side and a broadly west – east linear feature is noted on the south-east side. A further circular ring-feature is noted to the north-west of the area.

2.2.8 Harthill is recorded in Domesday Book. It is recorded as being in the hundred of Strafforth and the county of Yorkshire. It had a population of 12 households (11 villages and 13 freemen) in 1086 with the primary occupancy of ploughmen.

2.3 Recent investigations

2.3.1 A detailed gradiometer survey undertaken was on land north of Common Road, Harthill, 1.7 km to the south-east of the site. This identified number of anomalies of possible archaeological origin, including ditch-like features that could relate to Iron Age or Romano-British enclosures. However, the anomalies are consistent with geological responses sometimes associated with striations on dolostone geology (Wessex Archaeology 2017). A subsequent trial trenching evaluation revealed that these were partially associated elements of an extensive field system.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on the 2 and 3 March 2020 in Areas 1 and 3, and on the 1 April 2021 in Area 2. Field conditions were good throughout the period of survey. An overall coverage of 6.3 ha was achieved across all areas.

3.1.2 The methods and standards employed throughout the geophysical survey conform to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and

- To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.

3.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:

- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-site obstructions;

- To clarify the presence/absence of anomalies of archaeological potential; and

- Where possible, to determine the general nature of any anomalies of archaeological potential.

3.3 Fieldwork methodology

3.3.1 The cart-based gradiometer system used a Leica Captivate RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

3.3.2 The detailed gradiometer survey was undertaken using four Bartington Grad-01-1000L gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of 0.03 nT at a rate of 10 Hz, producing intervals of 0.15 m along transects spaced 4 m apart.

3.4 Data processing

3.4.1 Data from the survey were subjected to minimal correction processes. These comprise a 'DeStripe' function (±5 nT thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.

3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

4.1.1 The detailed gradiometer survey has identified magnetic anomalies across both sites. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:1000 and 1:1250 (**Figures 2** to **5**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale images.

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figure 3** and **5**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.

4.1.5 Gradiometer survey may not detect all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

4.2 Gradiometer survey results and interpretation

4.2.1 The geophysical survey has identified numerous anomalies that are likely to be associated with archaeological remains within each area. Some of these anomalies represent multiple phases and/or periods of land use and it is not possible to determine an exact date of any of these features based on the geophysical survey results alone. The results for each area are discussed in greater depth below.

Area 1

4.2.2 In the east of the survey area a positive curvilinear anomaly has been identified at **1000**. This protrudes from the northern boundary on a southerly trajectory for 32 m before turning to the east and continuing for a further 23 m towards the eastern boundary of the survey. The anomaly is 2.5 m wide and indicates a ditch-like feature that may form part of a larger enclosure, although the full extent of such a feature likely extends beyond the survey area. It is equally possible that it forms part of a wider network of ditches pertaining to a field system.

4.2.3 Within **1000**, numerous positive circular anomalies and curvi-linear trends have been identified at **1001**. The largest to the north is 8 m in diameter, although the northern portion is not visible due to the increased magnetic response noted in this area. Several smaller, positive trends are noted in the vicinity and such anomalies can indicate ring-ditches or gullies. Their location inside the enclosure implies that they are associated with roundhouses of a probable Iron Age / Romano-British date, though further investigation would be required to confirm this.

4.2.4 Two positive linear anomalies appear adjacent from the anomaly at **1000**. The first is on a west – east alignment at **1002**. This is 110 m long and 1 m wide. The second is on a north-east to south-west alignment at **1003** and is 27 m long by 1.5 m wide. These anomalies indicate further ditch-like features and could be former boundary features, possibly relating to a field system radiating from the enclosure at **1000**. However, the anomaly at **1002** is generally characterised by a positive response but is also surrounded a fragmented negative response, which indicates up-cast or remnant bank material.

