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DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE (GERMANY LAND)

CULTURAL HERITAGE REPORT NUMBER: 268310

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Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l **E** erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site north of Staythorpe over multiple deployments; 05 January, 09 – 12 January, 17 February and 27 – 31 March 2023. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Germany Land' comprises several arable and pasture fields immediately North of the hamlet of Ossington. This comprises a mixture of agricultural land located north-west of Newton on Trent, covering an area of 155 ha.

The gradiometer survey was successful in detecting one archaeological anomaly within the survey area. This anomaly is likely to be representative of a trackway or enclosure, although future archaeological investigation will be necessary in establishing a date and context for this feature.

A second feature has been identified which is of possible archaeological origin. This consists of two perpendicular linear features which possibly represent ditches of an unknown origin. However, they may also represent modern drains.

Additionally, several former field boundaries have been detected across the Site, as well as limited traces relating to historic agriculture, such as an isolated area of ridge and furrow.

Modern agricultural activity such as ploughing or drainage is well represented across the site, with drains a key feature in many of the surveyed fields.

Finally, two areas of increased magnetic response have also been detected. One of these is likely to have been caused by the presence of an overhead powerline which traverses the eastern portion of the site on a north-south alignment.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of **ENT486**, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (**ENT486**, **ENT1034**, **ENT3871**, **ENT3756** and **ENT3888**).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (**ENT738** and **ENT1125**). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in **section 4.3**.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in **section 4.3** below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (**MNT5596** and **MNT11139**). The only other Palaeolithic dated material is a hand axe found 1.5 km north-west of the site (**MNT4164**).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (**MNT3597**, **MNT14748**, **MNT17094**, **MNT17127**, and **MNT8542;** NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (**MNT17099**). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (**MNT17097**, **MNT14313**, **MNT17091**, **MNT11991**, and **MNT14315**), while an isolated small riverside settlement was found near Cromwell (**MNT25849**). The Cromwell barrow cemetery also remained in use during the Iron Age (**MNT15145**). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (**MNT17089**, **MNT17090**, **MNT8243**, **MNT8265**, **MNT17098**, **MNT8290**, and **MNT14318**). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (**MNT8243**, **MNT8265**, and **MNT17089**), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (**MNT11098**, **MNT11050**, **MNT11732**, **MNT11047**, **MNT8286**, **MNT2881**,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and **MNT3098**) and Kneesall (**MNT12174**, **MNT8556**, **MNT17128**, and **MNT12172**). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (**MNT14312**; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (**MNT26679**), Kelham Hall (**MNT26671**), Averham Park (**MNT26653**), Winkburn Park (**MNT26694**), and Beesthorpe Hall (**MNT26658**).

Of the parks discussed above, Averham Park falls within the site (**MNT26653**). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (**MNT14403**). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (**MNT14432**). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken over multiple deployments; 05 January, 09 – 12 January, 17 February and 27 – 31 March 2023. Of the total 155 ha site, an overall coverage of 75.2 ha was achieved. The remaining Fields 10 – 14 and 16-23 were either too wet or under established crop at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 GERMANY LAND – FIELD 10-16, 18-31

7.1 Site details

A detailed gradiometer survey was carried out over 21 fields located between the village of Moorhouse in the west and the A1 to the east (centred on NGR SK 76522 66245) (**Figures 4-19**).

Much of the survey area is bounded by agricultural land. Hedgerows divide all individual fields from each other. At its most south-easterly point, the survey area is bounded by a small road. Small pockets of woodland intersect and adjoin some fields, particularly at the centre of the survey area, surrounding fields 16, 21 – 25, and 29. A small river, Moorhouse Beck, also runs through a portion of the northern part of the study area, dividing Field 12 to the west from Field 13 to the east, abutting Field 10 just north of these fields, and Fields 15 and 20 to the south before flowing away from the survey area to the west. The A1 runs parallel to the eastern side of the parcel, 500 m away.

The survey area is undulating. The highest point across the area is in Field 20, at 43 m aOD. The lowest point is in Field 13, at 21 m aOD. Some fields are generally quite flat, whilst others have considerable slopes.

The underlying geology across the parcel is recorded as Mudstone from the Mercia Mudstone Group, with small areas of Dolomitic Siltstone of the same group running through Fields 23, 24, 28, and 29. Fields 13, 14, 18 – 21, and 29 also contains some superficial deposits of clay, silt, and gravel alluvium[10].

The soils underlying this survey area are likely to comprise argillic pelosols of the Worcester (431) association for most of the parcel, with stagnogleyic argillic brown earths of the Whimple 3 (572f) association to the north-east and pelo-alluvial grey soils of the Fladbury 2 (831c) association through the central west portion of the parcel[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed buildings

Nine listed buildings have been identified within a 1 km search radius. Three of these are situated to the west of the survey area, within the village of Moorhouse. Moorhouse Chapel (**NHLE 1045631**) is Grade II* listed. This chapel was built in 1860 by Henry Clutton for J. E. Denison in the French Gothic Revival style.

Four listed buildings are located within the Ossington Hall parklands to the south of the parcel. One of these, the Church of the Holy Rood (**NHLE 1045958**), is Grade I listed. This church was established in 1782 – 1783 and is built in a classical style. Some minor alterations were made in the 19th Century. Associated with the church is the Grade II listed Boundary Wall and Gate at Church of the Holy Rood (**NHLE 1045957**). Nearby is the Grade II* listed Sundial 50 m East of Church of Holy Rood (**NHLE 1301995**). Two buildings are more closely associated with the now-demolished Ossington Hall and are Grade II listed. These are Boundary Wall, Railing, Gate Piers, and Gate at Ossington Hall (**NHLE 1369971**) and Monumental Well at Ossington Hall (**NHLE 1045959**).

Ossington House (**NHLE 1045961**) is located at the edge of the village of Ossington and is Grade II listed. Several other listed buildings are also located within Ossington and other villages near to the survey area, such as Weston and Sutton on Trent, but these are outside of the 1 km study radius and so are outside the scope of this report.

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 20/05/2022)

[11] Soil Survey of England and Wales, 1983

7.2.2 Prehistoric

Some evidence of prehistoric activity is currently known within the study area. One large flint flake (alternatively interpreted as a knife) was found in or on the bank of the Moorhouse Beck approximately 40 m from Field 14. The item was not securely dated and has since been lost. A sandstone axe-hammer of Neolithic or Bronze Age origin has also been found 800 m west of Field 18

7.2.3 Iron Age – Roman

No Iron Age material has been recovered within the study area.

Several Roman findspots are located within the study area. Along with the flint blade mentioned above, Roman pottery was also found in the Moorhouse Beck in a similar location. Nearby, 100 m south of Field 10, trial trenching in the 1950s also revealed Roman pottery, although nothing more substantial was found. Two sherds of Roman grey ware have also been found 300 m east of Field 26.

Earthworks located at the northern edge of the village of Weston (900 m north – east of Field 10) may possibly be representative of a Roman camp, although the lack of intensive archaeological investigation here has meant that the earthworks are poorly understood and could be later in date.

7.2.4 Medieval

The site of the deserted medieval village (DMV) of Ossington is located 730 m to the south of Field 29. Although no remains are visible at the site or on aerial photographs, Ossington and the nearby villages of Weston and Sutton on Trent are represented in the Domesday book of 1086.

The scheduled Moat, Three Fishponds, Enclosures, Hollow Way and Part of a Road at Hall Yard (**NHLE1008247**) is located on the border of the study area, 1.1 km from Field 10. Moated sites were an important building tradition in this area during the medieval period, particularly from 1250 – 1350. This particular example may have been connected with the village of Weston and is also possibly connected to the original course of the Great North Road.

7.2.5 Post-Medieval

The post-medieval period saw the consolidation and appearance of many of the local towns, with many of the scheduled buildings listed above dating to this period.

This period also saw the development of country manor houses and parklands in the area. Ossington Hall and its surrounding parkland are examples of this trend. The house was first established in 1580 and replaced in 1729, with significant improvements in the late 18th century. The house was demolished in 1963 and no remains are currently visible. Much of the parkland still survives, either as agricultural land or as woodland. Several of the fields within the southern portion of the survey area are located within the Ossington Hall parklands.

Other elements of landscape control were introduced during this period, with several sluice gates installed in the Moorhouse Beck to better control its water. A reservoir was also installed just south of the Ossington parklands, 650 m south-west of Field 30.

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out over multiple deployments; 05 January, 09 – 12 January, 17 February and 27 – 31 March 2023 and covered 75.2 ha of the 155 ha survey area. The survey has identified a small, fragmented enclosure and possibly

associated trackway. In addition to several modern anomalies associated with the parcel's agricultural past.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (**Figures 4** – **19**). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (**Figure 3**).

7.3.1 Interpretation: Archaeology and Possible Archaeology

The only definitive example of archaeology identified at the area is in the south, in Field 30 at **GER-0001** (**Figure 17**). This consists of two weakly positive anomalies covering an area 40 m wide by 50 m long. The smaller linear anomaly, to the west, is on a north-west to south-east alignment 2.5 m wide by 25 m long. The larger anomaly consists of a sub-rectangular anomaly with a linear segment extending to the 30 m north-west, forming a broken 'b' shape, 2 m wide. The rectangular segment has an opening to the north-east. Together, these anomalies are thought to represent a possible trackway and ditched enclosure. Further investigation would be needed to determine a date for this anomaly.

A possible archaeological anomaly has been identified in Field 24 at **GER-0002** (**Figure 7**). It consists of two linear anomalies orientated perpendicular to one another. The western anomaly is 1 – 2 m wide by 50 m long, orientated north-west to south-east, whilst the eastern anomaly is 1 – 2 m wide by 55 m long on a north-east to south-west alignment. It is possible that **GER-0002** represents ditches, likely associated with former boundary features. Alternatively, the western anomaly runs parallel to the recorded drainage in the field and may therefore be representative of drains or an enhanced agricultural trend.

7.3.2 Interpretation: Historical Agriculture

Several former field boundaries have been identified across the parcel at **GER-0003** – **GER-0006. GER-0003** is a weakly dipolar linear anomaly identified in Field 29 (**Figure 15**). This anomaly runs on a north – south alignment, 3 m wide by 35 m long, and continues further northwards as a field drain. Anomalies **GER-0004**, **GER-0005** and **GER-0006** are weakly positive linear anomalies located in Field 31 (**Figure 18**). **GER-0004** runs on a north – south alignment, 2 m wide by 130 m long. **GER-0005** runs on a north-east to south-west alignment 2 m wide by 100 m long, extending from the existing field boundary. **GER-0006** runs north-west to south-east and is 4 m wide by 100 m long.

These field boundaries are recorded on OS mapping from 1888 – 1965 but disappear by the time that satellite imagery was taken of the area in 2000 (Google 2023). In later satellite images, taken in 2004 and 2007, the field boundary at **GER-0003** is in use again but it disappears fully from 2012 onwards. It is likely that **GER-0005** and **GER-0006** form two sides of the same field boundary.

In Field 25, an isolated area of weak, positive, parallel linear anomalies aligned east – west is recorded at **GER-0007** (**Figure 7**). These anomalies are thought to relate to ridge and furrow cultivation. The relatively straight nature of the anomalies suggests a post-medieval date.

7.3.3 Interpretation: Modern Agriculture

Several extensive areas of weakly positive linear anomalies are identifiable across the parcel. These are thought to be representative of modern ploughing.

7.3.4 Interpretation: Natural

The influence of geology is relatively minimal across the parcel. However, one major geomorphological feature is visible on a north-west to south-east orientation across Fields 26 – 28 (**Figures 11** and **13**). This feature is fragmented in the centre, dividing it into two

halves 5 – 12 m wide by 325 m long and 3 – 25 m wide by 380 m long respectively. It is likely that this feature represents a former watercourse or paleochannel.

7.3.5 Interpretation: Modern

Much of the survey area is dominated by regularly-spaced, parallel dipolar or weakly positive linear anomalies. Due to their form and magnetic properties, these are likely to represent modern drains.

Two areas of increased magnetic response have also been identified within the survey area. The first of these, located in Field 24 at **GER-0008** (**Figure 7**), covers an area 40 m in width by 60 m in length and is likely to have been caused by the presence of a drain head or a natural spring.

The second area of increased response is located in the western side of Field 31 at **GER-0009** (**Figure 19**). This response covers an area 25 m wide by 170 m long and is thought to be caused by a set of overhead powerlines which traverse the parcel. These powerlines also traverse Fields 27 and 25. In these fields, the area underneath the powerlines has not been surveyed due to their interference in the gradiometer data.

The survey has also detected multiple isolated clusters of low magnitude and dipolar anomalies that have been interpreted as ferrous in origin. These likely relate to natural variation in the soils and background geology and are of little archaeological impact.

7.3.6 Interpretation: Unknown

Several trends have also been observed across the survey area. These are likely a result of modern agricultural practices, but an archaeological origin cannot be wholly rejected at this point.

7.4 Preliminary Conclusions

The gradiometer survey has been successful in detecting one archaeological anomaly within the survey area. This anomaly is likely to be representative of a trackway or enclosure, although future archaeological investigation would be necessary to establish a date and context for this feature.

A second anomaly has been identified which is of possible archaeological origin. This consists of two perpendicular ditches that likely relate to former boundary features. However, they may also represent modern drains.

Additionally, several former field boundaries have been detected across the parcel, as well as limited traces relating to historic agriculture, such as an isolated area of ridge and furrow. Modern agricultural activity, such as ploughing and drainage is also well represented across the area.

Finally, two areas of increased magnetic response have also been detected. One of these is likely to have been caused by the presence of an overhead powerline which traverses the eastern portion of the parcel on a north-south alignment.

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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.

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

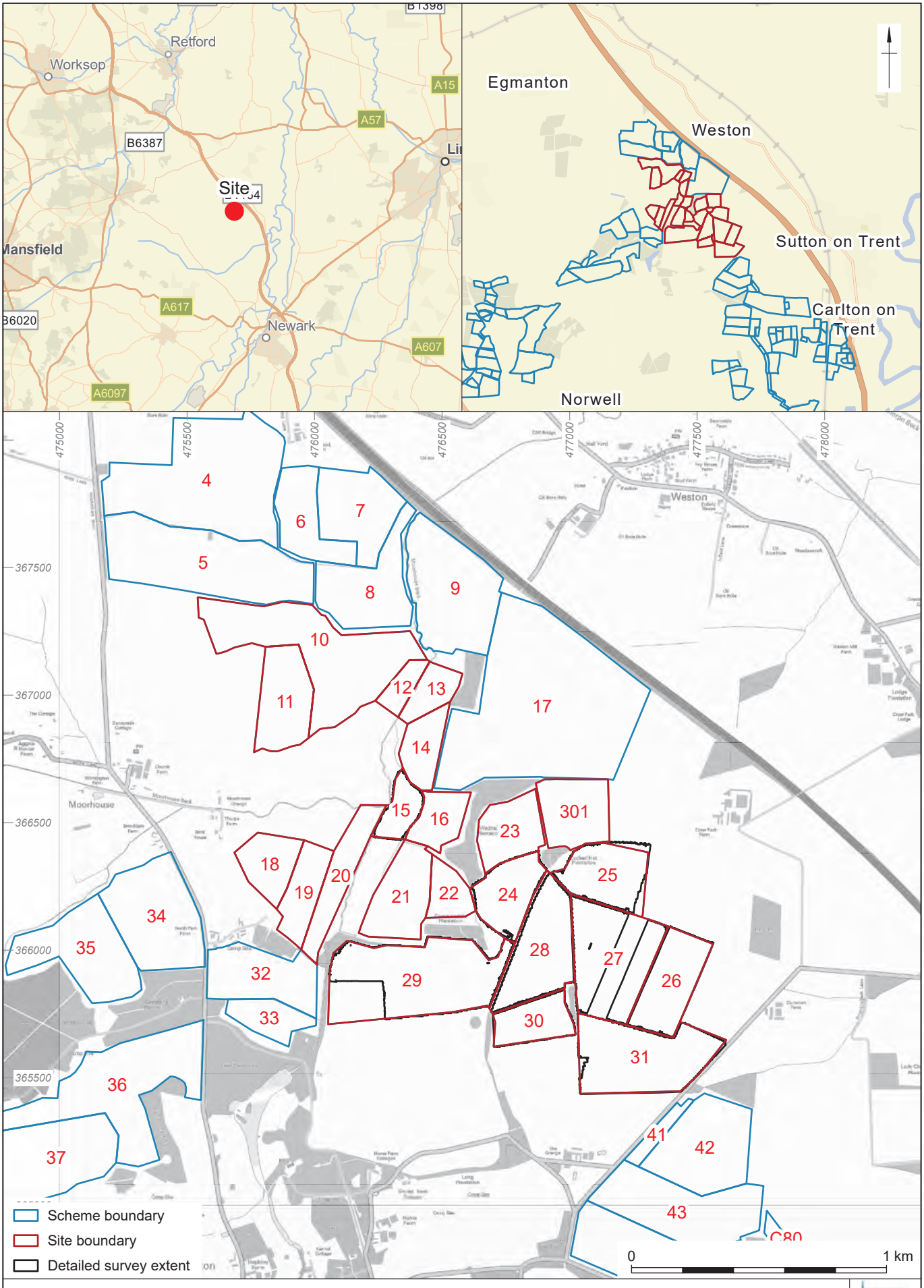
Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.

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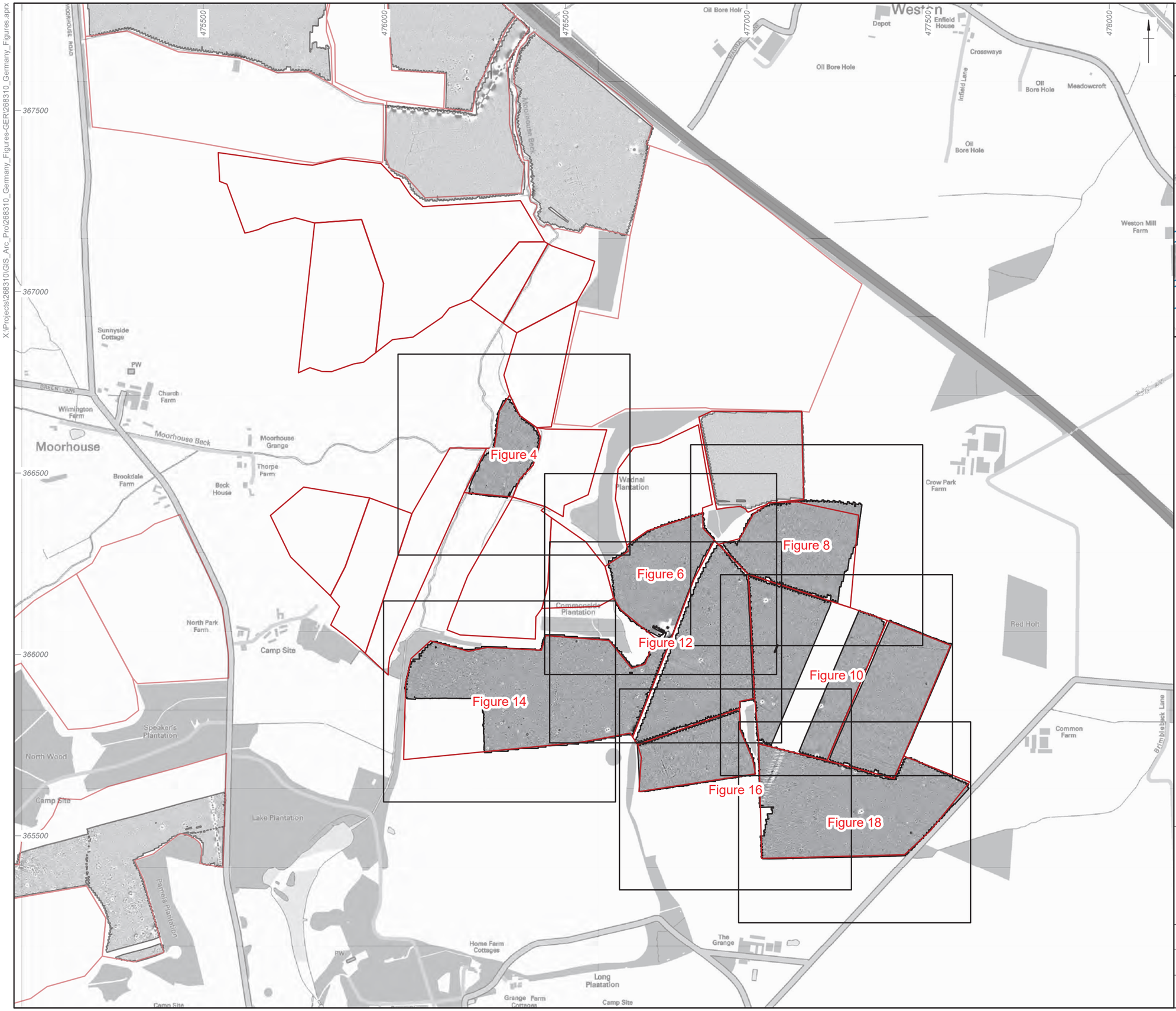


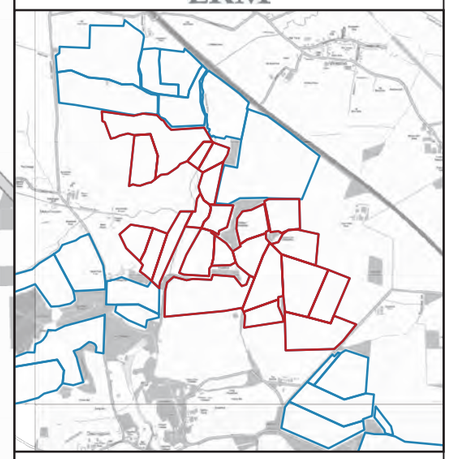
Coordinate system: OSGB 1936 British National Grid
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Figure 1: Site location and survey extents

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Site boundary

Detailed survey extent

-2 nT 3 nT

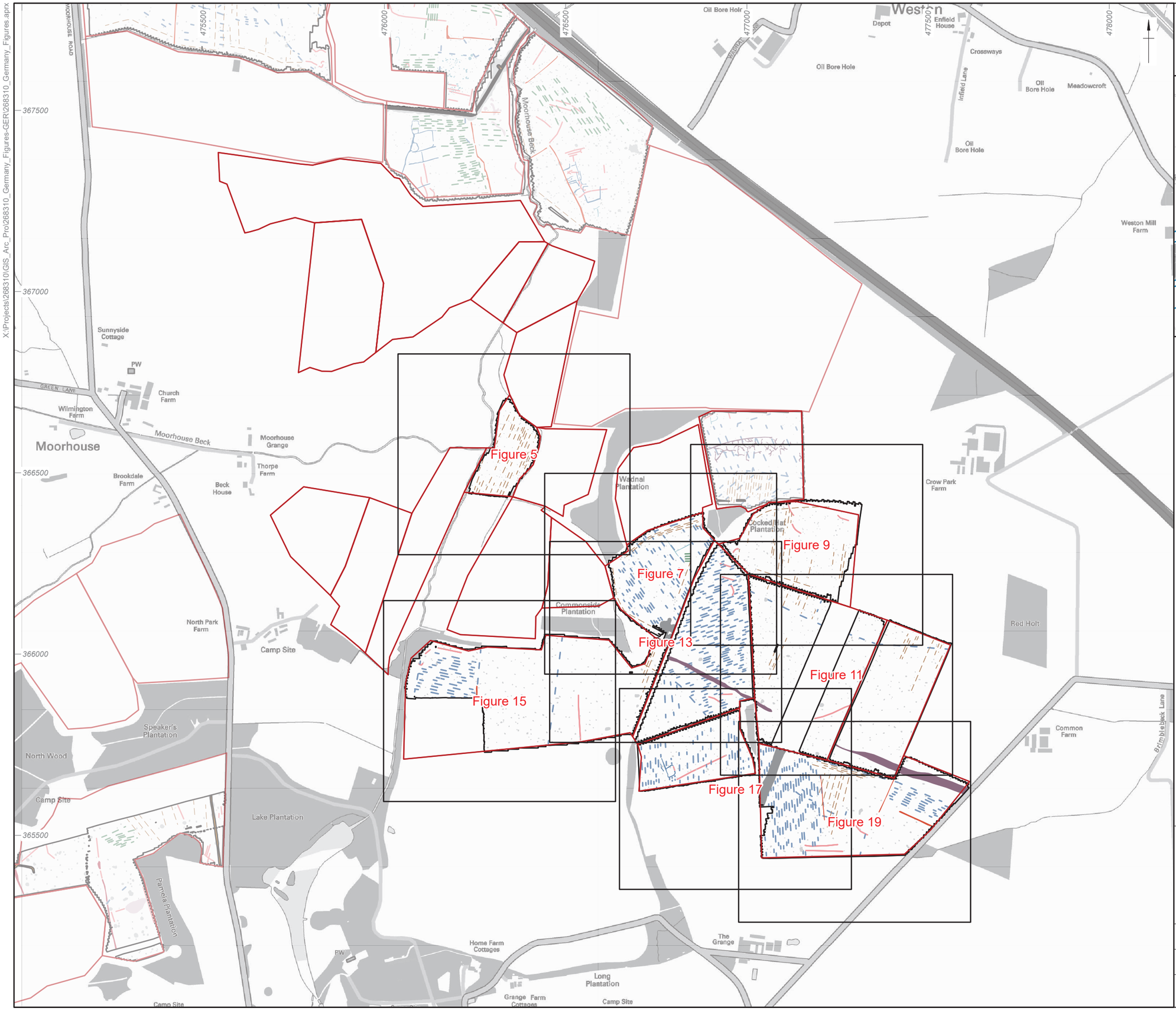
0 500 m

Coordinate system: OSGB 1936 British National Grid
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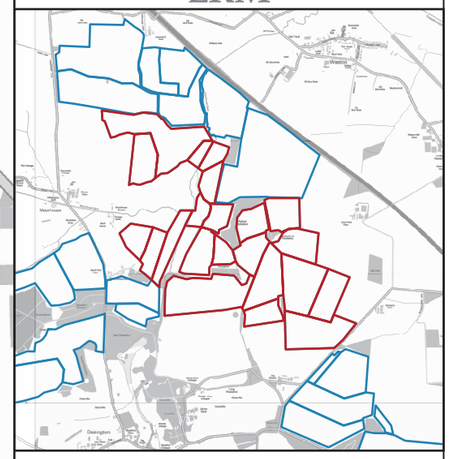
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Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

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ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 500 m

Coordinate system: OSGB 1936 British National Grid
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Figure 3: Detailed gradiometer survey results: overall interpretation

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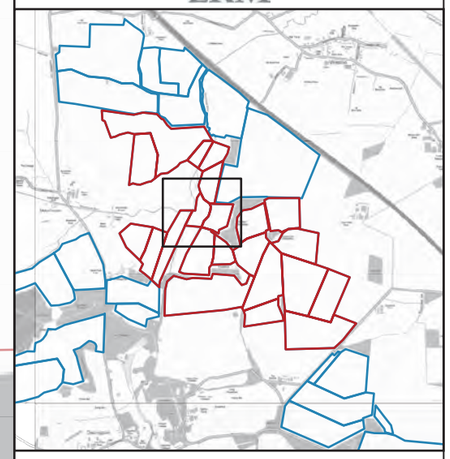
476400

476600

366800

366600

366400



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 4: Detailed gradiometer survey results: greyscale plot (15)

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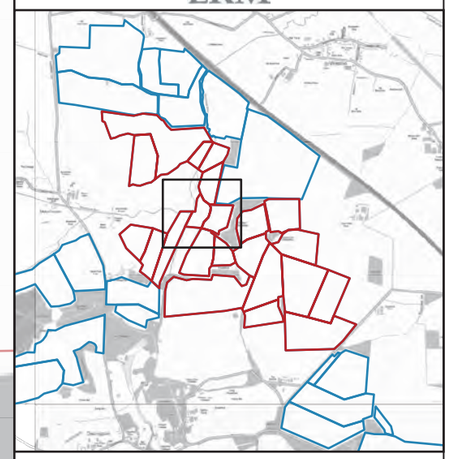
476400

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Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

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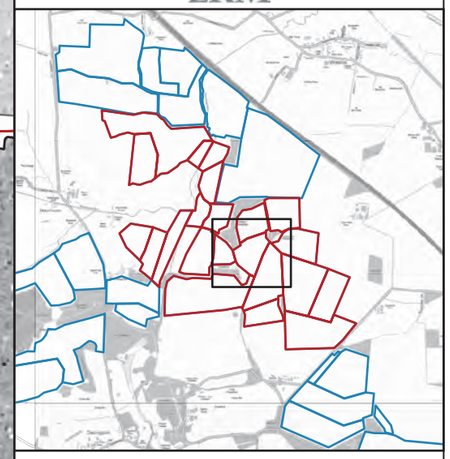
Figure 5: Detailed gradiometer survey results: interpretation (15)

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Wadnal Plantation

Commonside Plantation

476600
476800
477000
366400
366200
366000



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

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Figure 6: Detailed gradiometer survey results: greyscale plot (24)

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Wadnal Plantation

Cocked H Plantati

Commonside Plantation

GER-0002

GER-0007

GER-0008

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476800

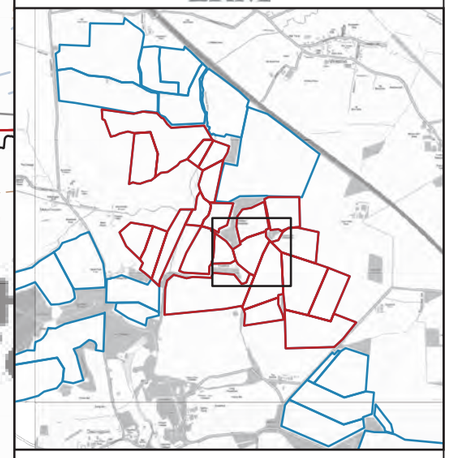
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366400

366200

366000

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 7: Detailed gradiometer survey results: interpretation (24)

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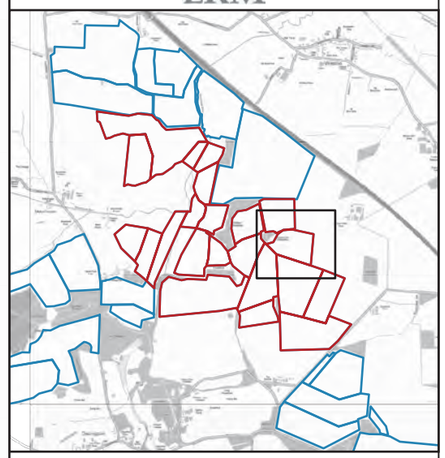
477000

477200

477400

366400

366200



Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

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Figure 8: Detailed gradiometer survey results: greyscale plot (25)

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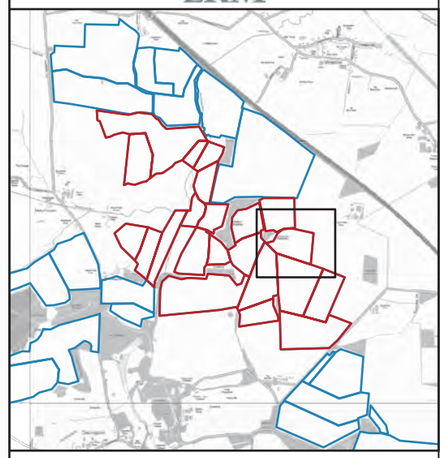
477200

477400

366400

366200

Cocked Hat Plantation



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

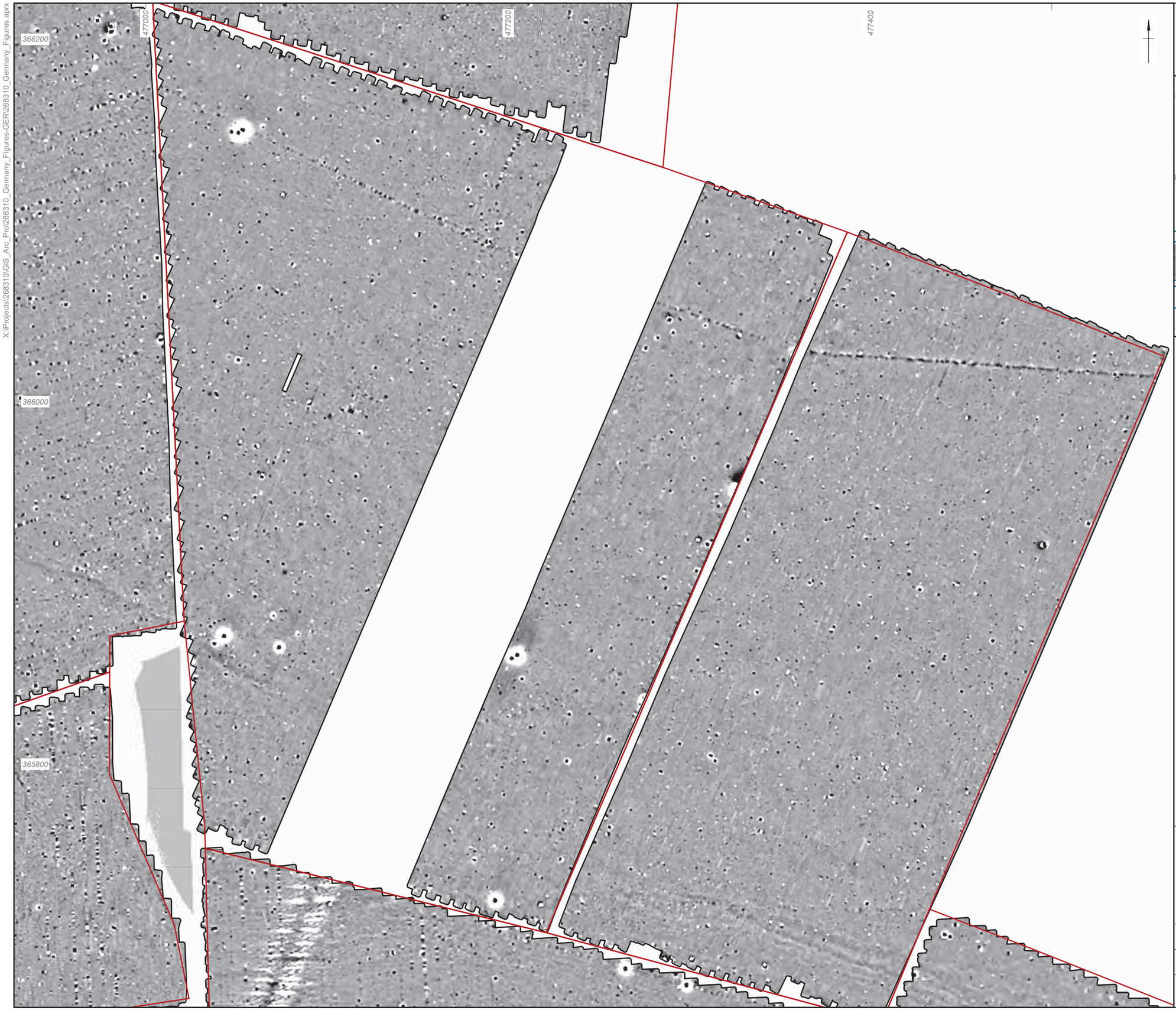
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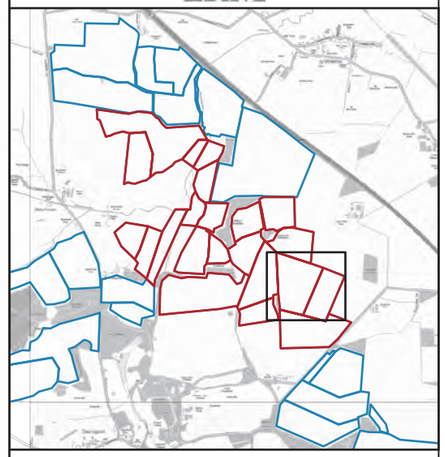
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Figure 9: Detailed gradiometer survey results: interpretation (25)

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ERM



Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

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Figure 10: Detailed gradiometer survey results: greyscale plot (26 - 27)

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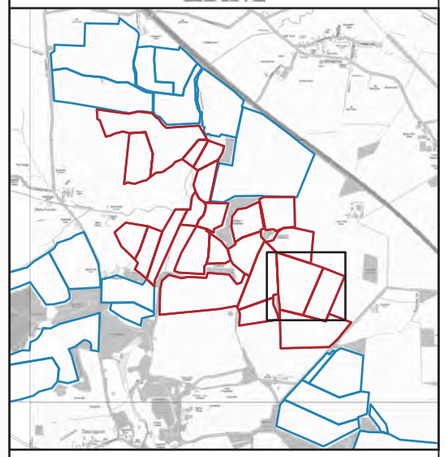
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477200

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- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 11: Detailed gradiometer survey results: interpretation (26 - 27)

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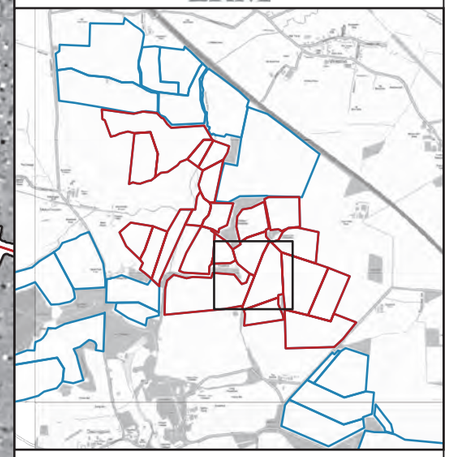
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Commonside Plantation

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365800



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

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Figure 12: Detailed gradiometer survey results: greyscale plot (28 - 29)

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366000

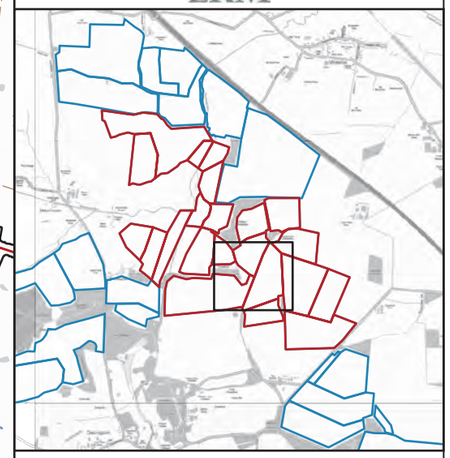
365800

GER-0002

GER-0007

GER-0008

Commonside Plantation



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

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Figure 13: Detailed gradiometer survey results: interpretation (28 - 29)

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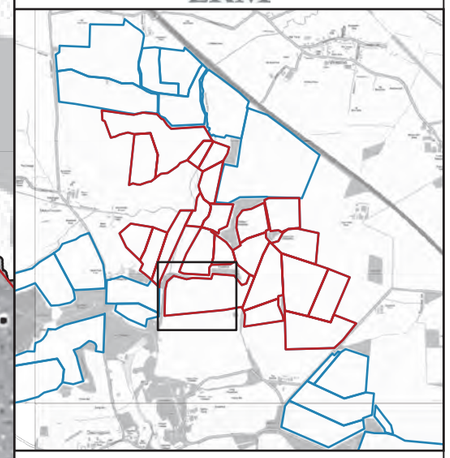
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Commonside Plantation



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 14: Detailed gradiometer survey results: greyscale plot (29)

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476200

476400

476600

Commonside Plantation

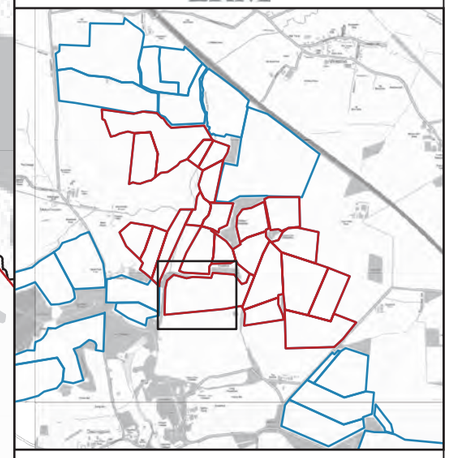
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GER-0003

365800

365600

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 15: Detailed gradiometer survey results: interpretation (29)

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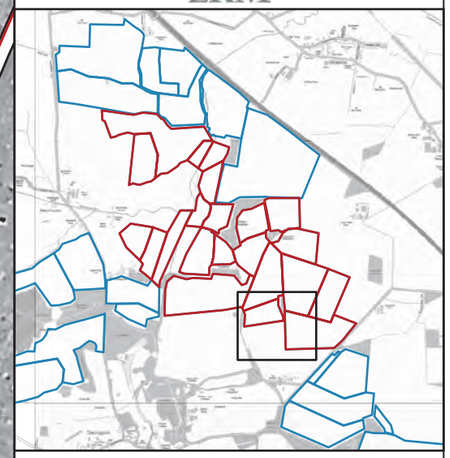
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477200

365800

365600

365400



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 16: Detailed gradiometer survey results: greyscale plot (30 - 31)

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476800

477000

477200

365800

365600

365400

GER-0001

GER-0009

GER-0004

ERM

Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid

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Date: 05/07/2023 | Created by: ADT

Scale: 1:2000 | Revision: 0

Figure 17: Detailed gradiometer survey results: interpretation (30 - 31)

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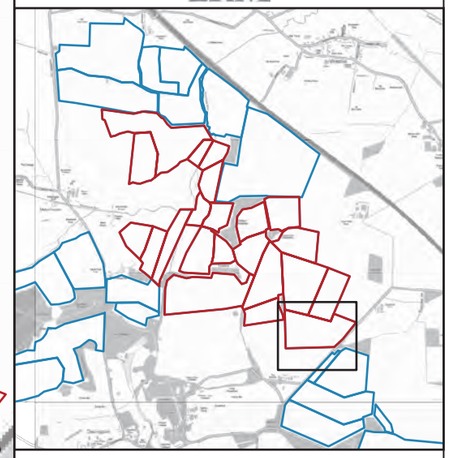
477000

477200

477400

365600

365400



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Date: 05/07/2023 | Created by: ADT

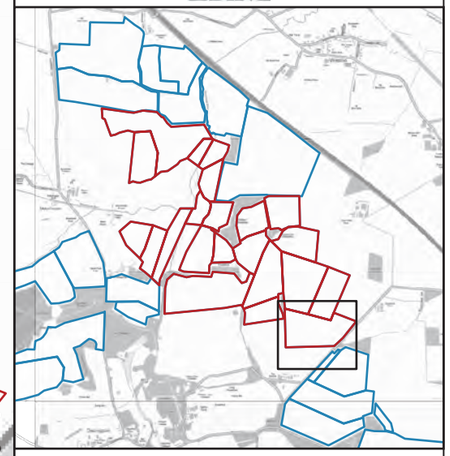
Scale: 1:2000 | Revision: 0

Figure 18: Detailed gradiometer survey results: greyscale plot (31)

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477000
477200
477400
365600
365400

GER-0009
GER-0004
GER-0005
GER-0006



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Date: 05/07/2023	Created by: ADT
Scale: 1:2000	Revision: 0

Figure 19: Detailed gradiometer survey results: interpretation (31)

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE

CULTURAL HERITAGE REPORT NUMBER: 268310

DATE: MAY 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l **E** erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site north of Staythorpe between 23 – 26 January 2023. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Dakin Land' comprises two arable and pasture fields, covering 53 ha, located between of the villages of Cromwell to the north and North Muskham to the south.