4.2.5 Numerous discrete positive anomalies have been identified throughout Area 1. Examples of these can be seen at **1004**. These are 1 – 3 m in diameter and indicate pit-like features. This could indicate wider settlement activity, such as localised extraction or refuse pits. However, it is not possible to confidently determine the origin of these anomalies and they could equally be natural in origin.

4.2.6 A possible alignment of positive anomalies is also noted crossing the anomaly at **1002** on a north-east to south-west alignment. While this could indicate an underlying cut feature(s) such as a ditch or pit-alignment, the strength of the anomaly at **1002** and the prevelance of anomalies associated with ridge and furrow in this area make confidently interpreting this feature difficult.

4.2.7 Broadly spaced, positive, parallel linear trends have been identified on a north – south alignment throughout Area 1. These are spaced 4 – 6 m apart and indicate ridge and furrow cultivation. The anomalies respect the pattern of land division visible on historical OS mapping and are therefore likely to be medieval or post-medieval in origin.

4.2.8 A large area of increased magnetic response has been identified along the northern boundary of the area **1005**. This indicates a headland at the northern end of the ridge and furrow activity. However, it is also possible that some of the ferritic response is associated with modern debris at the edge of the field.

4.2.9 Several further linear and curvi-linear trends can be discerned throughout the dataset. These are thought to be modern in origin, most likely associated with agricultural activity. However, it is not possible to rule out an archaeological or natural origin, though the response is considered too weak to be associated with any features of a significant scale.

Area 2

4.2.10 Traversing the western side of the area, a positive linear anomaly has been identified at **2000**. The anomaly is aligned north-east to south-west, measuring 223 m in length before coinciding with the extent of the survey area. The anomaly is 2.5 – 7.5 m wide, becoming wider towards its south-western end. The anomaly is interpreted as possible archaeology and indicates a ditch-feature. It is possible this anomaly is associated with the Broad Brook Dike located 60 m to the north-west. However, no obvious relationship can be discerned from the results of the geophysical survey alone.

4.2.11 A positive sub-circular anomaly is noted at the northern end of **2000** at **2001**. This is 12 m in diameter and indicates a former pit. A second much shorter linear anomaly aligned north-west to south-east is noted protruding on the south-western side of the possible pit, measuring at 7.5 m long and 2 m wide. This could indicate a further ditch, and projects towards the Broad Brook Dike.

4.2.12 An amorphous positive area to the north of **2001**, is also noted. The anomaly indicates a localised variation in the underlying deposits which could be archaeological in origin, such as a large pit or extraction feature. However, such a variation could equally be natural in origin, and it may relate to variation within the underlying coal measure formation deposits.

4.2.13 At **2002** a further linear anomaly is visible aligned broadly perpendicular to the anomaly at **2000**. This protrudes from the eastern boundary of the survey area and continues for 87 m, curving slightly to the south-west at its western end. The anomaly ranges between 1 – 2 m wide and appears to be on the same trajectory and is of a similar size and form to a probable ditch feature located in Area 1 (**1002**). This suggests a continued ditch across the land between the two Areas. However, it also corresponds with another feature located within Area 2 that is likely more recent in origin.

4.2.14 5 m from the western edge of the survey area is a weakly positive linear anomaly at **2003**. This is 25 m long by 2.5 m wide and is aligned west – east. The anomaly corresponds with a former field boundary visible on 20th century mapping.

4.2.15 Positive, parallel linear trends are noted across the area on a west – east, becoming less clear towards the northern-most portion of the survey area. These anomalies are parallel to the former boundary at **2003** and indicate ridge and furrow cultivation.

4.2.16 Two distinct areas of increased magnetic response have been identified at **2004** and **2005**. At **2004**, the response is focused on the western edge of the field, where just beyond the Broad Brook is noted. The 1854 OS County Series map of Yorkshire labels this area '*Osiers'.* This indicates the presence of a naturally wet area where weaving willow was being grown and corresponds with the position of the variable response. The response is caused by ground disturbance associated with this activity.

4.2.17 The increased response at **2005** is likely to be the result of modern cultivation impacting the earthworks formerly associated with the underlying ridge and furrow that has been detected.