The gradiometer survey has been successful in detecting anomalies of archaeological origin across the area, particularly the partial remains of enclosures associated with settlement activity located in the northern portion of the area.

An area of anomalies has been identified in the northern field. This group of ditches have been recorded orientated broadly north – south, consisting of multiple partial enclosures and pits thought to be associated with Romano-British/Iron Age settlement activity. An additional sub-rectilinear enclosure has been identified in the eastern half of the southern field, attached to a possible former field boundary not recorded on OS mapping.

Numerous linear and curvilinear anomalies of a possible archaeological origin have been identified across the area. The majority of these are too weak or isolated to offer a confident interpretation. It is possible they relate to archaeological ditches; however, it may be more likely they are the result of geomorphological variation or modern agricultural activity. This interpretation, however, cannot be confirmed from the geophysical data alone and would require further investigation.

The area's agricultural past is also evidenced by areas of medieval ridge and furrow. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on first-edition OS mapping. One example of historical landscape features has been identified in the form of a former footpath or access tracks visible on satellite mapping.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing and land drains and increased magnetic response associated with field boundary removal.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of **ENT486**, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (**ENT486**, **ENT1034**, **ENT3871**, **ENT3756** and **ENT3888**).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (**ENT738** and **ENT1125**). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in **section 4.3**.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in **section 4.3** below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (**MNT5596** and **MNT11139**). The only other Palaeolithic dated material is a handaxe found 1.5 km north-west of the site (**MNT4164**).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (**MNT3597**, **MNT14748**, **MNT17094**, **MNT17127**, and **MNT8542;** NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (**MNT17099**). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (**MNT17097**, **MNT14313**, **MNT17091**, **MNT11991**, and **MNT14315**), while an isolated small riverside settlement was found near Cromwell (**MNT25849**). The Cromwell barrow cemetery also remained in use during the Iron Age (**MNT15145**). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (**MNT17089**, **MNT17090**, **MNT8243**, **MNT8265**, **MNT17098**, **MNT8290**, and **MNT14318**). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (**MNT8243**, **MNT8265**, and **MNT17089**), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (**MNT11098**, **MNT11050**, **MNT11732**, **MNT11047**, **MNT8286**, **MNT2881**,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and **MNT3098**) and Kneesall (**MNT12174**, **MNT8556**, **MNT17128**, and **MNT12172**). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (**MNT14312**; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (**MNT26679**), Kelham Hall (**MNT26671**), Averham Park (**MNT26653**), Winkburn Park (**MNT26694**), and Beesthorpe Hall (**MNT26658**).

Of the parks discussed above, Averham Park falls within the site (**MNT26653**). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion ... on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (**MNT14403**). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (**MNT14432**). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken between 23 – 26 January 2023. Of the total 53 ha site, an overall coverage of 50.8 ha was achieved with some small areas deemed unsuitable for survey at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 DAKIN LAND – FIELD 299 AND 300

7.1 Site details

A detailed gradiometer survey was carried out over Field 299 and 300, North Muskham (centred on NGR 479572 360705) (**Figure 4 – 13**).

This survey comprises two arable fields. Both fields are bounded by the A1 to the east and a north – south railway line to the west, associated with the Great Northern Railway. The northern edge of Field 299 is delineated by Norwell Lane, a fishpond boundary to the south-west, and hedgerows leading to other arable fields on the remaining edges. The southern edge of Field 300 is bounded by farms and houses on Vicarage Lane. Whilst the remaining edges are tree-lined hedgerows with further arable fields.

The survey area is relatively flat at 10 m aOD.

The underlying geology across the survey area is recorded as Mercia Mudstone Group - Mudstone. Sedimentary bedrock formed between 252.2 and 201.3 million years ago during the Triassic period[10].

The soils underlying this survey area are likely to comprise loamy soils and clayey floodplain soils with naturally high groundwater of the Frome (0812a) association[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed Buildings

To the north of the parcel there are two listed buildings; Scarthingmoor House situated on the old Great North Road (**NHLE 1045943**) and Scarthingmoor Mill Farmhouse (**NHLE 1179802**). Both sites are 800 – 900 m from the parcel. The Windmill (**NHLE 1266846**) 1.3 km north, is also listed at Grade II.

To the south-west in the village of Moorhouse three listed buildings lie 1.3 km away from the parcel consisting of; a Grade II Church Farmhouse (**NHLE 1045632**), Aggrie House (**NHLE 1302636**), a post-medieval redbrick house, and the 12th century Grade II* Moorhouse Chapel (**NHLE 1045631**). At 1.8 km SSW, halfway between the villages of Moorhouse and Ossington, lies the Grade II listed North Park Farmhouse and adjoining farm buildings (**NHLE 1179405**).

To the east in the village of Weston four listed buildings lie 1 km away from the parcel consisting of the 13th century Grade I parish Church of All Saints (**NHLE 1179778**), Grade II listings for a dovecote and adjoining pigeoncote (**NHLE 1045942**), a sundial (**NHLE 1370001**), and a stable and pigeoncote at Sunnyside Farm House (**NHLE 1179789**).

7.2.2 Prehistoric

A few findspots of worked flints and stone are scattered across the study area, including undefined tools found in the field to the north of parcel (**MNT322541**), a large flint flake in the river bed 1 km to the south-east (**MNT322556**), a sandstone axe-hammer of late Neolithic or Early Bronze Age date 1.8 km south-west (**HER L4171**), and a scatter of Neolithic flints at Scarthing Moor 1 km to the north-east (**HER L4221**).

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[11] Soil Survey of England and Wales, 1983

7.2.3 Iron Age – Roman

The is little to no evidence of Iron Age activity in the study area though there are Roman findspots; a collection of sherds found while trial trenching 1 km due south of the parcel (**MNT322529**), a small scatter of Roman pottery sherds found 1.3 km east of the parcel (**MNT322535**), and some sherds in the same riverbed investigation as the large flint flake above (**MNT322556**).

7.2.4 Medieval

There are several medieval areas in the study area including ridge and furrow, trackways and, individual dwellings and settlements. Ridge and furrow can be seen as cropmarks in fields 1.2 km east (**MNT1380326**) and probably represent a larger medieval agricultural landscape.

Two trackways run near the parcel and are of probable medieval date, one at Infield Lane 1.6 km south-east (**MNT1380324**) and Wadnall Lane 1.1 km to the east (**MNT1380331**).

Two medieval dwellings are documented in the study area; Lodge Farm (**MNT1378997**) and ancient outbuilding has timber framing dating to the 15th century 1.2 km east of the parcel, and a moated site with fishponds, enclosures and a hollow way 1 km ENE (**MNT322517**). This area is a scheduled monument called Moat, three fishponds, enclosures, hollow way and part of a road at Hall Yard (**1008247**).

The village of Weston 1 km east has origins as a nucleated medieval village that straddled the Great North Road and is of 12th century origin (**MNT1380345**), with a high likelihood of buried deposits.

7.2.5 Post-medieval

The village of Weston 1 km east of the parcel contains a number of post-medieval buildings, some listed as mentioned above, but many others have been recognised as historically significant residential and agricultural dwellings, such as the School Hall (**MNT1378962**), Ivy House Farm (**MNT1378970**).

Weston also has a set of post-medieval stocks (**MNT1380329**), a milepost (**MNT1380328**) and some field boundaries that may be planted on previous medieval hedgerows (**MNT1380317**).

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out between 23 – 26 January 2023 and covered 50.8 ha of the 53 ha survey area. The survey has identified a series of partial enclosures indicative of settlement activity in the north of the parcel and a sub-rectilinear enclosure in the southern field, possibly associated with a former field boundary not recorded on OS mapping.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (**Figures 4** – **13**). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (**Figure 3**).

7.3.1 Interpretation: Archaeology and Possible Archaeology

A series of strongly positive rectilinear and curvilinear anomalies have been identified in the western end of Field 299 at **DKN-0001** (**Figure 5**). These anomalies are between 2 – 3 m wide orientated broadly north – south over an area 100 m wide and 170 m long. Although these anomalies are all interconnected, they appear to be sub-divided into three areas at **a** – **c**. The anomalies in area **a** are located centrally in the series and contain an

oval anomaly with a 30 m diameter with additional associated linears. Area **b** to the south contains linear and rectilinear anomalies between 20 and 30 m in length orientated north – south or east – west. This area also contains the longest linear anomaly, 75 m long, that appears to be forming the western boarder of the anomalies. It also appears to contain a collection of small, rounded anomalies 1 m in diameter. Area **c** appears to be a continuation of activity to the north. A 20 m square rectilinear extends from area **a** via a 40 m long linear. Two additional linears extend further north from the square's north-east and north-west corners for a further 30 m.

Given this group of anomalies form and orientation, they are representative of ditches and pits, combining to form multiple interconnected enclosures possibly relating to Romano-British settlement activity. It is likely that that the anomaly at **a** represents the remains of rounded enclosure with internal divisions, possibly Iron Age or Romano-British in origin.

A strongly positive collection of linear and curvilinear anomalies has been identified in the eastern portion of Field 300 at **DKN-0002** (**Figure 11**). The collection at **DKN-0002** consists of two main anomalies. The first is a 3 m wide by 260 m long linear orientated WNW – ESE, like other former field boundaries in proximity to the anomaly. The western end of this linear is also almost truncated by a recorded former field boundary on a perpendicular orientation. Whilst the second is a 25 m x 35 m sub-rectangular anomaly extending from the north of the linear. Both anomalies have been heavily impacted by ridge and furrow in the area.

It is likely that these anomalies are ditches of an unknown origin. The WNW – ESE linear could be a former field boundary not recorded on OS mapping, with the sub-rectilinear anomaly forming an attached enclosure of an unknown date.

Additional linear and curvilinear anomalies have been identified immediately north and south of **DKN-0002** at **DKN-0003** and **DKN-0004** (**Figure 11**). These anomalies are between 2 – 3 m wide and are either orientated broadly WNW – SSE, like **DKN-0002**, or north-east to south-west. It is likely that they represent additional ditches or former field boundaries associated with **DKN-0002**. These anomalies do have slightly weaker magnetic properties and may relate to drainage or agricultural practices similar to the wealth of ridge and furrow in the area.

Several further positive curvilinear and penannular anomalies have been recorded across the parcel at **DKN-0005** – **DKN-0009** (**Figures 7** – **13**). These all have the potential to be ring ditch features, possibly relating to small enclosures or round houses. However, their weak magnetic response and relative isolation from any associated anomalies make confident interpretation difficult. It is equally possible that these represent natural geological variation or agricultural activity.

7.3.2 Interpretation: Historical Agriculture

Former field boundaries visible on OS mapping have also been recorded as linear anomalies across the parcel at **DKN-0010** – **DKN-0019** (**Figures 5** – **13**). Boundaries **DKN-0010** and **DKN-0011** (**Figure 5**) are located in Field 299 orientated north – south and are 3 m wide by 40 m long and 5m wide by 100 m long respectively. In Field 300, the former boundary at **DKN-0012** and **DKN-0013** (**Figures 7 – 13**) transects the entire field for 290 m on a NNE – SSW orientation, although it is heavily fragmented throughout. The remaining boundaries in Field 300 (**DKN-0014** – **DKN-0019**) are orientated ENE – WSW.

All of the boundaries are first recorded on 1888 OS mapping, although appear to have been removed or modified at different periods since. Boundaries **DKN-0010** – **DKN-0017** are still recorded on the 1961 OS mapping but no longer visible on satellite mapping dated 2002 (Google Earth 2023). Whilst **DKN-0018** – **DKN-0019** are last visible on 1914 OS mapping. A former access track or footpath has also been recorded as a historic landscape

feature in the north of Field 300 at **DKN-0020** (**Figure 9**). The faint linear anomaly corresponds satellite mapping of the area.

Several areas of weak, positive, parallel, linear anomalies have been identified at **DKN-0021** and **DKN-0026** (**Figures 5 – 13**). The average distance between lines is 6 m, orientated either north – south (**DKN-0021** – **DKN-0023**) or ENE – WSW (**DKN-0024** – **DKN-0026**). These anomalies have been interpreted as areas of ridge and furrow.

7.3.3 Interpretation: Modern Agriculture

Evidence of modern agriculture has been recorded across the parcel as enhanced linear trends. The majority of these trends are likely associated with modern ploughing or manoeuvring of agricultural machinery around the Field headlands.

7.3.4 Interpretation: Natural

Limited evidence for natural or geomorphological variation has been identified within the survey area. A small number weakly positive curvilinear anomalies have been recorded in the eastern portion of Field 299, possibly associated with paleochannels. It is also possible, however, that some unknown linear and curvilinear trends are actually geological in origin.

7.3.5 Interpretation: Modern

Three area of increased magnetic response have been identified centrally in Field 300. Two central areas surround the former field boundary **DKN-0012** orientated north – east to south – west. Whilst the third area of disturbance to the west corresponds with the known location of a former field boundary noted on 1888 OS mapping, orientated east – west. This boundary, however, is not visible in the survey data. Given their proximity, it is likely that these areas of disturbance have been generated by the removal of field boundaries.

Three negative linear anomalies have been recorded across Fields 299 and 300. These anomalies are straight and thin when compared to others recorded on site. Given their form and magnetic properties, they are likely to be associated with land drains.

Numerous small, isolated, dipolar anomalies have been recorded throughout the survey, typically caused by ferrous material, either on the ground surface or in the plough-soil. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil. Further examples of ferrous responses have been identified around the periphery of certain areas. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks.

7.3.6 Interpretation: Unknown

Isolated linear and curvilinear anomalies have been recorded across the parcel. These anomalies are of unknown origin, due to their faint magnetic properties. It is possible that some may be associated with archaeological features when identified in close proximity. The majority, however, are likely geological in origin or the result of modern agricultural practices.

7.4 Preliminary Conclusions

The gradiometer survey has been successful in detecting anomalies of archaeological origin across the area, particularly the partial remains of enclosures associated with settlement activity located in the northern portion of the area.

An area of anomalies has been identified in the northern field. This group of ditches have been recorded orientated broadly north – south, consisting of multiple partial enclosures and pits thought to be associated with Romano-British/Iron Age settlement activity. An

additional sub-rectilinear enclosure has been identified in the eastern half of the southern field, attached to a possible former field boundary not recorded on OS mapping.

Numerous linear and curvilinear anomalies of a possible archaeological origin have been identified across the area. The majority of these are too weak or isolated to offer a confident interpretation. It is possible they relate to archaeological ditches; however, it may be more likely they are the result of geomorphological variation or modern agricultural activity. This interpretation, however, cannot be confirmed from the geophysical data alone and would require further investigation.

The area's agricultural past is also evidenced by areas of medieval ridge and furrow. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on first-edition OS mapping. One example of historical landscape features has been identified in the form of a former footpath or access tracks visible on satellite mapping.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing and land drains and increased magnetic response associated with field boundary removal.

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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.

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

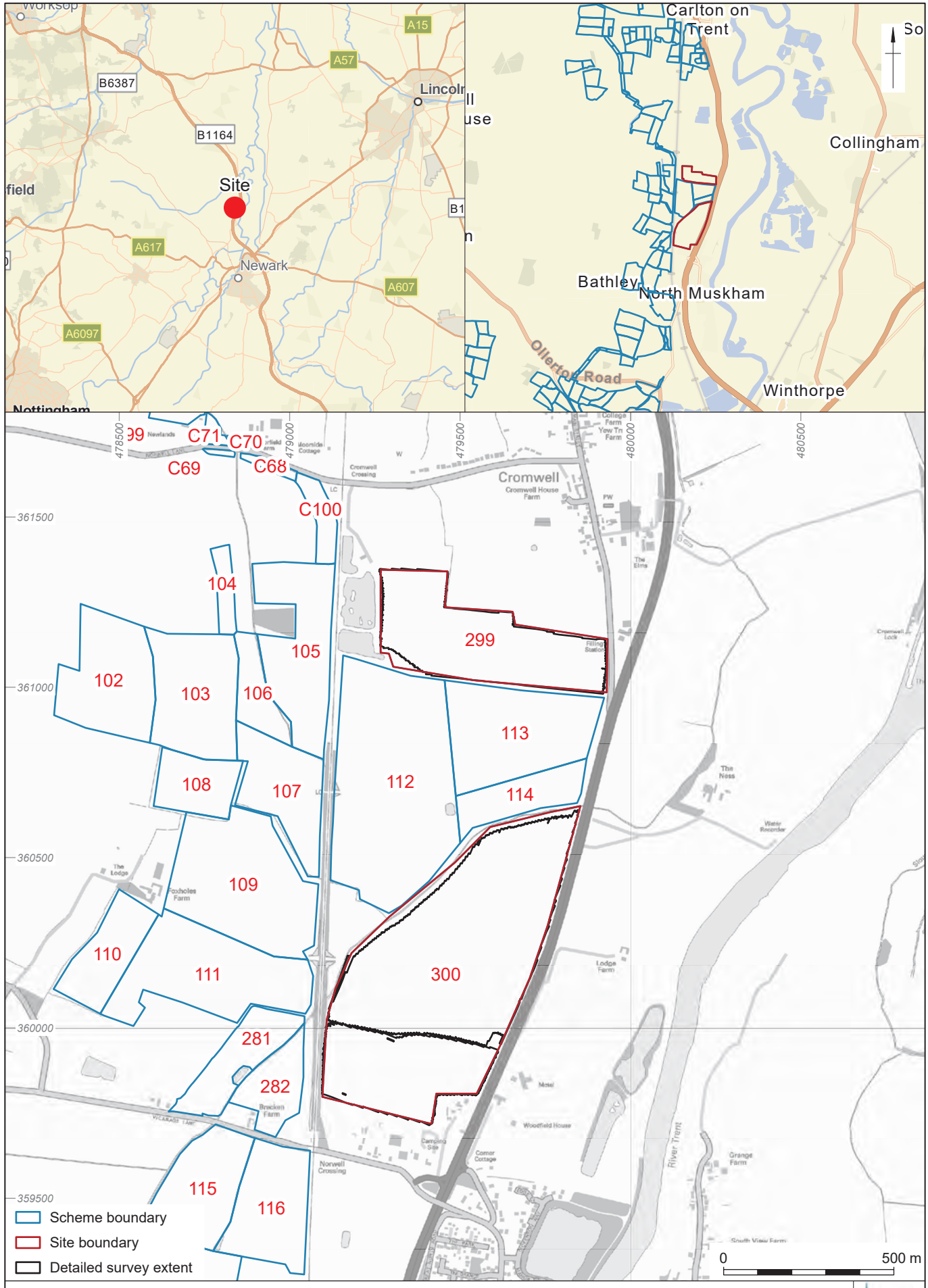
Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.



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Figure 1: Site location and survey extents

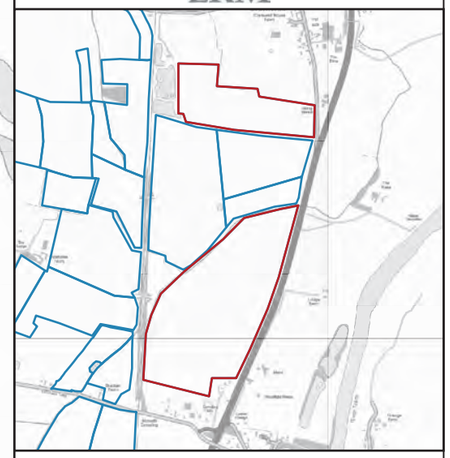
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478000 478500 479000 479500 480000 480500 481000

361500 361000 360500 360000 359500

Beck Bridge
Newlands
Moorfield Farm
Moorside Cottage
NORWELL LANE
Cromwell Crossing
Cromwell
Cromwell House Farm
Milestone Farm
Mano Farm
College Farm
Yew Tree Farm
LC
PW
The Elms
Cromwell Lock
The Oven
The Ness
Water Recorder
Slough Dyke
The Lodge
Foxholes Farm
Lodge Farm
Motel
Bracken Farm
VICARAGE LANE
Woodfield House
Camping Site
Corner Cottage
Norwell Crossing
River Trent
Grange Farm
South View Farm
Hadfields Farm
The Hall
Holme
Depot

Figure 4
Figure 6
Figure 8
Figure 10
Figure 12



Site boundary
Detailed survey extent

-2 nT 3 nT

0 500 m

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Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

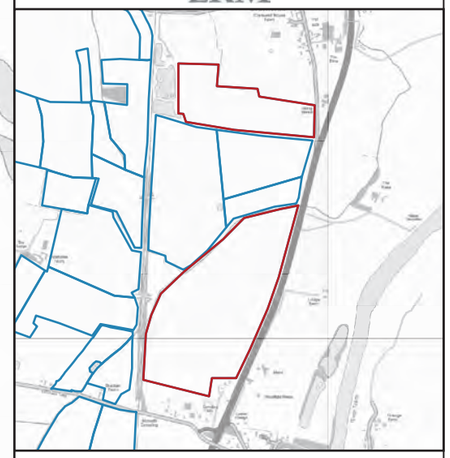
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478000 478500 479000 479500 480000 480500 481000

361500 361000 360500 360000 359500

Figure 5
Figure 7
Figure 9
Figure 11
Figure 13

Beck Bridge
Newlands
Moorfield Farm
Moorside Cottage
NORWELL LANE
Cromwell Crossing
Cromwell
Cromwell House Farm
Milestone Farm
Mano Farm
College Farm
Yew Tree Farm
The Elms
Cromwell Lock
The Oven
The Ness
Water Recorder
Slough Dyke
The Lodge
Foxholes Farm
Lodge Farm
Bracken Farm
VICARAGE LANE
Motel
Woodfield House
Camping Site
Corner Cottage
Norwell Crossing
River Trent
Grange Farm
South View Farm
Hadfields Farm
The Hall
Holme
Depot
THE PARK
THE GRANGE
CROFT HOUSE DRIVE
GREAT NORTH ROAD
BECKSIDE



- Site boundary
- Detailed survey extent
- Land parcel
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 500 m

Coordinate system: OSGB 1936 British National Grid

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Figure 3: Detailed gradiometer survey results: overall interpretation

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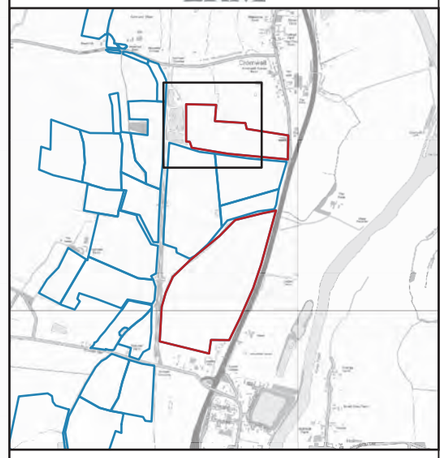
479400

479600

361400

361200

361000



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

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Figure 4: Detailed gradiometer survey results: greyscale plot (299)

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479400

479600

361400

361200

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c

DKN-0001

a

b

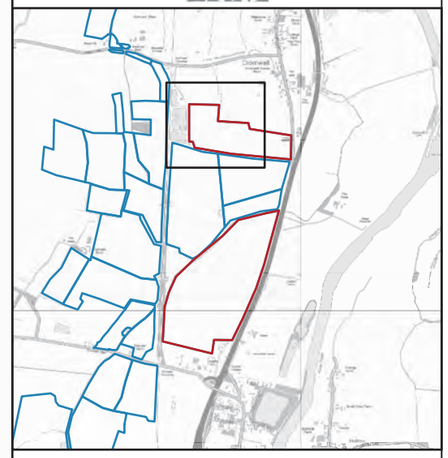
DKN-0021

DKN-0010

DKN-0011

DKN-0009

ERM



Site boundary

Detailed survey extent

Archaeology

Possible archaeology

Former field boundary

Historic landscape feature

Geology

Geomorphology

Historic cultivation

Modern service

Increased response

Ferrous

Agricultural feature

Drain

Trend

0 50 m

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Figure 5: Detailed gradiometer survey results: interpretation (299)

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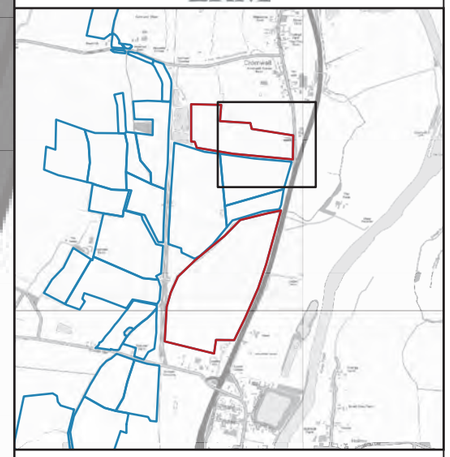
479600

479800

480000

361200

361000



Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

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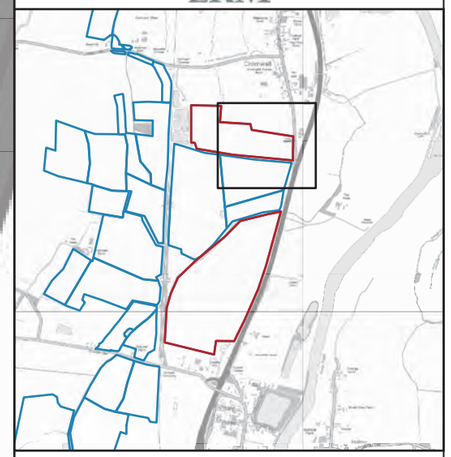
Figure 6: Detailed gradiometer survey results: greyscale plot (299)

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479600
479800
480000
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DKN-0010
DKN-0011
DKN-0009
DKN-0024
JKN-0037
JKN-0055
JKN-0007
Filling Station
Elms
a
b
c
d
e
f
g
h

ERM



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

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Figure 7: Detailed gradiometer survey results: interpretation (299)

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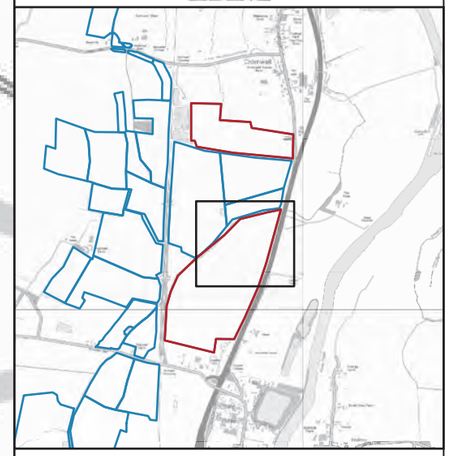
479600

479800

360600

360400

360200



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

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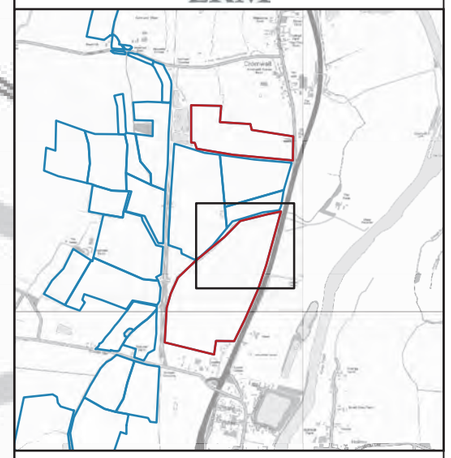
Figure 8: Detailed gradiometer survey results: greyscale plot (300)

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479400
479600
479800
360600
360400
360200

JKN-0006
a
c
d
e
DKN-0020
DKN-0008
DKN-0007
DKN-0006
DKN-0018
DKN-0014
DKN-0025
DKN-0019
DKN-0012
DKN-0004
DKN-0002

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 9: Detailed gradiometer survey results: interpretation (300)

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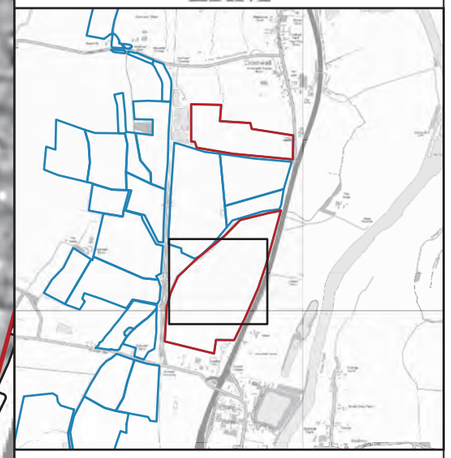
479400

479600

360400

360200

360000



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

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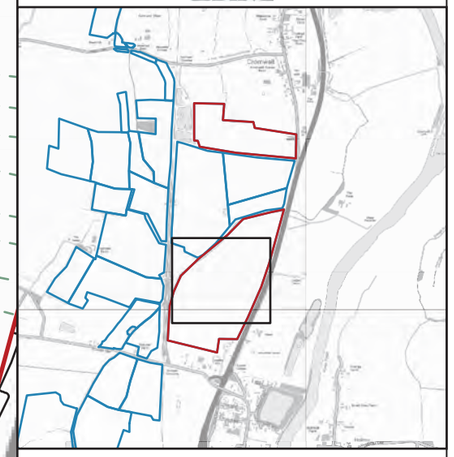
Figure 10: Detailed gradiometer survey results: greyscale plot (300)

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479200
479400
479600
360400
360200
360000

DKN-0006
DKN-0018
DKN-0014
DKN-0025
DKN-0019
DKN-0012
DKN-0004
DKN-0002
DKN-0003
DKN-0015
DKN-0016
DKN-0022
DKN-0026
DKN-0005
DKN-0017

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 11: Detailed gradiometer survey results: interpretation (300)

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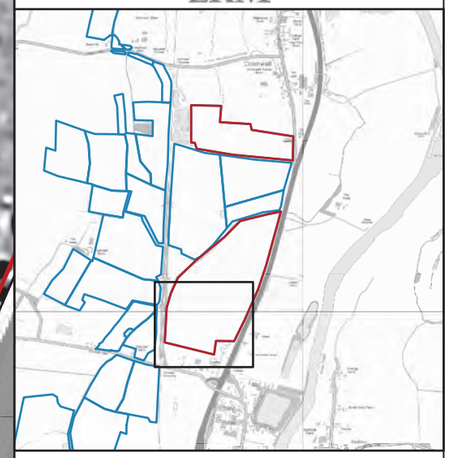
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Camping Site



Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 12: Detailed gradiometer survey results: greyscale plot (300)

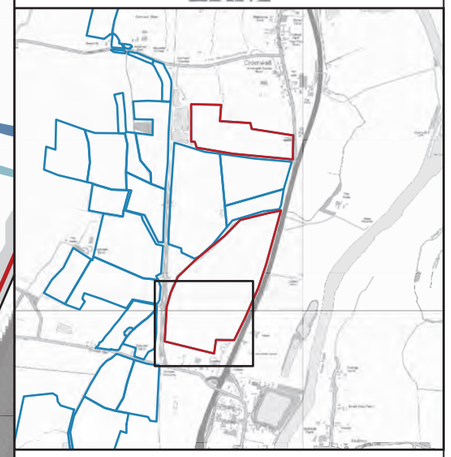
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DKN-0002
DKN-0003
DKN-0015
DKN-0016
DKN-0022
DKN-0026
DKN-0005
DKN-0017
DKN-0013
DKN-0023

Camping Site

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 13: Detailed gradiometer survey results: interpretation (300)

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE (CHASE LAND)

CULTURAL HERITAGE REPORT NUMBER: 268310

DATE: JUNE 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l **E** erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the Chase site, north of Staythorpe between 12 – 14 December 2022. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Chase Land' comprises three fields west of Weston village and the A1 roadway. This comprises a mixture of agricultural land located north-west of Moorhouse, covering an area of 25.8 ha.

The gradiometer survey has been successful in detecting anomalies of archaeological origin in the southern portion of the area.

A collection on rectilinear enclosed ditches have been identified in Field 8. These anomalies are orientated broadly north – south and expected to be associated with Romano-British occupation. The linear nature of these multiple square enclosures could be indicative of a ladder settlement. The activity also likely contains an internal ring-gully.

Two areas of possible archaeological activity have been recorded in the northern Field, as an isolated, 'hook-shaped' ditch and a collection of globular anomalies indicative of extraction. Whilst possibly archaeological in origin associated with the Romano-British activity to the south, these anomalies could also be associated with modern agricultural practices, like those in close proximity recorded on satellite mapping.

Evidence of the sites historical past has been recorded in the form of several former field boundaries and areas of medieval ridge and furrow. Modern services and agricultural land drains have also been recorded in the area.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of **ENT486**, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (**ENT486**, **ENT1034**, **ENT3871**, **ENT3756** and **ENT3888**).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (**ENT738** and **ENT1125**). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in **section 4.3**.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in **section 4.3** below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (**MNT5596** and **MNT11139**). The only other Palaeolithic dated material is a hand axe found 1.5 km north-west of the site (**MNT4164**).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (**MNT3597**, **MNT14748**, **MNT17094**, **MNT17127**, and **MNT8542;** NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (**MNT17099**). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (**MNT17097**, **MNT14313**, **MNT17091**, **MNT11991**, and **MNT14315**), while an isolated small riverside settlement was found near Cromwell (**MNT25849**). The Cromwell barrow cemetery also remained in use during the Iron Age (**MNT15145**). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (**MNT17089**, **MNT17090**, **MNT8243**, **MNT8265**, **MNT17098**, **MNT8290**, and **MNT14318**). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (**MNT8243**, **MNT8265**, and **MNT17089**), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (**MNT11098**, **MNT11050**, **MNT11732**, **MNT11047**, **MNT8286**, **MNT2881**,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and **MNT3098**) and Kneesall (**MNT12174**, **MNT8556**, **MNT17128**, and **MNT12172**). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (**MNT14312**; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (**MNT26679**), Kelham Hall (**MNT26671**), Averham Park (**MNT26653**), Winkburn Park (**MNT26694**), and Beesthorpe Hall (**MNT26658**).

Of the parks discussed above, Averham Park falls within the site (**MNT26653**). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion ... on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (**MNT14403**). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (**MNT14432**). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken between 12 – 14 December 2022. Of the total 25.8 ha site, an overall coverage of 18.9 ha was achieved. The remaining Field 6 was under crop at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 CHASE LAND - FIELD 6-8

7.1 Site details

A detailed gradiometer survey was carried out over Fields 6 – 8, Weston (centred on NGR 476146 367661) (**Figures 4** – **7**).

This survey comprises three arable fields. Fields 7 and 8 are bounded by the A1 to the north-east, with the northern edge of 7 then delineated by a hedgerow leading to another arable field. The remaining edges of all fields are tree-lined hedgerows with further arable fields beyond bar the northern edge of 6 which joins to pasture just south of the farm house.

The survey area is on an incline from 21 m aOD at the southern point to 33 m aOD at the northern edge.

The underlying geology across the survey area is recorded as a narrow strip of Dolomitic Siltstone of the Mercia Mudstone Group across the northern edge of the parcel and Mudstone of the Mercia Mudstone Group across the rest of the area. Superficial deposits of alluvium made up of clay, silt, sand and gravel are recorded at the south-eastern edge of Field 8[10].

The soils underlying this survey area are likely to comprise argillic pelosols of the Worcester (431) association to the west of Field 6, pelo-alluvial gley soils of the Compton (813e) association in the centre of the parcel running north – south, and stagnogleyic argillic brown earths of the Whimple 3 (572f) association with the south-east of Field 8[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed Buildings

To the north of the parcel there are two listed buildings; Scarthingmoor House situated on the old Great North Road (**NHLE 1045943**), Scarthingmoor Mill Farmhouse (**NHLE 1179802**), both sites are 800 – 900 m away, and The Windmill (**NHLE 1266846**) 1.3 km north, all listed at Grade II.

To the south-west in the village of Moorhouse three listed buildings lie 1.3 km away from the parcel, consisting of a Grade II Church Farmhouse (**NHLE 1045632**) and Aggrie House (**NHLE 1302636**), a post-medieval redbrick house, and the 12th century Grade II* Moorhouse Chapel (**NHLE 1045631**). At 1.8 km SSW halfway between the villages of Moorhouse and Ossington lies the Grade II listed North Park Farmhouse and adjoining farm buildings (**NHLE 1179405**).

To the east in the village of Weston four listed buildings lies approximately 1 km away from the parcel, consisting of the 13th century Grade I parish Church of All Saints (**NHLE 1179778**), and Grade II listings for a Dovecote and Adjoining Pigeoncote (**NHLE 1045942**), a sundial (**NHLE 1370001**), and a stable and pigeoncote at Sunnyside Farm House (**NHLE 1179789**).

7.2.2 Prehistoric

A few findspots of worked flints and stone are scattered across the study area, including undefined tools found in the field to the north of the survey area (**MNT322541**), a large flint flake in the river bed 1 km to the south-east (**MNT322556**), a sandstone axe-hammer

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 09/02/2023)
[11] Soil Survey of England and Wales, 1983

of late Neolithic or Early Bronze Age date 1.8 km south-west (**HER L4171**), and a scatter of Neolithic flints at Scarthing Moor 1 km to the north-east (**HER L4221**).

7.2.3 Iron Age – Roman

The is little to no evidence of Iron Age activity in the study area though there are Roman findspots; a collection of sherds found while trial trenching 1 km due south of the parcel (**MNT322529**), a small scatter of Roman pottery sherds found 1.3 km east of the parcel (**MNT322535**), and some sherds in the same riverbed investigation as the large flint flake above (**MNT322556**).

7.2.4 Medieval

There are several medieval sites in the study area including ridge and furrow, trackways, and individual dwellings and settlements. Ridge and furrow can be seen as cropmarks in fields 1.2 km east of the parcel (**MNT1380326**) and probably represent a larger medieval agricultural landscape.

Two trackways run near the parcel and are of probable medieval date, one at Infield Lane 1.6 km south-east of the parcel, now bisected by the A1 (**MNT1380324**), and Wadnall Lane 1.1 km east of the parcel (**MNT1380331**).

Two medieval dwellings are documented in the study area; Lodge Farm (**MNT1378997**) and ancient outbuilding has timber framing dating to the 15th century 1.2 km east of the parcel, and a moated site with fishponds, enclosures and a hollow way 1 km ENE (**MNT322517**). This area is a scheduled monument called Moat, three fishponds, enclosures, hollow way and part of a road at Hall Yard (**NHLE 1008247**).

The village of Weston 1 km east has origins as a nucleated medieval village that straddled the Great North Road and is of 12th century origin (**MNT1380345**), with a high likelihood of buried deposits.

7.2.5 Post-medieval

The village of Weston, 1 km east of the parcel contains a number of post-medieval buildings, some listed as mentioned above, but many others recognised as historically significant, such as the School Hall (**MNT1378962**) and Ivy House Farm (**MNT1378970**). There are also four, buildings now vacant or converted for domestic use, including a post-medieval Baptist church (**MNT1379001**).

Weston also has a set of post-medieval stocks (**MNT1380329**), a milepost (**MNT1380328**) and some field boundaries that may be planted on previous medieval hedgerows (**MNT1380317**).

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out between 12 – 14 December 2022 and covered 18.9 ha of the 25.8 ha survey area. The survey has identified an area of multiple ditched enclosures housed in a linear settling, possibly relating to a Romano-British ladder settlement.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (**Figures 4** – **7**). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (**Figure 3**).

7.3.1 Interpretation: Archaeology and Possible Archaeology

A series of positive linear and curvilinear anomalies have been identified in the western portion of Field 8 at **CHS-0001** (**Figure 7**). Most anomalies are between 2 – 3 m wide within an area 160 m long and 100 m wide, orientated broadly north – south or east – west. The collection of anomalies at **CHS-0001** are likely ditches that combine to form a larger feature. These ditches can be subdivided into areas **a** – **f**. Anomaly **a** forms the main linear ditch that all others stem from, it is 120 m long orientated NNE – SSW. Whilst **b** – **d**, to the east of **a**, consist of interconnected rectilinear ditches that likely form square enclosures of variable sizes. Linear anomaly **e** to the south is 55 m long, orientated east – west, and is likely either the remains of a larger enclosure or a defensive boundary ditch. Whilst area **f** delineates a curvilinear anomaly located internally within enclosure **b**.

Given their linear from and broadly north – south orientation, these anomalies are likely ditches associated with settlement activity of Romano-British origin. A linear assortment of multiple square enclosures such as this could be associated with a ladder settlement. The curvilinear anomaly at **f** is expected to be associated with an internal ring gully.