4.2.18 Other linear anomalies have been identified as field drains (**2006**, **2007**). These are noted predominantly to the north of the survey area on different alignments (north to south, north-east to south-west, north-north-west to south-south-east) and display a slightly stronger magnetic response.

4.2.19 Traversing the western edge of the field, several faint linear trends are identified. These are most likely an artefact of the impacted earth of a trackway circumnavigating the field (**2008**).

4.2.20 Closely spaced parallel linear anomalies are noted traversing the western edge of the survey area. These correspond to the modern pattern of land cultivation and indicate plough lines.

Area 3

4.2.21 Towards the south of Area 3, a large 'double-ringed', circular feature has been identified at **3000**. This comprises two circular positive anomalies. The smaller internal anomaly has a diameter of 26 m and is 1 m wide, consisting of an almost complete circular feature with a 3 m break on its eastern side. The outer anomaly is larger at 38 m in diameter and is largely fragmented on the eastern side. There is a similarly aligned 3 m gap on the eastern side. This response corresponds with cropmarks identified in aerial imagery (Google Earth). A negative 'halo' is noted surrounding both the internal and outer ring-ditch. This could relate to upcasted/bank material or compacted deposits within and/or surrounding the ditches. Based on its size and form this indicates a round barrow or similar large funerary monument. Round barrow features of this type typically date to the Bronze Age.

4.2.22 Protruding from the north-west side of **3000** is a smaller double-ringed, sub-circular anomaly has been identified at **3001**. This anomaly consists of two positive circular anomalies - the internal anomaly has a diameter of 15 m and the outer 26 m. This anomaly is notably more fragmented and irregular than **3000** but also corresponds to a cropmark, albeit a single ring-feature. A corresponding negative response is noted surrounding the outer ring-ditch on the inside edge. This could indicate similar upcasted or compacted material in between the two ditches. It is probable that this is a further round barrow or enclosure of a similar character to that of **4000**. The close proximity of the two probable barrows suggests that they are closely associated, but it is not clear whether they are abutting one another, or whether one 'cuts' the other.

4.2.23 Two further circular anomalies that indicate further barrow features have been identified in Area 3 at **3002** and **3003**. The example at **3002** is 25 m in diameter and 1 m wide. This response is fragmented in form and corresponds to a cropmark identified in aerial imagery (Google Earth). The majority of the feature is characterised by an area of increased magnetic response. This is most likely associated with disturbance or the presence of modern ferrous debris. At the centre of the probable barrow there are some larger positive anomalies that could be associated with pit-like features, but these are obscured by the dominance of the former responses. As such, it is possible that further archaeological deposits are present within **3002** that are not detailed by this survey. In addition, a recti-linear anomaly appears to enclose the anomaly at **3002** (**3006**). This indicates a later enclosure encompassing an earlier barrow feature, and appears to delimit the majority of the increased magnetic response

4.2.24 The anomaly at **3003** is smaller than **3002**, measuring 14 m in diameter. It is also not as apparent in the data and the northern side of the ditch is not visible, which suggests it has been heavily ploughed down. These anomalies are on a broadly north-west to south-east alignment with **3000** and **3001** and indicate further round barrow features.

4.2.25 A diffuse, weakly positive circular anomaly is noted in the north at **3004** that could indicate further funerary activity. However, this anomaly is not strong enough to confidently interpret as archaeological in origin and could equally be an indication of natural variation in the underlying bedrock. Similarly, in the centre of survey area, to the south-east of **3002**, a fragmented circular anomaly has been identified that could also be an indication of similar archaeological activity at **3005**. However, its ill-defined form and weak magnitude, make it difficult to confidently interpret this anomaly.

4.2.26 Throughout the survey area, an interconnected network of larger, recti-linear anomalies has been identified (**3006** – **3017**). These anomalies are largely positive with periodically adjacent negative responses. They indicate underlying ditch-features with probable embankments or compacted deposits alongside them. A negative response is noted adjacent to a considerable portion of these anomalies that indicates upcasted or embankment material.