Along the western boundary of Field 7, a positive curvilinear anomaly has been identified at **CHS-0002** (**Figure 5**). The anomaly is 'hook-shaped' to the west, 2 m wide by 60 m long, orientated broadly north – south. It is possible that this anomaly is representative of an archaeological ditch of unknown origin. It is also possible, however, that **CHS-0002** is an enhanced agricultural trend, like similar curvilinear patterns visible on satellite mapping (Google 2023).

An assortment of positive and dipolar globular anomalies have been recorded in the southern portion of Field 7 at **CHS-0003** (**Figure 5**). The anomalies are between 1 – 6 m wide contained within an area 100 m wide by 130 m long. Given their size and variable magnetic properties it is possible that these anomalies are representative of extraction, likely associated with the Romano-British activity 100 south – west. It is also possible that these anomalies represent a build-up of magnetic material in the sub-soil as a result of modern agricultural practises.

7.3.2 Interpretation: Historical Agriculture

A number of strongly positive linear anomalies have been identified across the parcel that correlate with known former field boundaries at **CRT-0004** – **0007** (**Figures 5** and **7**). All are first recorded on 1888 OS mapping, although appear to have been removed or modified since. All are last recorded on the 1961 mapping, but no longer visible on satellite mapping dated 2002 (Google Earth 2023).

Several areas of weak, positive, parallel, linear anomalies have been identified at **CHS-0008** – **CRT-0012** (**Figures 5** and **7**). The average distance between lines is 6 m, orientated either east – west (**CRT-0008** – **CRT-0011**) or north – south (**CRT-0012**), with a slight curvature in form. These anomalies have been interpreted as areas of ridge and furrow. Given their spacing and curved form, it is possible that these anomalies are medieval in date. Like other recorded cropmarks in the east.

7.3.3 Interpretation: Modern Agriculture

Limited evidence of modern agriculture has been recorded within this survey. Some enhanced linear trends have been identified along the field boundaries, likely associated with modern ploughing generating headland areas.

7.3.4 Interpretation: Natural

Limited evidence of geological variation has been identified within the survey. A small assortment bands of low magnitude anomalies have been identified in the east of Field 8. Due to their lack of clear shape or pattern, these have been interpreted as natural

geological variations, thought to be caused by variations in the depth and composition of the soils and the superficial deposits from which they derive.

7.3.5 Interpretation: Modern

A strong linear dipolar anomaly has been identified at **CHS-0013** and **CHS-0014** (**Figure 7**). From its western extent, the anomaly runs on an east – west orientation for 245 m, before being diverted to the north-east for 265 m parallel to Field 8's extant boundary. The strong dipolar magnetic characteristics of this anomaly are indicative of a modern service.

Several thin linear anomalies have been identified in across the survey area. These anomalies are exclusively highlighted due to their either negative or dipolar magnetic properties, indicative of modern drainage.

The survey has also detected multiple isolated clusters of low magnitude and dipolar anomalies that have been interpreted as ferrous in origin. These likely relate to natural variation in the soils and background geology and are of little archaeological impact. Further examples of ferrous responses have been identified around the periphery of certain fields. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks. No evidence of increased magnetic response has been recorded across the parcel.

7.3.6 Interpretation: Unknown

A series of linear trends have been recorded across the parcel. They have been recorded as such due to their uncertain origin. Whilst the majority are expected to be modern in origin associated with agricultural activity, a possibly archaeological origin cannot be ruled out entirely. Especially those recorded in the south of the parcel in proximity to **CHS-0001**.

7.4 Preliminary Conclusions

The gradiometer survey has been successful in detecting anomalies of archaeological origin in the southern portion of the parcel.

A collection on rectilinear enclosed ditches have been identified in Field 8. These anomalies are orientated broadly north – south and expected to be associated with Romano-British occupation. The linear nature of these multiple square enclosures could be indicative of a ladder settlement. The activity also likely contains an internal ring-gully.

Two areas of possible archaeological activity have been recorded in the northern Field, as an isolated, 'hook-shaped' ditch and a collection of globular anomalies indicative of extraction. Whilst possibly archaeological in origin associated with the Romano-British activity to the south, these anomalies could also be associated with modern agricultural practices, like those in close proximity recorded on satellite mapping.

Evidence of the parcel's historical past has been recorded in the form of several former field boundaries and areas of medieval ridge and furrow. Modern services and agricultural land drains have also been recorded in the area.

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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.

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

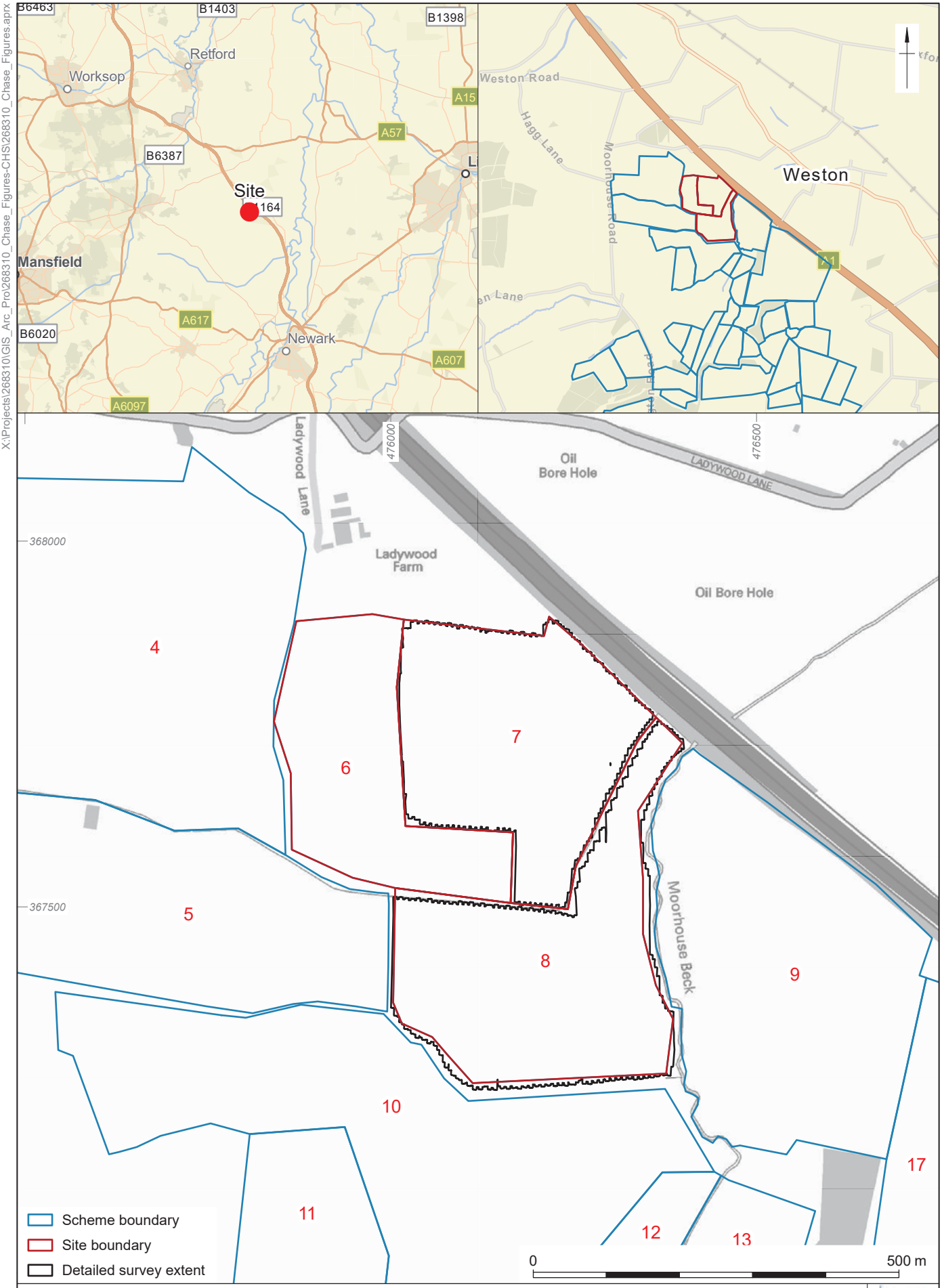
Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.



Coordinate system: OSGB 1936 British National Grid

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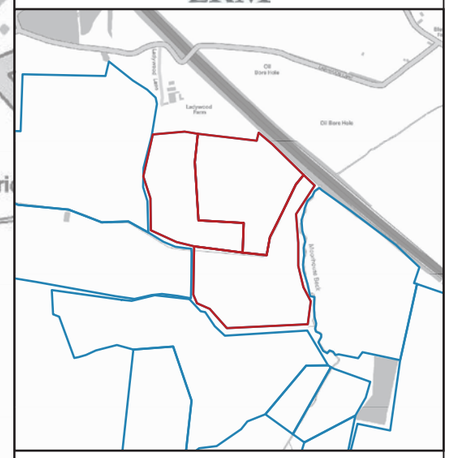
Figure 1: Site location and survey extents

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475500
476000
476500
368000
367500
367000

Oil Bore Hole
Oil Bore Hole
Oil Bore Hole
Oil Bore Hole
Ladywood Lane
LADYWOOD LANE
Ladywood Farm
Bluebell Farm
Cliff Bri
Oil B
Moorhouse Beck

Figure 4
Figure 6



Site boundary
Detailed survey extent

-2 nT
3 nT

0
250 m

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Scale: 1:5,000	Revision: 0	

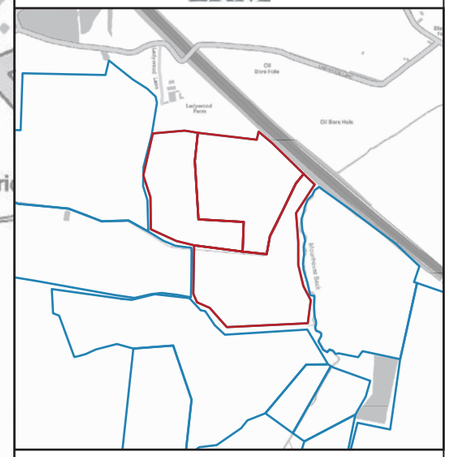
Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

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475500
476000
476500
368000
367500
367000

Oil Bore Hole
Oil Bore Hole
Oil Bore Hole
Ladywood Lane
LADYWOOD LANE
Bluebell Farm
Cliff Bri
Ladywood Farm
Oil B
Figure 5
Figure 7
Moorhouse Beck

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 250 m

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Figure 3: Detailed gradiometer survey results: overall interpretation

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Lady Wood Farm

476000

476200

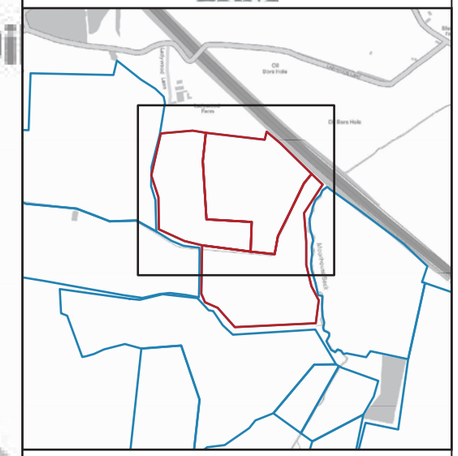
476400

367800

367600

Morhouse

ERM



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 4: Detailed gradiometer survey results: greyscale plot (7)

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Lady Wood Farm

476000

476200

476400

367800

367600

CHS-0012

CHS-0004

CHS-0008

CHS-0002

CHS-0005

CHS-0009

CHS-0014

CHS-0003

CHS-0013

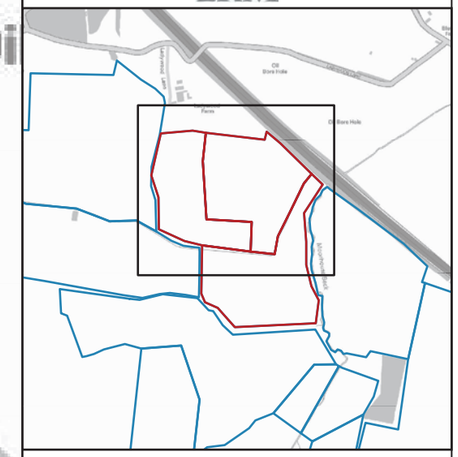
CHS-0006

CHS-0011

d

Moorhouse

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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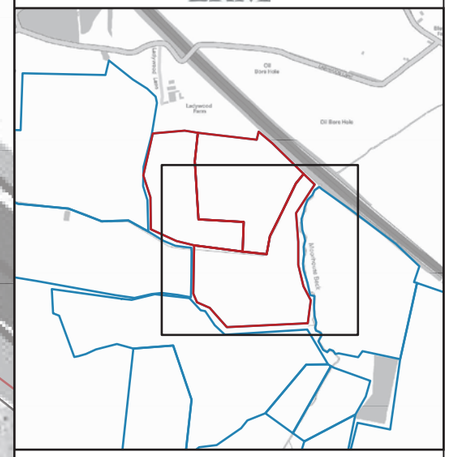
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Figure 5: Detailed gradiometer survey results: interpretation (7)

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476000
476200
476400
367600
367400

Northhouse Beck



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 6: Detailed gradiometer survey results: greyscale plot (8)

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476000
476200
476400
367600
367400

CHS-0002
CHS-0005
CHS-0009
CHS-0003
CHS-0014
HWN-0010
CHS-0013
CHS-0006
HWN-0017
CHS-0011
CHS-0001
a
b
c
d
e
f
CHS-0010
CHS-0007
Moorhouse Beck
HWN-0011
HWN-0012

ERM

Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

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Figure 7: Detailed gradiometer survey results: interpretation (8)

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE (CARLTON LAND)

CULTURAL HERITAGE REPORT NUMBER: 268310

DATE: JUNE 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l **E** erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site, north of Staythorpe between 31 January 2023 and 10 February 2023. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Carlton Land' comprises several arable and pasture fields immediately west of the village hamlet of Carlton-on-Trent. This comprises a mixture of agricultural land located north-west of Newton on Trent, covering an area of 85.7 ha.

The gradiometer survey has been successful in detecting anomalies of archaeological origin across the area, particularly the collection of possible enclosures and possibly multi-phase settlement located centrally and in the eastern portion.

Two areas of anomalies have been identified in the eastern and southern half of the area. The first group of ditches have been recorded orientated broadly north – south, consisting of a large enclosure with multiple internal divisions and roundhouses. These complex findings may be an example of multi-phased settlement activity similar to the Iron Age to Romano-British cropmarks recorded in the surrounding area. The second area is located 100 m to the south – east, consisting of a sub-rounded enclosure with a defensive boundary ditch and a possible ring-ditch. It is likely that this secondary area is an extension of the Iron Age – Romano-British settlement activity recorded to the north-east. An additional enclosure has been identified in the western half of the area, with an adjacent ring-ditch to the south-west.

Numerous linear and curvilinear anomalies of a possible archaeological origin have been identified across the area. The majority of these are too weak or isolated to offer a confident interpretation. Further anomalies of possible archaeological origin include, several possible former field boundary features and boundary ditches not recorded on OS mapping. Whilst it is possible these relate to the archaeological activity in the area, they could equally relate to natural features or modern agricultural activity.

The area's agricultural past is also evidenced by medieval ridge and furrow. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on first-edition OS mapping. Several examples of historical landscape features have also been identified in the form of several former footpaths access tracks.

There are multiple large bands of low magnitude anomalies across the south of the area. Due to their lack of coherent shape or pattern, these have been interpreted as natural geological variations. Isolated ferrous anomalies have also been identified throughout the area.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drains, and services.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of **ENT486**, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (**ENT486**, **ENT1034**, **ENT3871**, **ENT3756** and **ENT3888**).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (**ENT738** and **ENT1125**). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in **section 4.3**.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in **section 4.3** below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (**MNT5596** and **MNT11139**). The only other Palaeolithic dated material is a hand axe found 1.5 km north-west of the site (**MNT4164**).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (**MNT3597**, **MNT14748**, **MNT17094**, **MNT17127**, and **MNT8542;** NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (**MNT17099**). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (**MNT17097**, **MNT14313**, **MNT17091**, **MNT11991**, and **MNT14315**), while an isolated small riverside settlement was found near Cromwell (**MNT25849**). The Cromwell barrow cemetery also remained in use during the Iron Age (**MNT15145**). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (**MNT17089**, **MNT17090**, **MNT8243**, **MNT8265**, **MNT17098**, **MNT8290**, and **MNT14318**). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (**NHLE 1003490**), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (**MNT8243**, **MNT8265**, and **MNT17089**), including the Scheduled settlement discussed above (**NHLE 1003490**). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (**MNT11098**, **MNT11050**, **MNT11732**, **MNT11047**, **MNT8286**, **MNT2881**,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and **MNT3098**) and Kneesall (**MNT12174**, **MNT8556**, **MNT17128**, and **MNT12172**). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (**MNT14312**; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (**MNT26679**), Kelham Hall (**MNT26671**), Averham Park (**MNT26653**), Winkburn Park (**MNT26694**), and Beesthorpe Hall (**MNT26658**).

Of the parks discussed above, Averham Park falls within the site (**MNT26653**). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (**MNT14403**). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (**MNT14432**). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken between 31 January 2023 and 10 February 2023. Of the total 85.7 ha site, an overall coverage of 67.2 ha was achieved. The remaining Fields 57 and 66 were under plough, whilst 74 and 75 were under crop at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 CARLTON LAND – FIELD 51, 53 – 59, 61 – 63, 66 – 68, 70 – 71, AND 73 – 79

7.1 Site details

A detailed gradiometer survey was carried out over Fields 51, 53 – 59, 61 – 63, 66 – 68, 70 – 71, and 73 – 79, Carlton-on-Trent (centred on NGR 473052 363751) (**Figures 4 – 19**).

This survey comprises mixed arable and pasture fields. The land parcel is bisected by the north – south railway line. The fields east of the railway line (Fields 73 – 79) are bounded by the Carton-on-Trent slip road and electricity substation to the north, the railway line to the west, tree-lined field boundaries to the south leading to arable fields, and the A1 to the east. The fields west of the railway line (Fields 51, 53 – 59, 61 – 63, 66 – 68, and 70 – 71) sit within a wider complex of fields with small sections of woodland. The northern edge of Field 59 is bounded by Ossington Road.

The survey area east of the railway line is flat at 10 m aOD, spreading just west of the railway line, then inclining up to 33 m aOD at the western edge of the survey area.

The underlying geology across the survey area is recorded as mudstone of the Mercia Mudstone Group with bands of dolomitic siltstone from the Mercia Mudstone Group following major contour lines on the western side of the parcel[10]. The flat parts of the parcel at 10 m aOD east and just west of the railway line also contains superficial deposits of sand and gravel of the Holme Pierrepont Sand and Gravel Member. To the north of the parcel where the railway line meets the survey area there are superficial deposits of alluvium made up of clay, silt, sand, and gravel.

The soils underlying this survey area are likely to comprise gleyic brown earths of the Arrow (543) association to the east of the parcel, stagnogleyic argillic brown earths of the Whimple 3 (572f) association through the centre of the parcel, and typical argillic pelosols of the Worcester (431) association to the west[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed Buildings

There are two scheduled monuments within 2 km of the parcel. The first is at Wiloughby deserted medieval village (DMV), situated 700 m south of the parcel (**MNT1013884**). Whilst the second is a possible Iron Age – Romano British settlement and villa complex, 2 km south-east of the parcel (**MNT1003487**). Within the survey area, there are 2 Grade II* listed buildings and 19 Grade II listed buildings. The majority of the listed buildings are associated with either residential or agricultural dwellings dating from the 16th to the 20th century.

7.2.2 Prehistoric

Evidence of prehistoric activity in the immediate vicinity is minimal consisting only of a polished Neolithic axe head found 800 m north of Field 73 (**HER L5842**). In a wider search, cropmarks of two or possibly three ring ditches with other associated features have been identified 1.8 km north-east from the parcel (**MNT1430197**).

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 20/05/2022)
[11] Soil Survey of England and Wales, 1983

7.2.3 Iron Age – Roman

Iron Age and Roman activity is prevalent in this parcel, identified via cropmarks. The most significant area of activity is located 2 km south-east of the area consisting of multiple enclosures of different styles, showing multiple phases of occupation, round houses, and pits datable to the Iron Age, and a Roman villa overlaying the southern extent of the Iron Age settlement enclosed by a double ditch. Pottery and rooftiles have been uncovered through excavation (**MNT324520**, **MNT322663**).

Cropmarks of a triple ditched ring set within a sub-rectangular enclosure that is either of Bronze Age or Iron Age date (**MNT322689**) have been recorded 900 m north of the parcel. Most other features identified are probably Iron Age – Roman/Romano British in date including; a linear cropmark and rectangular enclosure just south of Field 79 (**MNT322713**), a pit alignment 300 m to the north-east (**MNT322708**) near a series of rectangular enclosures 800 m to the north-east (**MNT324604**), cropmarks of a possible Romano-British farmstead 700 m south-east of the parcel (**MNT322702**), another possible Iron Age – Romano-British settlement seen as cropmarks 1.2 km to the south (**MNT322715**), and some rectangular enclosures along a linear feature with a ring ditch at north end 2 km north-east of the parcel (**MNT324473**).