4.2.27 In the central portion of the survey, one of the aforementioned recti-linear anomalies is noted at **3006**. The anomaly appears to respect the outer extent of the anomaly at **3002** and measures 25 m across. it is characterised by a positive response and is slightly fragmented in parts. This indicates a ditch feature that could be evidence of an enclosure. This may relate to part of a wider field system, but more likely relates to a small enclosure surrounding **3002**, which was perhaps positioned to protect or avoid the barrow. The amount of magnetic debris in the vicinity of this suggests that this may be of relatively recent origin.

4.2.28 Extending to the north and south of **3006**, two positive linear anomalies have been identified (**3007** and **3008**). The anomaly at **3007** protrudes from the northern boundary of the survey area and continues for 80 m on a north-north-east to south-south-west alignment. The anomaly at **3008** continues to the south for 76 m on the same alignment. Both anomalies are 1 m wide. A further positive linear anomaly is noted on an east – west alignment crossing the southern end of **3008** at **3009**. The anomaly is 80 m long and 1 m wide, becoming fragmented at the eastern end towards **3001**. The anomaly likely indicates a further ditch feature.

4.2.29 Similarly, to the north and south of **3000**, two further anomalies (**3010** and **3011**) are noted that parallel the responses at **3007** and **3008**. These are similarly fragmented and perpendicular to further linear anomalies on a west-north-west to east-south-east alignment (**3012** and **3013**) measuring 65 m in length and 1 m wide. A further linear anomaly is noted parallel to **3010** at **3014**. The anomalies form a large enclosure measuring 104 m north – south and 58 m east – west.

4.2.30 In the west of the survey area, a recti-linear anomaly is noted at **3015**. The anomaly protrudes from the western boundary on a west – east alignment before turning to the north and continuing for a further 30 m. The anomaly turns again to the east and stops after a further 34 m becoming fragmented towards the eastern end. Toward the eastern most end of **3015**, a small enclosure has been identified at **3016**. This measures 7 m by 8 m. A second small enclosure has been identified to the south at **3017**, which is parallel to **3008** and only visible on the west and northern side. It is, therefore, not possible to ascertain the complete dimensions of the feature.

4.2.31 These anomalies (**3006** – **3017**) are all on broadly the same co-axial alignment and are thought to form part of an unrecorded pattern of land division, likely comprising significant ditch and embankment boundary features. Such an arrangement is commonly associated with Iron Age / Romano-British ('Celtic') field systems, but it is not possible to provide a chronology for these features based on these results alone.

4.2.32 Three anomalies that correspond to features noted on historical mapping have been identified traversing the site. The anomalies on a north – south alignment at **3018** and **3019**, as well as the anomaly on an east – west alignment at **3020**, all correspond to former field boundaries visible on 1854 OS mapping. Positive, parallel linear trends have been identified throughout the survey area on a north – south alignment that appear to respect this alignment. These are interpreted as evidence of earlier cultivation such as ridge and furrow.

4.2.33 Several strong positive anomalies have been identified on the same north – south alignment (**3021** and **3022**) or on an east – west alignment (**3023**) that are interpreted as possible archaeology. These could indicate further features associated with this phase of activity.

4.2.34 Two parallel linear anomalies have been identified in the south of the survey area that indicate further ditch-features (**3024** and **3025**). These anomalies are on a north-west to south-east alignment and are 17.5 m apart, although the southern example is predominantly located south of the survey extent. The anomalies are not on the same alignment as **3006** – **3017** and so indicate a different, possibly later, period of activity. The alternative

orientation to the anomalies at **3000** – **3005** and **3018** – **3020** suggests that they are unrelated to the majority of activity at the site.

4.2.35 Numerous discrete positive anomalies have been identified throughout Area 3. Two examples of concentrated areas of such anomalies can be seen at **3026** and **3027**. These are 1 – 3 m in diameter and indicate pit-like features. This could indicate wider settlement activity, such as localised extraction or refuse pits. However, it is not possible to confidently determine the origin of these anomalies and they could equally be natural in origin.

4.2.36 Closely spaced, weak trends have been identified throughout the survey area on a north-north-east to south-south-west alignment. These are interpreted as evidence of modern agricultural activity such as ploughing. Numerous further weak trends have been identified throughout the dataset. These are likely to be modern in origin and associated with agricultural activity. However, these are typically too weak and isolated to interpreted more confidently.

4.2.37 A single, weakly dipolar linear trend has been identified traversing the entire dataset on a north-north-east to south-south-west alignment (**3028**). This is thought to indicate a field drain.

5 DISCUSSION

5.1.1 The detailed gradiometer survey has been successful in detecting anomalies that are likely to be archaeological in origin each area. In particular, those contained within Area 3 are of significant archaeological interest.

5.1.2 In Area 1 a possible enclosure and several boundary features have been identified as well as several circular anomalies that could indicate round houses or other settlement activity. In addition, evidence of ridge and furrow cultivation has also been identified. The limited size of the area has slightly hampered more detailed interpretation, but it is possible that it relates to a wider distribution of archaeological remains in the vicinity.

5.1.3 Area 2 contains several possible ditch-features, one of which may be a continuation of the same features identified in Area 1. It is not possible to more confidently interpret these anomalies as other origins cannot be ruled out. A former field boundary and ridge and furrow have also been detected in Area 2.

5.1.4 Area 3 is more complex with several phases of activity noted. Two distinct, adjoining double ring-ditch features have been identified in the south of the site. This could relate to an irregular round barrow monument but may also relate to a small arrangement of circular enclosures. It is probable that such features could relate to the Bronze Age, but further investigation would be required to confirm this.

5.1.5 In the north of Area 3, two further circular ring ditch anomalies have been identified that are interpreted as probable Bronze Age barrow monuments. Many of these were previously identified on aerial imagery of the site as cropmarks, but further clarity has been added by this survey. Collectively, the monuments may form part of a barrow cemetery or funerary complex of significant archaeological interest.

5.1.6 In addition to these, an unrecorded pattern of land use has been identified that likely forms an interconnected network of ditch-features forming land divisions. Several recti-linear enclosures have also been identified on a corresponding alignment. These anomalies could date to the Iron Age or Romano-British period.

5.1.7 Several linear anomalies have been identified that correspond to former field boundaries recorded on 1854 OS mapping. On the same alignment, numerous parallel trends have been detected that indicate ridge and furrow cultivation. These respect the pattern of land

division identified on historical maps. Anomalies of this type can typically date to the medieval or late-medieval period.

5.1.8 The remaining anomalies throughout both areas are thought to be modern. These likely pertain largely to agricultural activity including ploughing and field drains.

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Google Earth (accessed March 2020)

Heritage Gateway (accessed April 2017) http://www.heritagegateway.org.uk/gateway

Magic Maps (accessed March 2020) https://magic.defra.gov.uk/MagicMap.aspx

Old Maps (accessed March 2020) https://www.old-maps.co.uk

Open Domesday (accessed March 2020) https://opendomesday.org/

APPENDICES

Appendix 1: Survey Equipment and Data Processing

Survey methods and equipment

The magnetic data for this project were acquired using a non-magnetic cart fitted with 4x Bartington Grad-01-1000L magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03 nT over a ±100 nT range, and measurements from each sensor are logged at intervals of 0.25 m. All of the data are then relayed to a Leica Viva CS35 tablet, running the MLgrad601 program, which is used to record the survey data from the array of Grad601 probes at a rate of 10 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Viva system with rover and base station. This receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) for geophysical surveys.

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the detail survey are downloaded from the Bartington cart system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

The cart-based system generally requires a lesser amount of post-processing than the handheld Bartington Grad 601-2 fluxgate gradiometer instrument. This is largely because mounting the gradiometers on the cart reduces the occurrence of operator error; caused by inconsistent walking speeds and deviation in traverse position due to varying ground cover and topography.