Roman finds in the surrounding area include colour coated greyware sherds found 500 m south-east in a possible agger of a roman road (**MNT322678**), a pottery sherd and flanged tile found 1.4 km to the south-east where the A1 now lies (**MNT322711**), and a red clay loom weight found 1.6 km WNW (**MNT324556**).

7.2.4 Medieval

The DMV of Wiloughby, 700 m south of the parcel is a scheduled monument consisting of significant earthwork remains of the village, including a square moated platform, six fishponds, and visible ridge and furrow, which probably spread further into the surrounding landscape (**MNT322658**). Evidence of further ridge and furrow has been identified as cropmarks via aerial photography, now ploughed out from modern farming 1.2 km to the north-east (**MNT1456180**) and up to 1.9 km south of the parcel (**MNT1456212**).

In 2012 gradiometer and resistivity surveys were conducted in the fields surrounding the moated site, including the field due south of Field 71. All three were found to contain evidence of ridge and furrow ploughing (**MNT26876**). The survey also identified three ponds in the fields immediately next to the moated site (**MNT26877**).

7.2.5 Post-medieval

Excavations undertaken in the 1940s revealed post-medieval pottery and slate from the moated site at Wiloughby DMV, suggesting continued use for slightly longer than the life of the rest of the village.

Hill Farm, located just south-west of Field 51 contains a number of redbrick farm buildings, barns, and a cobbled yard, in use by at least 1835 (**HER M17695**).

The discontinued Crow Park train station at Sutton-on-Trent was opened in 1850 and closed entirely in 1964. This lies 2 km north of the parcel (**MNT508992**), while the station at Carlton-on-Trent lies 600 m north-east, was built in 1855, and closed in 1955 (**MNT509021**).

Excavations at 12 Main Street, Sutton-on-Trent in 1992 found post-medieval finds and features including a drain, well, pit, and post hole[12].

[12] Spence, U, 1992, Site Inspection Report - 12 Main Street, Sutton on Trent

Brick kilns, present by 1836, are visible in the garden of a house called Castlehill, just north of the survey area, though there is no evidence of a castle in this location (**HER M4235**). The house is set within medieval ridge and furrow. Other occupations are present through the remains of buildings such at the Malthouse 1.2 km east of the parcel in Carlton-on-Trent (**HER M4309**), a riverbank warehouse next to Carlton Mill (**HER M17635**), as well river control methods still in place on the River Trent running past Carlton-on-Trent such as two sluice gates (**HER L6652**, **L6653**) and flood defences (**HER M6538**, **L6654**).

According to first edition OS mapping, Field 73 was formerly occupied by a woodland area associated with Carlton Hall. This woodland was last recorded in 1961 and is no longer visible on satellite imagery dated in 2002.

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out between 31 January 2023 and 10 February 2023 and covered 67.3 ha of the 85.7 ha survey area. The survey has identified anomalies of archaeological origin, likely pertaining to multi-phase settlement activity and associated enclosures.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (**Figures 4** – **19**). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (**Figure 3**).

7.3.1 Interpretation: Archaeology and Possible Archaeology

A series of strongly positive rectilinear and penannular anomalies have been identified in the eastern half of the area in Field 76 at **CRT-0001** (**Figure 17**). The anomalies are between 1 – 3 m wide confined to an area 70 m wide by 90 m long, broadly orientated north – south. The majority of anomalies are aligned on a coaxial orientation, trending either east – west or north – south. These anomalies are likely ditches combining to form a larger enclosure with internal divisions. The four penannular anomalies at **a** – **d** are located internally within these divisions, between 1 – 2 m wide. Anomalies **a** – **c** are positioned within in the smaller partitions and are 8 – 12 m in diameter. Whilst **d** is housed centrally in the larger southern section, with a larger 23 m diameter.

Due to **CRT-0001**'s rectilinear form and broadly north – south orientation, the collection of ditches is likely to represent a Romano-British enclosure with multiple internal divisions. The internal penannular anomalies are the correct form and size to represent the remains of drip gullies associated with round houses. This kind of feature, however, is usually associated with the Iron Age. These complex findings may therefore be an example of multi-phased settlement activity similar to the Iron Age to Romano-British cropmarks recorded to the east in Cromwell.

Several curvilinear anomalies have been recorded in the south of the parcel in Field 71 at **CRT-0002** (**Figure 13**). The collection of anomalies are orientated broadly north – south over an area 40 m wide by 70 m long. The anomalies are 2 m wide, likely the remains of ditches and can be sub-divided into three areas at **a** – **c**. Area **a** comprises anomalies of the strongest positive magnetic properties vaguely forming either a square or stepped form, with additional anomalies continuing to the north and south. Area **b** is a reverse L-shaped linear 30 m long, orientated north-south and then east-west. Finally, area **c** outlines a possible penannular anomaly with an almost complete circumference of 30 m, with a slight break to the north.

Given their shape and strong magnetic properties it is possible that **CRT-0006** reflect the remains of ditches associated with settlement activity, likely related to **CRT-0001** 100 m north-east. Area **a** could represent a sub-rounded enclosure, with **b** forming a boundary ditch, and **c** a possible ring-ditch.

In the central portion of the parcel, a collection of linear and rectilinear anomalies has been recorded in Field 62 at **CRT-0003** (**Figure 9**). The anomalies are 2 – 3 m wide and orientated either north – south or east – west. It is likely that these anomalies are ditches that once connected to form a 65 m square-shaped enclosure. The north-eastern anomaly appears to form a double ditched feature, different to the other supporting anomalies, possibly related to a defensive feature. Given its orthogonal form and square-shape this enclosure is likely to be Romano-British in origin.

Immediately south-west of **CRT-0003** is a faint penannular anomaly at **CRT-0004** (**Figure 9**). This anomaly is 2 m wide with an almost complete circumference of 30 m, with a slight break in the north-east. Given its size and form it is possible that **CRT-0004** is a ring-ditch, with the break in the north-east possibly representing an opening. If it is a ring-ditch, it may relate to a Bronze Age barrow or Iron Age round house. However, given the weak nature of the anomaly, it could equally relate to geomorphological activity or modern agricultural practises.

Four positive, linear anomalies have been identified in Field 59 at **CRT-0005** (**Figure 9**). The anomalies are 1 m wide and orientated east – west. The anomalies are of varying lengths between 30 – 70 m long. While these may relate to archaeological ditch features, they share a similar alignment with modern agricultural activity, so are considered more likely to be associated with this.

In the north-eastern corner of Field 62 a strongly positive linear anomaly has been identified at **CRT-0006** (**Figure 9**). The anomaly is 3 m wide and 60 m long, orientated broadly north – south, with a small east – west diversion towards its southern end. It is possible that **CRT-0006** represents a ditch of unknown origin. Given its proximity and similar orientation to the extant field boundary to the east, however, it is more likely to be associated with modern agricultural activity. The anomaly could be representative of an enhanced agricultural trend linked to headland ploughing, although an archaeological origin cannot be ruled out entirely.

A strongly magnetic linear anomaly has been identified parallel to the eastern boundary of the parcel in Field 73 at **CRT-0007** (**Figure 15**). The linear is 5 m wide and 200 m long, orientated north-west to south-east. It is possible that this anomaly is a ditch of archaeological origin. Given its strong, almost ferrous-like magnetic properties, however, it is more likely that **CRT-0007** reflects a former access track not recorded on OS mapping.

In the southern end of the parcel, a positive linear anomaly has been identified in Field 79 at **CRT-0008** (**Figure 19**). The anomaly is 3 m wide by 130 m long, orientated east – west. The anomaly could be a ditch of unknown archaeological origin; however, it could also be an enhanced agricultural trend or former field boundary not recorded on first-edition mapping.

A faint, isolated, semi-circular anomaly 1 m wide by 20 m long has been identified in the western portion of the parcel in Field 56 at **CRT-0009** (**Figure 7**). The anomaly is horse-shoe shaped and could possibly represent the northern half of a ring-ditch of unknown origin. Given **CRT-0009**'s weak magnetic properties and isolation from any other archaeological activity, it is likely that the anomaly is geomorphological in origin.

7.3.2 Interpretation: Historical Agriculture

A trio of former field boundaries have been identified in the south-eastern portion of the parcel at **CRT-0010** – **0012** (**Figure 17**). All are first recorded on 1888 OS mapping, although appear to have been removed or modified at different periods since. In Field 76, former boundaries **CRT-0010** and **CRT-0011** are still recorded on the 1961 OS mapping but no longer visible on satellite mapping dated 2002 (Google Earth 2023). Whilst in Field 78 **CRT-0012** is last visible on 1914 OS mapping.

Several former paths and tracks have also been identified as historical landscape features in Fields 62, 63, and 73 at **CRT-0013** – **0016** (**Figure 17**). Features **CRT-0013** and **0014** were both recorded on 1888 OS mapping. Whilst anomaly **CRT-0015** was not recorded on OS mapping, is likely to be a continuation of **CRT-0013** and **CRT-0014** to the east as it follows a similar trajectory containing similar magnetic properties. Anomaly **CRT-0016**, is visible as an access track on satellite mapping dated in 2018 (Google 2023).

Two areas of weak, positive, parallel, linear anomalies have been identified at **CRT-0017** – **CRT-0018** (**Figures 17** and **19**). The average distance between lines is 8 m, orientated east – west, with a slight curvature in form. These anomalies have been interpreted as areas of ridge and furrow. Given their spacing and curved form, it is possible that these anomalies are medieval in date.

7.3.3 Interpretation: Modern Agriculture

Evidence of modern agriculture has been recorded across the parcel as enhanced linear trends. The majority of these trends are likely associated with modern ploughing.

7.3.4 Interpretation: Natural

There are multiple large bands of low-magnitude anomalies across the south of the parcel. Due to their lack of clear shape or pattern, these have been interpreted as natural geological variations, thought to be caused by variations in the depth and composition of the soils and superficial deposits. The most dominant example of this can be seen in Field 79 (**Figure 19**). Some more isolated and coherent geomorphological anomalies such as paleochannels, hollows and former higher grounds have also been identified across the parcel.

7.3.5 Interpretation: Modern

Several negative linear trends have been identified a across the parcel in Fields 59, 71, 73, and 76 (**Figures 9**, **13**, **15**, and **17**). Due to their straight form and negative magnetic properties, these have been interpreted as modern land drains.

Numerous small, isolated, dipolar anomalies have been recorded throughout the survey, typically caused by ferrous material, either on the ground surface or in the plough-soil. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil. Further examples of ferrous responses have been identified around the periphery of certain areas. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks.

Four magnetically strong dipolar linear anomalies are present within this survey at **CRT-0019** – **CRT-0022** (**Figures 9** and **17**). They are on a variety of orientations, surrounded by ferrous disturbance. These anomalies are all indicative of modern services, such as pipes or cables.

7.3.6 Interpretation: Unknown

Isolated linear and curvilinear have been recorded in the eastern portion of the parcel. These anomalies are of unknown origin, due to their faint magnetic properties. It is possible that some may be associated with archaeological features, when identified in close proximity. The majority, however, are likely geological in origin or the result of modern agricultural practises.

7.4 Preliminary Conclusions

The gradiometer survey has been successful in detecting anomalies of archaeological origin across the parcel, particularly the collection of possible enclosures and possibly multi-phase settlement located centrally and in the eastern portion.

Two areas of anomalies have been identified in the eastern and southern half of the parcel. The first group of ditches have been recorded orientated broadly north – south, consisting of a large enclosure with multiple internal divisions and roundhouses. These complex findings may be an example of multi-phased settlement activity similar to the Iron Age to Romano-British cropmarks recorded in the surrounding area. The second area is located 100 m to the south – east, consisting of a sub-rounded enclosure with a defensive boundary ditch and a possible ring-ditch. It is likely that this secondary area is an extension of the Iron Age – Romano-British settlement activity recorded to the north-east. An additional enclosure has been identified in the western half of the parcel, with an adjacent ring-ditch to the south-west.

Numerous linear and curvilinear anomalies of a possible archaeological origin have been identified across the parcel. The majority of these are too weak or isolated to offer a confident interpretation. Further anomalies of possible archaeological origin include, several possible former field boundary features and boundary ditches not recorded on OS mapping. Whilst it is possible these relate to the archaeological activity in the area, they could equally relate to natural features or modern agricultural activity.

The parcel's agricultural past is also evidenced by medieval ridge and furrow. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on first-edition OS mapping. Several examples of historical landscape features have also been identified in the form of several former footpaths access tracks.

There are multiple large bands of low magnitude anomalies across the south of the parcel. Due to their lack of coherent shape or pattern, these have been interpreted as natural geological variations. Isolated ferrous anomalies have also been identified throughout the parcel.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drains, and services.

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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.

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

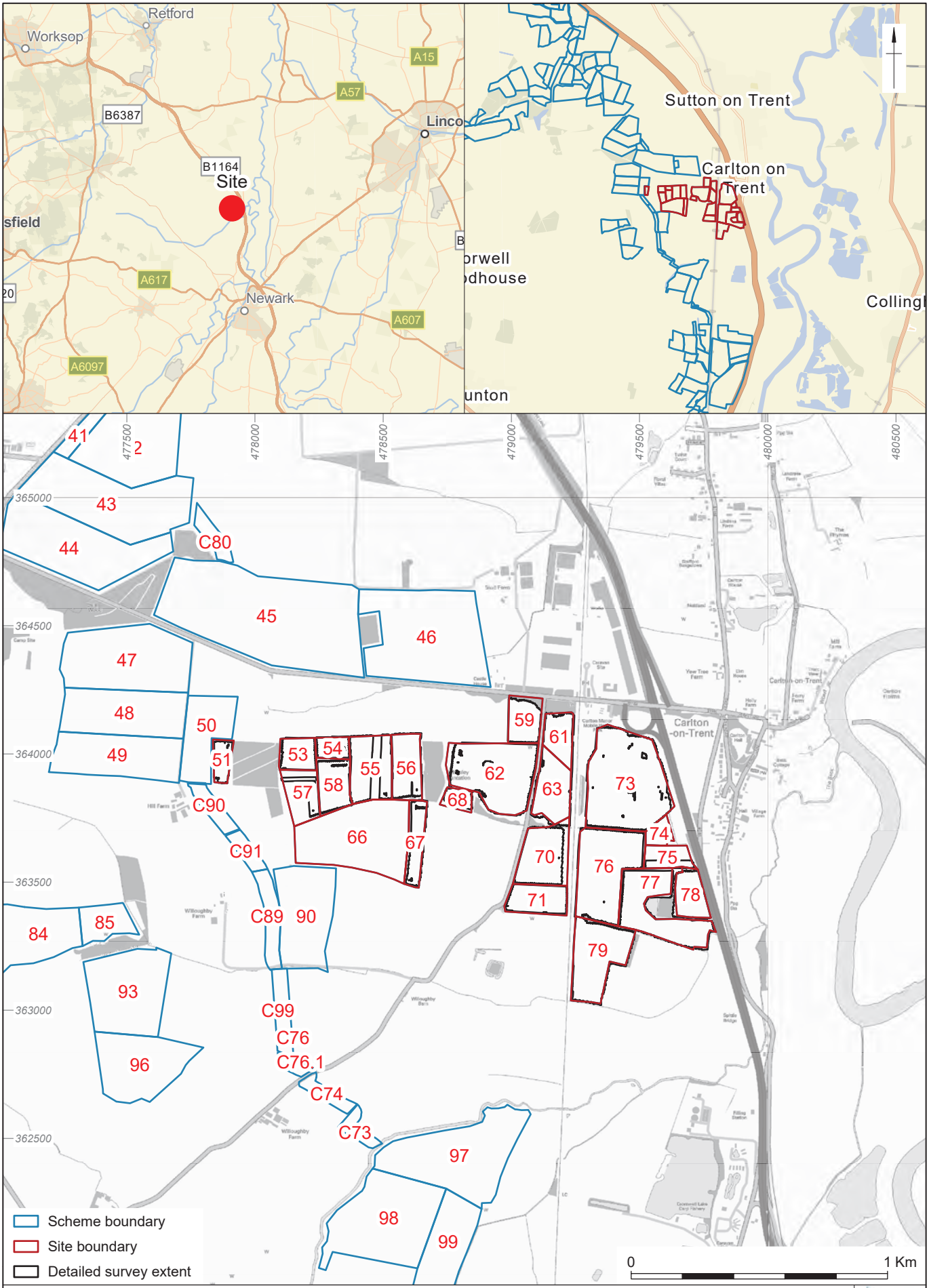
Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.



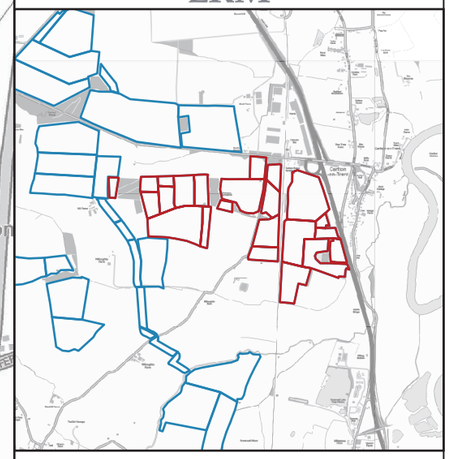
Coordinate system: OSGB 1936 British National Grid
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Figure 1: Site location and survey extents

X:\Projects\2268310\GIS_Arc_Pro\2268310_Carlton_Figures-CRT\2268310_Carlton_Figures.aprx

ERM



Site boundary

Detailed survey extent

-2 nT 3 nT

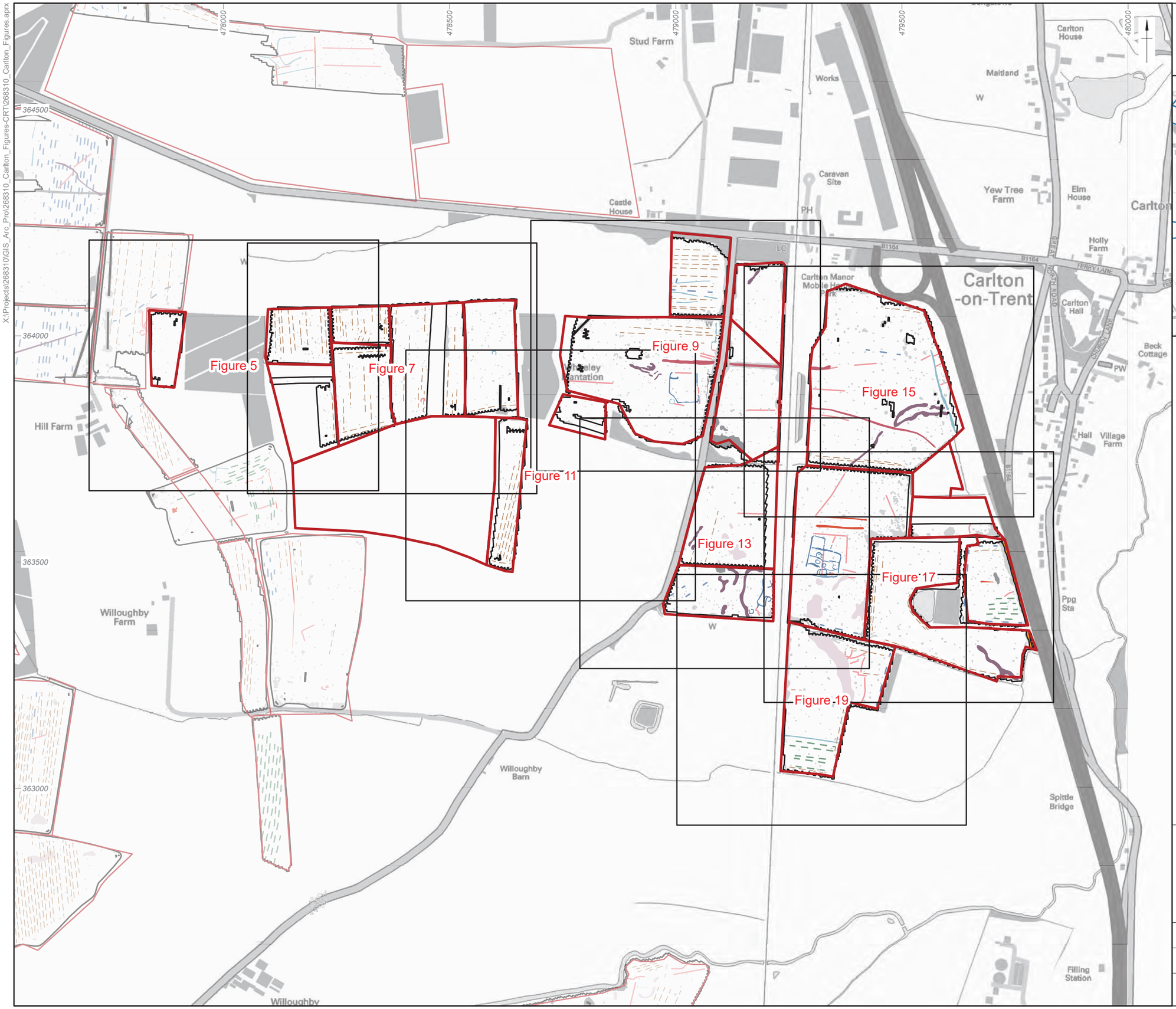
0 250 m

Coordinate system: OSGB 1936 British National Grid
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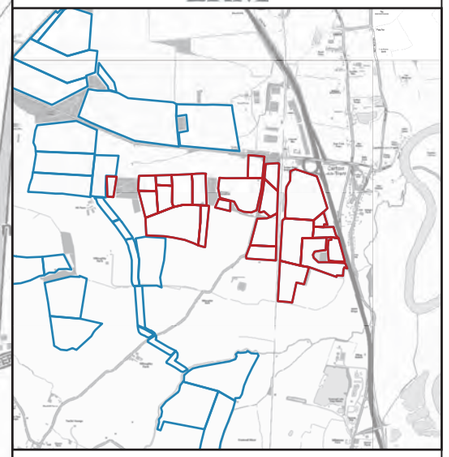
Date: 05/07/2023	Created by: ADT	
Scale: 1:8,000	Revision: 0	

Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

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ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 250 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:8,000	Revision: 0	

Figure 3: Detailed gradiometer survey results: overall interpretation

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364200

477800

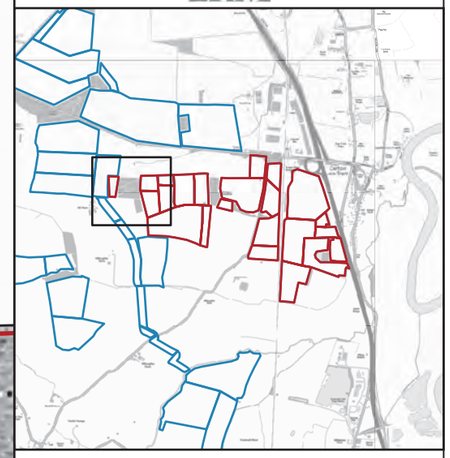
478000

478200

W

364000

363800



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000 | Revision: 0

Figure 4: Detailed gradiometer survey results: greyscale plot (51 - 53)

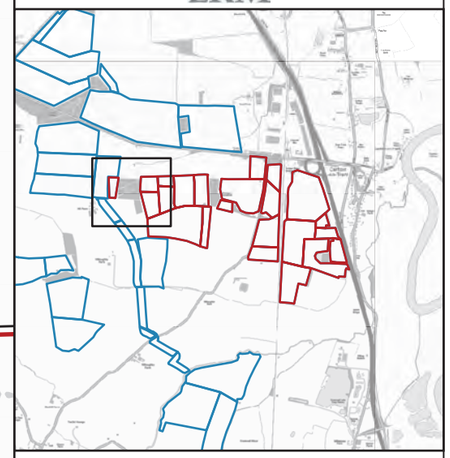
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477800
478000
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W

JKN-0044
JKN-0049
JKN-0011
JKN-0039
JKN-0027

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 5: Detailed gradiometer survey results: interpretation (51 -53)

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364200

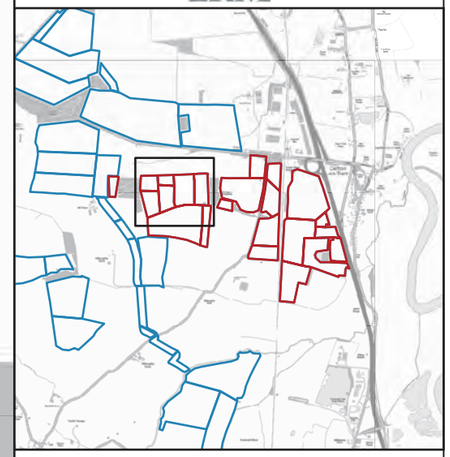
478200

478400

478600

364000

363800



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0	

Figure 6: Detailed gradiometer survey results: greyscale plot (53 - 57)

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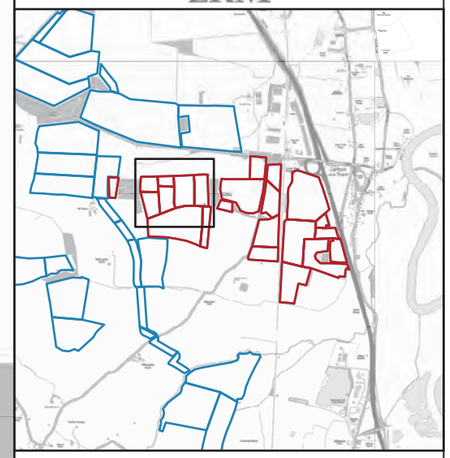
478600

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363800

CRT-0009

JKN-0027



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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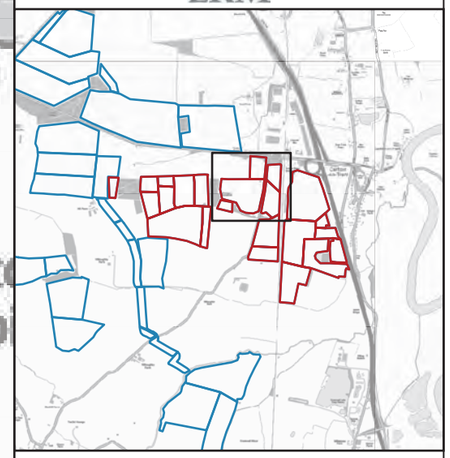
Figure 7: Detailed gradiometer survey results: interpretation (53 - 57)

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479000
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364200
364000
363800

LC

Carlto
Mobi



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0	

Figure 8: Detailed gradiometer survey results: greyscale plot (59 - 63)

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LC

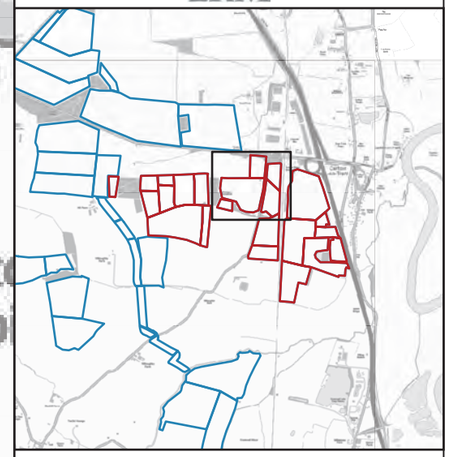
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CRT-0019
CRT-0006
CRT-0015
CRT-0013
CRT-0003
CRT-0004

Whiteley Plantation

Carlto
Mob

W

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 9: Detailed gradiometer survey results: interpretation (59 - 63)

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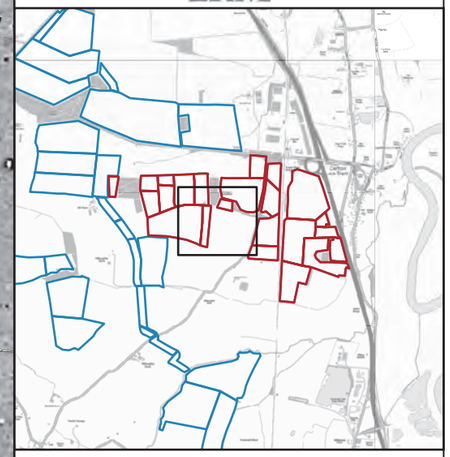
478600

478800

479000

363800

363600



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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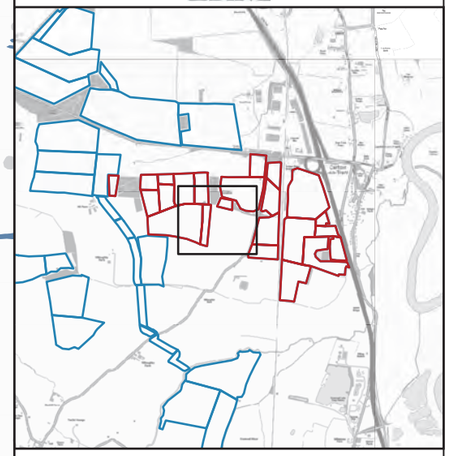
Scale: 1:2000 | Revision: 0

Figure 10: Detailed gradiometer survey results: greyscale plot (67 - 68)

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ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 11: Detailed gradiometer survey results: interpretation (67 - 68)

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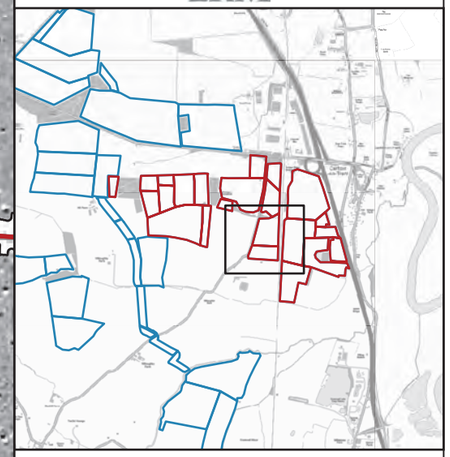
479200

479400

363600

363400

W



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 12: Detailed gradiometer survey results: greyscale plot (70 - 71)

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478800

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479200

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363600

363400

CRT-0010

CRT-0011

CRT-0001

CRT-0002

CRT-0022

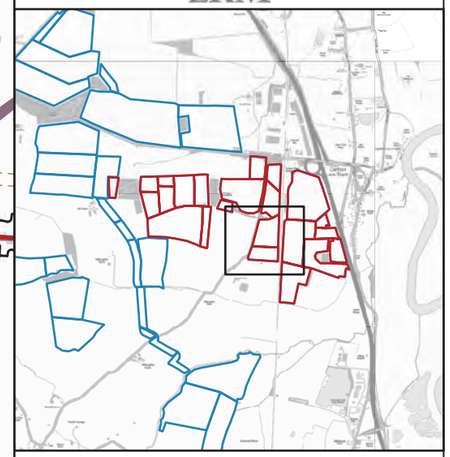
a

b

c

d

W



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

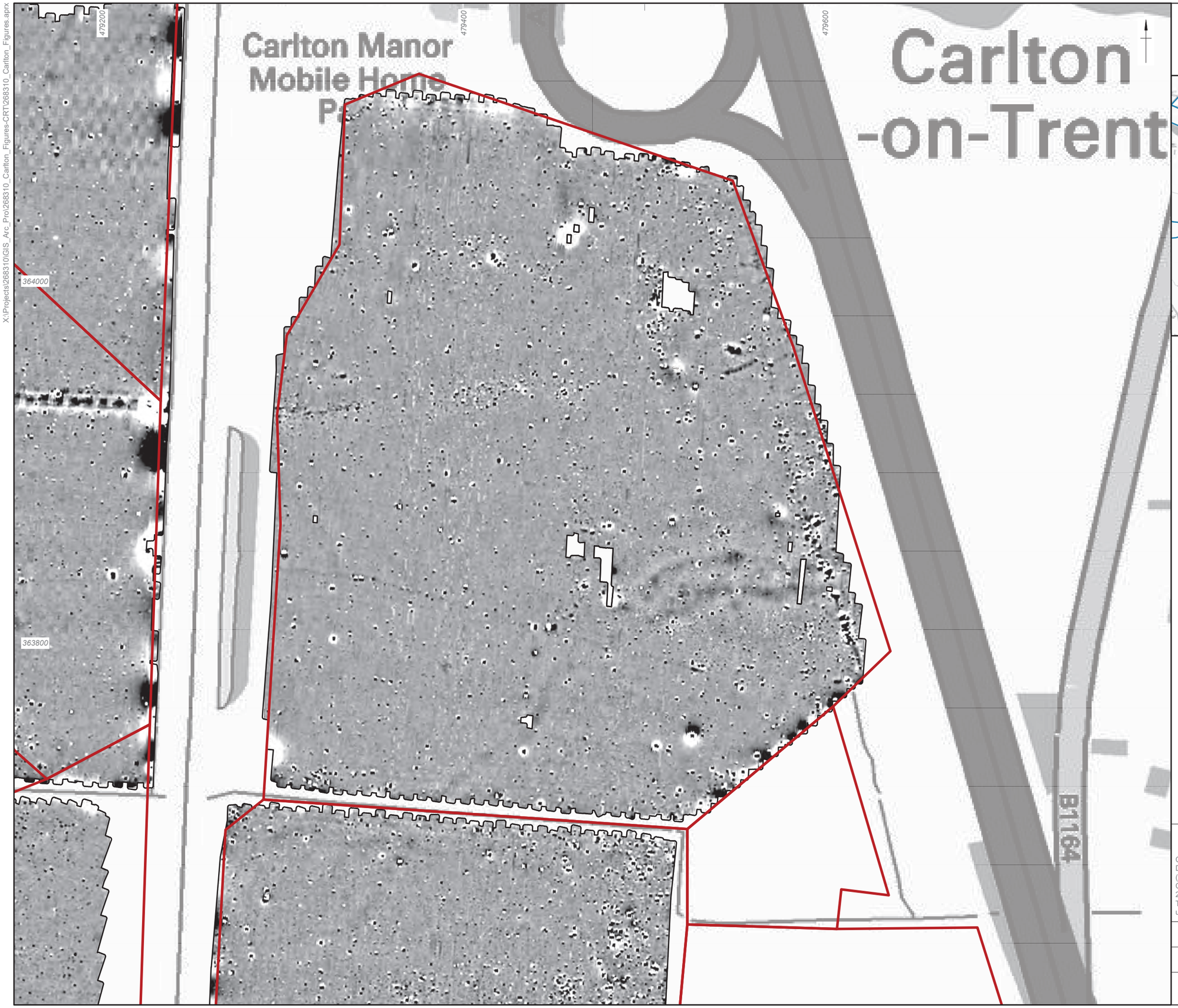
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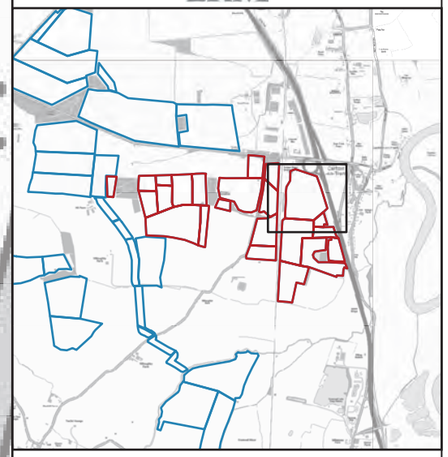
Date: 05/07/2023 | Created by: ADT

Scale: 1:2000 | Revision: 0

Figure 13: Detailed gradiometer survey results: interpretation (70 - 71)

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Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

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Figure 14: Detailed gradiometer survey results: greyscale plot (73 - 75)

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Carlton Manor Mobile Home Park

Carlton -on-Trent

479200

479400

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363800

CRT-0013

CRT-0014

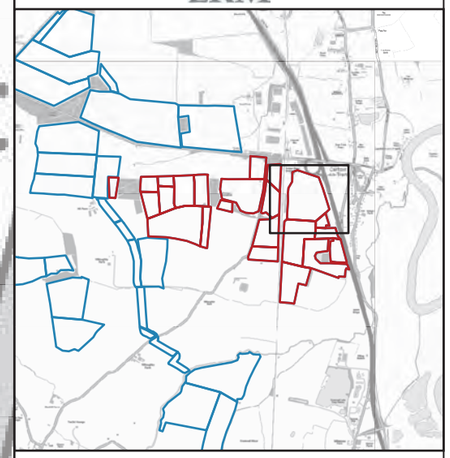
CRT-0007

CRT-0016

CRT-0010

B1164

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 15: Detailed gradiometer survey results: interpretation (73 - 75)

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479400

479600

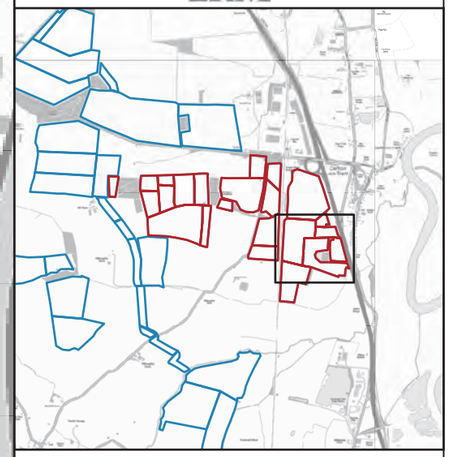
479800

B1164

363600

363400

363200



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0

Figure 16: Detailed gradiometer survey results: greyscale plot (75 - 78)

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479400
479600
479800
363600
363400
363200

B1164

CRT-0010
CRT-0011
CRT-0001
CRT-0012
CRT-0020
CRT-0017
CRT-0022
CRT-0021

a
b
c
d
b
a

ERM

Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000 | Revision: 0

Figure 17: Detailed gradiometer survey results: interpretation (75 - 78)

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479200

479400

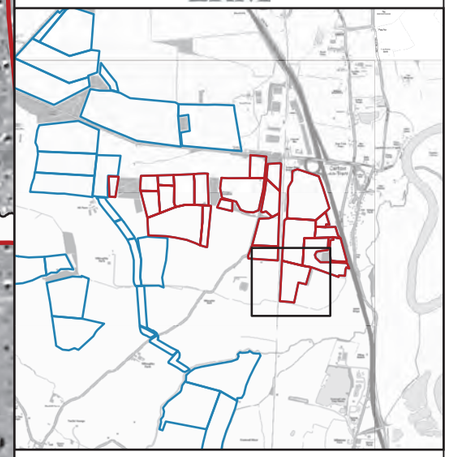
479600

363400

W

363200

363000



Site boundary

Detailed survey extent

-2 nT

3 nT

0

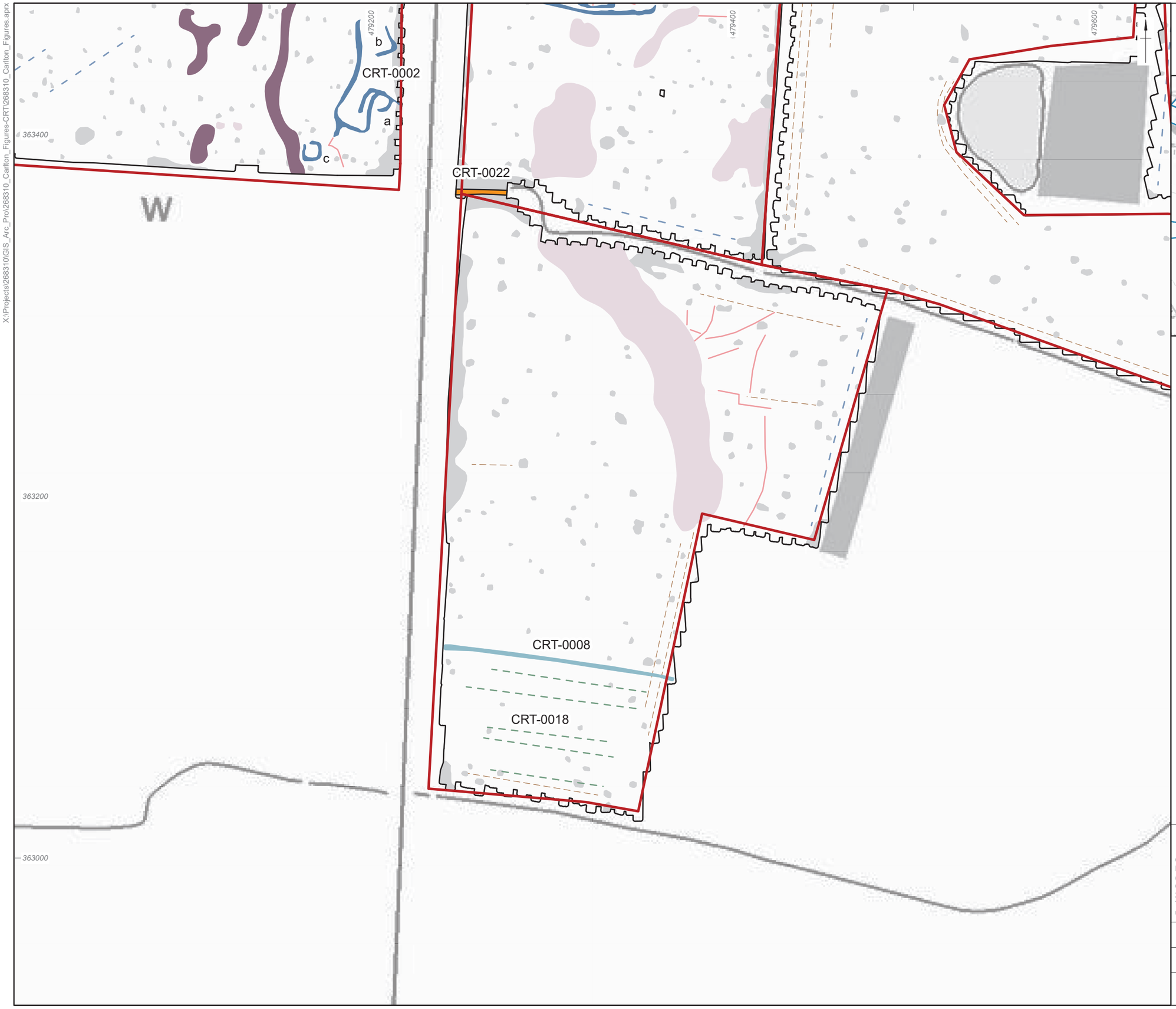
50 m

Coordinate system: OSGB 1936 British National Grid
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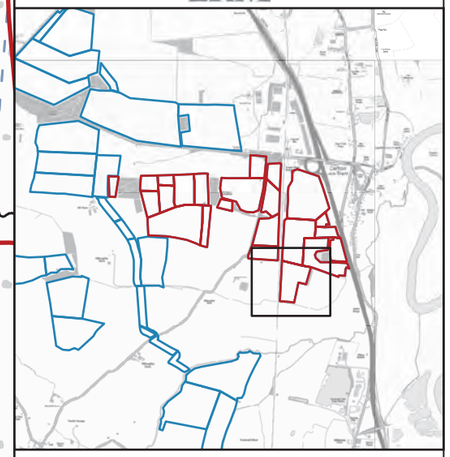
Date: 05/07/2023	Created by: ADT
Scale: 1:2000	Revision: 0

Figure 18: Detailed gradiometer survey results: greyscale plot (79)

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ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0

Figure 19: Detailed gradiometer survey results: interpretation (79)

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE

CULTURAL HERITAGE REPORT NUMBER: 268310

DATE: JUNE 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l **E** erm.information@erm.com
w www.erm.com

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site, north of Staythorpe over multiple deployments on 22 November 2022, 04 – 05 and 16 January 2023. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Burnett Land' comprises several arable and pasture fields immediately west of the village hamlet of Little Carlton. This comprises a mixture of agricultural land located north-west of Newton on Trent, covering an area of 6.6 ha.