Typical data and image processing steps may include:

- GPS Destripe – Determines the median of each transect and then subtracts that value from each datapoint in the transect. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.

- GPS Base Interpolation – Sets the X & Y interval of the interpolated data and the track radius (area around each datapoint that is included in the interpolated result).

- Discard Overlaps - Intended to eliminate a track(s) that have been collected too close to one another. Without this, the results of the interpolation process can be distorted as it tries to accommodate very close points with potentially differing values.

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies. XY plots can be made available upon request.

- Greyscale – Presents the data in plan using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

Appendix 2: Geophysical Interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural, and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.

- Possible archaeology – used for features which give a response, but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.

- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.

- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.

- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.

- Trend – used for low amplitude or indistinct linear anomalies.

- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.

Appendix 3: OASIS form

Project Details:

Project name		Harthill Community Geophysics, Rotherham, South Yorkshire			
Type of project		Detailed gradiometer survey (Field evaluation)			
Project description		In Area 1 a possible enclosure and several boundary features have been identified as well as several circular anomalies that could indicate round houses or other settlement activity. In addition, evidence of ridge and furrow cultivation has also been identified. The limited size of the area has slightly hampered more detailed interpretation, but it is possible that it may relate to a wider distribution of archaeological remains in the vicinity. Area 3 is more complex with several phases of activity noted. Two distinct, adjoining double ring-ditch features have been identified as well as two single ring-ditch features that could indicate round barrows. Two further, weaker anomalies have been identified that are tentatively interpreted as additional similar features. These could all date to the Bronze Age and may represent barrow monuments. Some of these were previously identified on aerial imagery of the site as cropmarks, but further clarity has been added by this survey. Collectively, the monuments may form part of a barrow cemetery or funerary complex of significant archaeological interest. In addition to these, unrecorded pattern of land use has been identified that is likely comprised of an interconnected network of ditch-features forming land divisions. Several recti-linear enclosures have also been identified on a corresponding alignment. These anomalies could date to the Iron Age or Romano-British period. Several linear anomalies identified that correspond to former field boundaries recorded on historical OS mapping dating 1854. On the same alignment, numerous parallel trends have been detected that indicate ridge and furrow cultivation.			
Project dates		**Start:** 02-03-2020		**End:** 01-04-2021	
Previous work		None			
Future work		No			
Project Code:	229320	**HER event no.**	If relevant	**OASIS form ID:**	wessexar1-424841
		NMR no.	N/A		
		SM no.	N/A		
Planning Application Ref.		N/A			
Site Status		None			
Land use		Cultivated land 3 – operations to a depth of more than 0.25 m			
Monument type			**Period**		

Project Location:

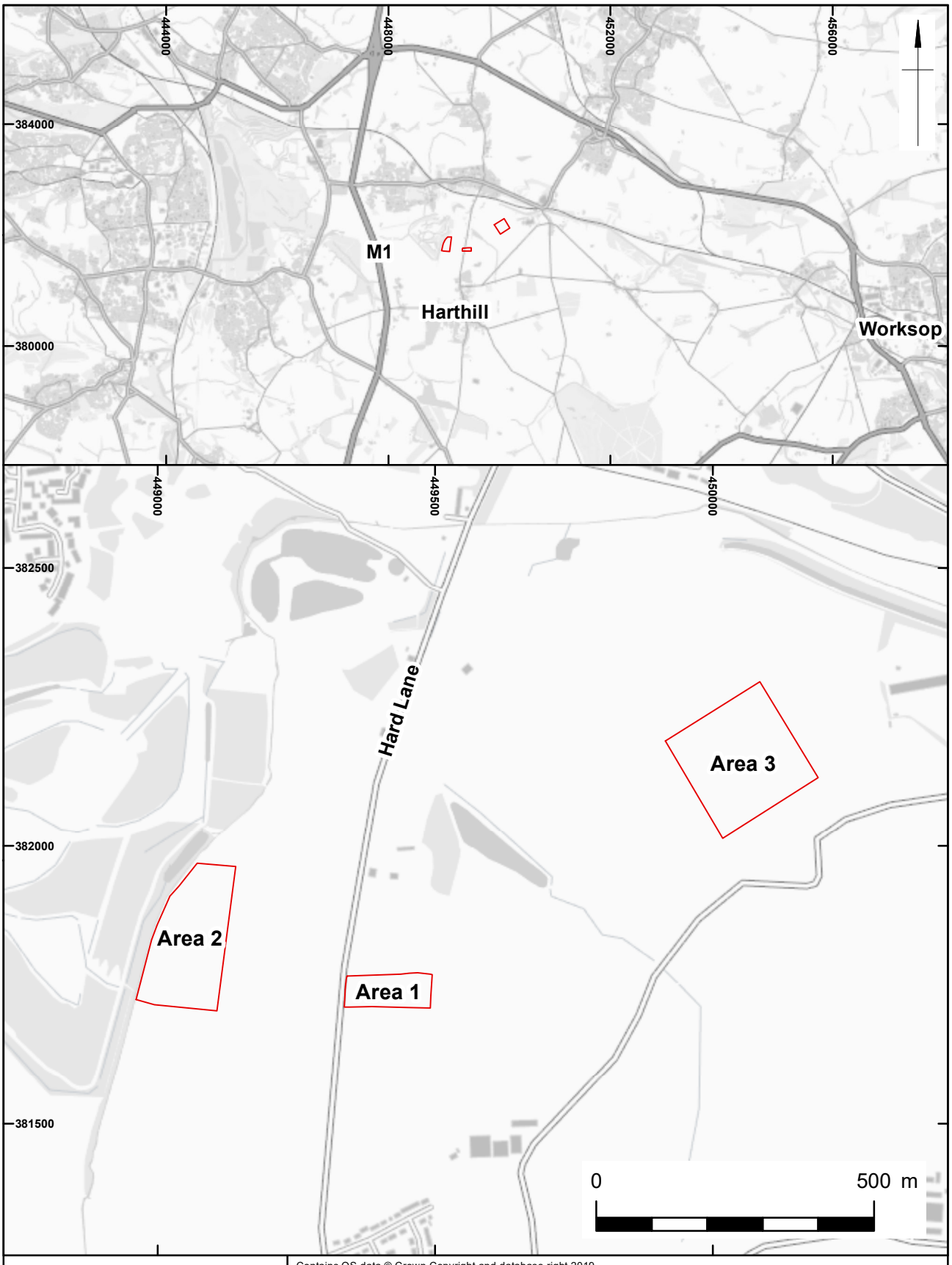
Site Address	Hard Lane, Harthill, Rotherham			**Postcode**	
County	South Yorkshire	**District**	Rotherham	**Parish**	Harthill with Woodall
Study Area	6.1 ha	**Height OD**	102 – 110 m aOD	**NGR**	

Project Creators:

Name of Organisation	Wessex Archaeology		
Project brief originator	Alexander Schmidt	**Project design originator**	
Project Manager	Milica Rajic	**Project Supervisor**	Matt Tooke
Sponsor or funding body	Harthill Community Project	**Type of Sponsor**	Community

Project Archive and Bibliography:

Physical archive	N/A	**Digital Archive**	Geophysical survey and report	**Paper Archive**	N/A
Report title	Harthill Community Geophysics, Rotherham, South Yorkshire Detailed Gradiometer Survey Report			**Date**	2020
Author	Wessex Archaeology	**Description**	Unpublished report	**Report ref.**	229320.03



Site Boundary

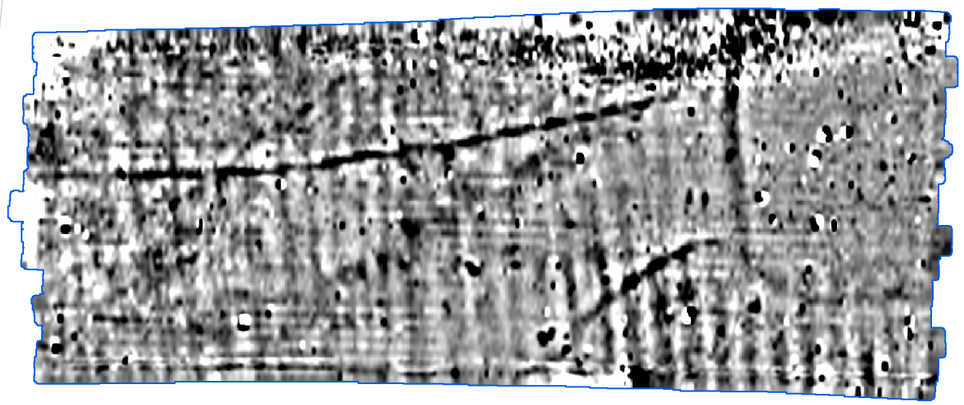
Date:	11/03/2020	Revision Number:	0
Scale:	1:100.000 & 1:10.000 at A4	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics\		

Site location and survey extent

Figure 1

449400

381800



-2nT +3nT

0 50 m

Site Boundary

Detailed Survey Extent

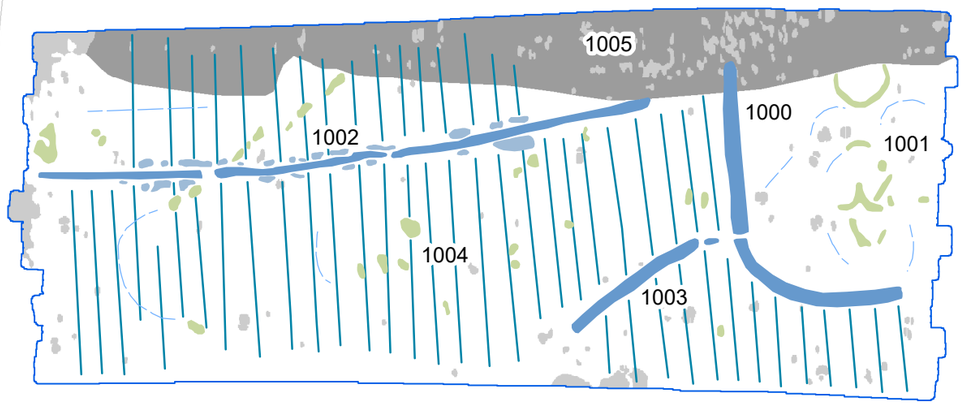
Date:	11/03/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: greyscale plot (Area 1)

Figure 2

449400

381800



Detailed Survey Extent
Archaeology (Positive)
Archaeology (Negative)
Possible Archaeology
Increased Magnetic Response
Ferrous
Ridge & Furrow
Ploughing
Land Drain
Trend

-2nT +3nT

0 50 m

Date:	11/03/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: interpretation (Area 1)

Figure 3

449000

449200

381800

-2nT +3nT

0 50 m

Site Boundary

Detailed survey extent

Date:	02/06/2021	Revision Number:	0
Scale:	1:1,250 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: greyscale plot (Area 2)

Figure 4

Date:	02/06/2021	Revision Number:	0
Scale:	1:1,250 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: interpretation (Area 2)

Figure 5

450000

450200

382200

-2nT +3nT

0 50 m

Detailed Survey Extent

Date:	11/03/2020	Revision Number:	0
Scale:	1:1,250 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: greyscale plot (Area 2)

Figure 6

Date:	26/05/2020	Revision Number:	0
Scale:	1:1,250 at A3	Illustrator:	AJS
Path:	S:\PROJECTS\229320\HARTHILL COMMUNITY\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: interpretation (Area 3)

Figure 7

Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk

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