The gradiometer survey has not been successful in detecting anomalies of archaeological or possible archaeological origin across the site. One former field boundary has been identified, as well as traces relating to modern agriculture such as ploughing and drainage.

Modern disturbances caused by modern services are identifiable in two areas across the site, including two areas of increased response caused by the presence of pylons just outside the survey area.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of **ENT486**, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (**ENT486**, **ENT1034**, **ENT3871**, **ENT3756** and **ENT3888**).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (**ENT738** and **ENT1125**). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in **section 4.3**.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in **section 4.3** below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (**MNT5596** and **MNT11139**). The only other Palaeolithic dated material is a hand axe found 1.5 km north-west of the site (**MNT4164**).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (**MNT3597**, **MNT14748**, **MNT17094**, **MNT17127**, and **MNT8542;** NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (**MNT17099**). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (**MNT17097**, **MNT14313**, **MNT17091**, **MNT11991**, and **MNT14315**), while an isolated small riverside settlement was found near Cromwell (**MNT25849**). The Cromwell barrow cemetery also remained in use during the Iron Age (**MNT15145**). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (**MNT17089**, **MNT17090**, **MNT8243**, **MNT8265**, **MNT17098**, **MNT8290**, and **MNT14318**). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (**MNT8243**, **MNT8265**, and **MNT17089**), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (**MNT11098**, **MNT11050**, **MNT11732**, **MNT11047**, **MNT8286**, **MNT2881**,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and **MNT3098**) and Kneesall (**MNT12174**, **MNT8556**, **MNT17128**, and **MNT12172**). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (**MNT14312**; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (**MNT26679**), Kelham Hall (**MNT26671**), Averham Park (**MNT26653**), Winkburn Park (**MNT26694**), and Beesthorpe Hall (**MNT26658**).

Of the parks discussed above, Averham Park falls within the site (**MNT26653**). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (**MNT14403**). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (**MNT14432**). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken over multiple deployments on 22 November 2022, 04 – 05 and 16 January 2023. Of the total 6.6 ha site, an overall coverage of 6 ha was achieved, with small patches of the site deemed unsuitable for survey at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 BURNETT LAND - FIELD C126-C127, C132-C134 AND C136

7.1 Site details

A detailed gradiometer survey was carried out over Fields C126, C127, C132, C133, C136, and C137, surrounding Manor House Farm in Little Carlton (centred on NRG 477559 357732) (**Fig. 4 – 7**).

This survey comprises five arable and one pasture field. The survey area is bounded by the A616 at its southern extent, the junction of Bathley Lane and Crow Lane at its north eastern extent, Manor House Farm and its associated agricultural buildings to its south-east and east, and further arable fields to its north and west.

The survey area is relatively flat, the majority of the parcel being at between 12 – 13 m aOD. At its southern end the ground rises up towards the A616 from 13 m aOD to 19 m aOD.

The underlying geology across the survey area is recorded as Mudstone of the Mercia Mudstone Group. Superficial deposits of sand and gravel of the Holme Pierrepont Sand and Gravel Member are recorded across the majority of the parcel, with a narrow band of alluvium recorded running north to south through the west of Field 126[10].

The soils underlying this survey area are likely to comprise gleyic brown earths of the Arrow (543) association in Fields C126 and C133, peloalluvial gley soils of the Compton (813e) association in Field C136, and stagnogleyic argillic brown earths of the Whimple 3 (572f) association[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Prehistoric

A Bronze Age barrow cemetery (**MNT17094**) is located 350 m to the north of Field C126 and comprises four barrows identified via aerial photography. Immediately to the east of this parcel are enclosures and pit alignments (**MNT8262** and **MNT8264**) however these are undated.

Several Mesolithic-Neolithic find spots have been recorded in the immediate vicinity of the survey area. One, consisted of 13 worked flints (**MNT10989**), 290 m to the south of Field C137.

7.2.2 Iron Age to Roman

A settlement (**MNT14313**) including rectangular enclosures, pits, a hut circle, double ring ditch, and pit alignment was identified 290 m to the south of Field C137 via aerial photography. A scatter of Roman pottery was found close by.

7.2.3 Roman

In the east of Field C126 Roman enclosures, including a double ditched enclosure, linear features as well as pit alignments and numerous pottery sherds (**MNT8265**) were identified in trenching.

In Field 127, enclosures and a ring ditch (**MNT8243**) were identified from a combination of aerial photography and magnetic survey. Excavation found ditches and Roman pottery. Roman pottery has also been found in the fields in the immediate vicinity of the survey area including immediately to the east of Field C136 (**MNT10681**).

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[11] Soil Survey of England and Wales, 1983

7.2.4 Medieval

Immediately to the south and east of the survey area are the two scheduled monuments of Little Carlton medieval village and part of the meadow field system (**NHLE 1019870**), containing an earthwork and buried remains. The village was first mentioned in the Domesday survey of 1086 and the remains contain a rectangular enclosures or crofts, a hollow way, ponds and water management banks, and ditches. Medieval pottery has been found in Field C136 (**MNT8245**) and in fields in the immediate vicinity.

7.2.5 Post-medieval

The Grade II listed 18th century Manor Farm Cottages (**NHLE 1301913**) are located 285 m to the east of Field C136. A post-medieval animal burial was found in Field C136 (**MNT10725**). The site of an old brickyard (**MNT14403**) is located 125 m south of Field C137.

7.2.6 Undated

In Field C132 and C133 a cropmark complex was identified via aerial photography (**MNT8244**) and subsequently surveyed and excavated revealing post-holes, pits, ring ditches, and various linear ditches. A record (**MNT8246**) for undated linear ditched features and a ring ditch is located within Field C136.

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out over multiple deployments on 22 November 2022, 04 – 05 and 16 January 2023and covered 6.04 ha of the 6.59 ha survey area. The survey has identified no features of archaeological or possible archaeological origin.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (**Figures 4 – 7**). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (**Figure 3**).

7.3.1 Interpretation: Archaeology and Possible Archaeology

The geophysical survey has not identified any anomalies thought to relate to archaeological or possible archaeological activity.

7.3.2 Interpretation: Historical Agriculture

One former field boundary has been identified within the survey area at **BNR-0001** (**Figure 5**), in Field C126, as a fragmentary dipolar anomaly. This anomaly runs on a broadly north – south alignment, 5 m wide by 55 m long. The field boundary is recorded on OS mapping from 1888 – 1961 but is no longer visible by the time that satellite imagery was taken of the area in 2000 (Google 2023).

7.3.3 Interpretation: Modern Agriculture

Limited evidence pertaining to modern agriculture has been identified within the survey. In Field C137 several weakly positive linear anomalies have been recorded, thought to be representative of modern ploughing.

7.3.4 Interpretation: Natural

Limited evidence of geological variation has been identified within the survey. Only a weakly positive linear trend has been recorded in Field C126, 6 m wide by 49 m long. This trend could possibly be related to a paleochannel or modern agricultural drainage.

7.3.5 Interpretation: Modern

Several examples of modern intervention are visible across the survey area. A strong linear dipolar anomaly has been identified at **BNR-0002** (**Figure 5**). This anomaly runs parallel to the edge of Fields C126 and C127, on a WNW – ESE alignment. In Field C126, the anomaly is 25 m long, and is 85 m long in Field C127. The strong dipolar magnetic characteristics of this anomaly are indicative of a modern service.

Two areas of increased magnetic response have been identified in fields C127 and C136 at **BNR-0003** and **BNR-004** (**Figure 5** and **Figure 6**). This response is thought to result from the presence of two pylons, one to the west of **BNR-0003** and one to the north of **BNR-0004**.

A number of drains are identifiable across the survey area as dipolar or weakly positive linear anomalies. These are best expressed in Fields C133 and C136.

The survey has also detected multiple isolated clusters of low magnitude and dipolar anomalies that have been interpreted as ferrous in origin. These likely relate to natural variation in the soils and background geology and are of little archaeological impact. Further examples of ferrous responses have been identified around the periphery of certain areas, particularly in Field C126. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks.

7.3.6 Interpretation: Unknown

Several trends have been observed across the survey area, particularly in Fields C132, C127, and C126. These are likely a result of modern agricultural practices but given the wealth of archaeological activity recorded in the area, and possibly archaeological origin cannot be ruled out entirely.

7.4 Preliminary Conclusions

The gradiometer survey has not been successful in detecting anomalies of archaeological or possible archaeological origin across the area. One former field boundary has been identified, as well as modern agriculture such as ploughing and drainage.

Modern disturbances caused by modern services are identifiable in two areas across the parcel, including two areas of increased response caused by the presence of pylons just outside the survey area.

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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)

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

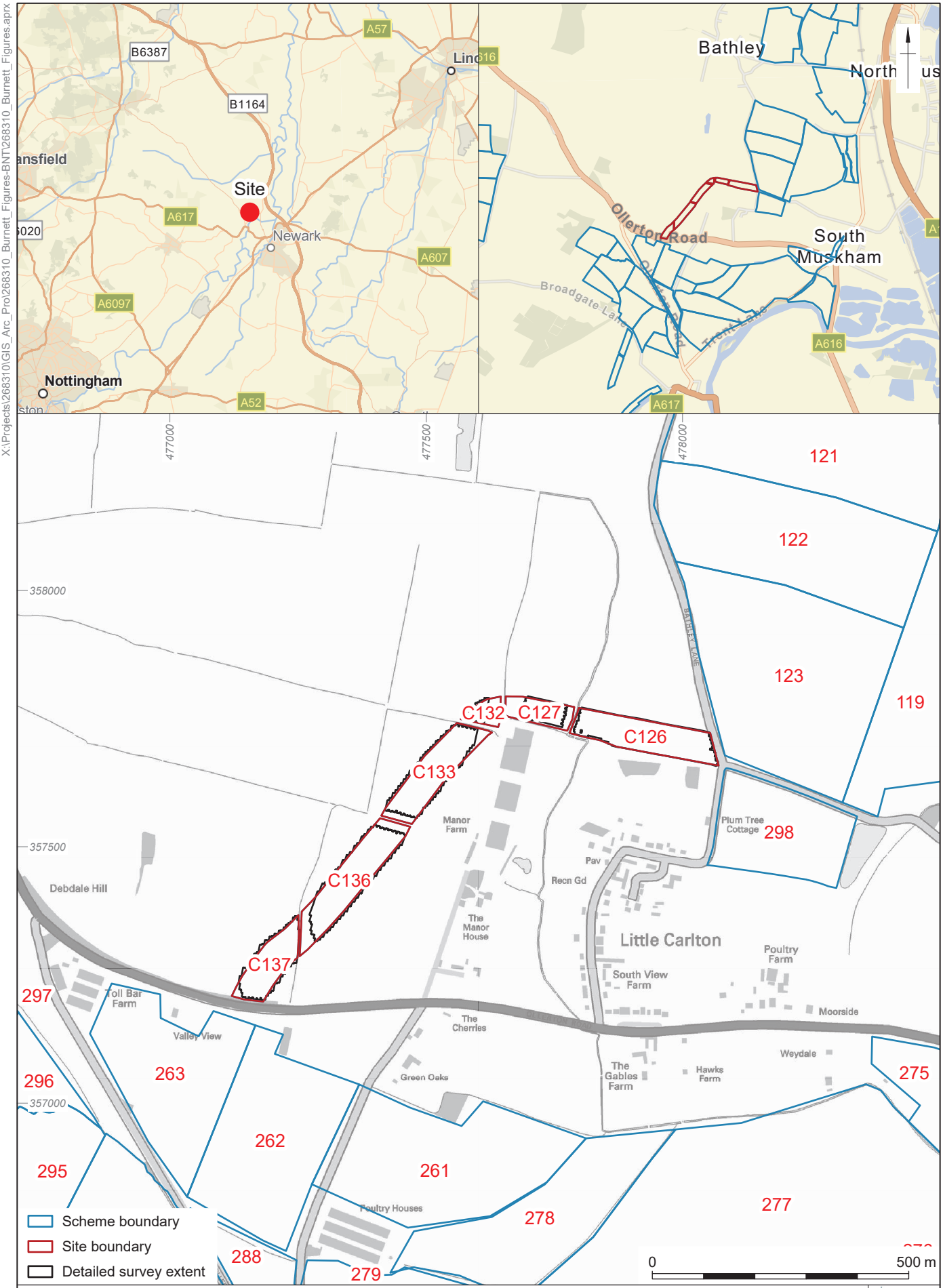
Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.



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Figure 1: Site location and survey extents

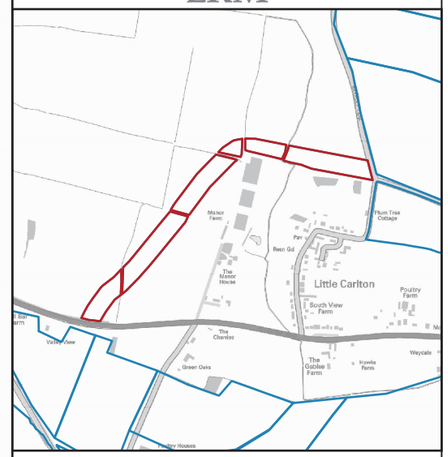
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477000
477500
478000
358000
357500
357000

BATTLEY LANE
OLLERTON ROAD

Figure 4
Figure 6

Manor Farm
Plum Tree Cottage
Pav
Recn Gd
The Manor House
Little Carlton
Poultry Farm
South View Farm
The Cherries
Valley
Green Oaks
The Gables Farm
Hawks Farm
Weyc



Site boundary
Detailed survey extent

-2 nT
3 nT

0
200 m

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Date: 05/07/2023 | Created by: ADT
Scale: 1:4,000 | Revision: 0

Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

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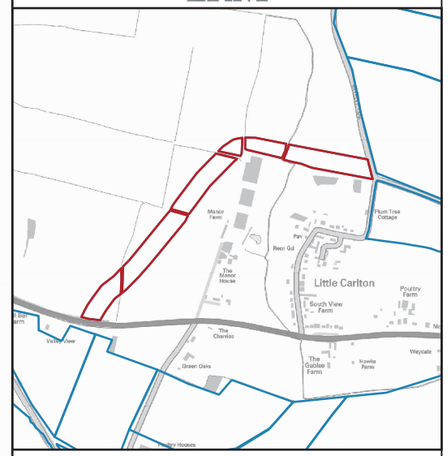
477000
477500
478000
358000
357500
357000

BATTLEY LANE
OLLERTON ROAD

Figure 5
Figure 7

Manor Farm
Plum Tree Cottage
Pav
Recn Gd
The Manor House
Little Carlton
Poultry Farm
South View Farm
The Cherries
Valley View
Green Oaks
The Gables Farm
Hawks Farm

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 200 m

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Date: 05/07/2023 | Created by: ADT
Scale: 1:4,000 | Revision: 0

Figure 3: Detailed gradiometer survey results: overall interpretation

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477600

477800

478000

BATHLEY LANE

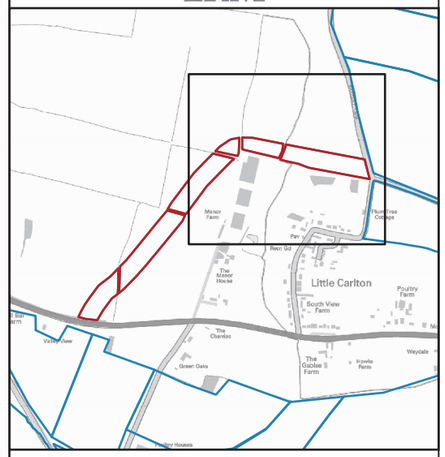
357800

357600

Manor Farm

Pav

Plum
Cot



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0

Figure 4: Detailed gradiometer survey results: greyscale plot (C126 - C133)

X:\Projects\2668310\GIS_Arc_Pro\2668310_Burnett_Figures-BNT\2668310_Burnett_Figures.aprx

477600

477800

478000

357800

357600

BATHLEY LANE

BNR-0003

BNR-0002

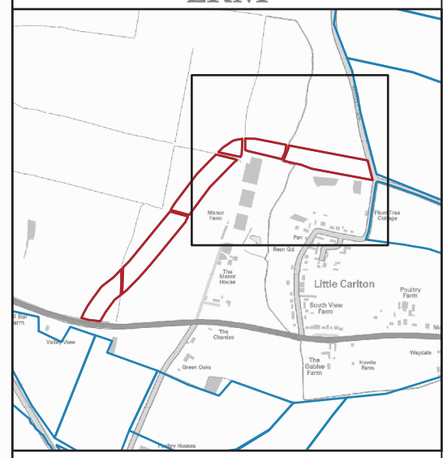
BNR-0001

Manor Farm

Pav

Plum Cott

ERM



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid

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Scale: 1:2000	Revision: 0

Figure 5: Detailed gradiometer survey results: interpretation (C126 - C133)

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477200

477400

477600

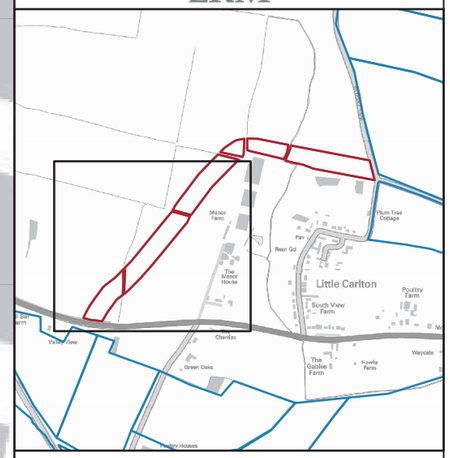
357600

357400

357200

Manor Farm

The Manor House



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000 | Revision: 0

Figure 6: Detailed gradiometer survey results: greyscale plot (C133 - C137)

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477200

477400

477600

357600

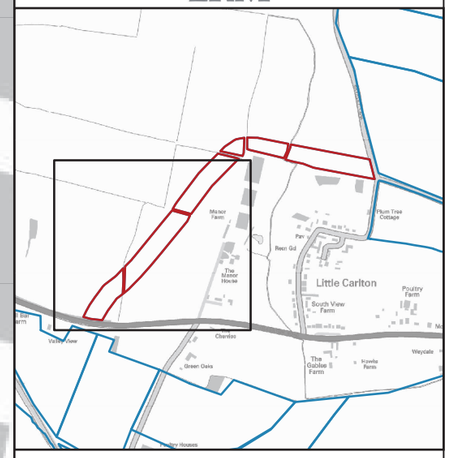
357400

357200

BNR-0004

Manor Farm

The Manor House



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Date: 05/07/2023	Created by: ADT
Scale: 1:2000	Revision: 0

Figure 7: Detailed gradiometer survey results: interpretation (C133 - C137)

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE (WARD LAND)

CULTURAL HERITAGE REPORT NUMBER: 268310

DATE: JULY 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l E erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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Figure 11: Detailed gradiometer survey results: interpretation (36)

1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site north of Staythorpe between 14 – 16 December 2022. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Ward Land' comprises several arable and pasture fields immediately east Norwell village. This comprises a mixture of agricultural land located between North Muskham and Ossington, covering an area of 192.7 ha.

The gradiometer survey has been successful in detecting anomalies of possible archaeological origin in the western portion of the site. These anomalies are expected to be ditches of possibly archaeological origin. One assortment of ditches could combine to form a small, 'square-shaped enclosure'. Chronological information about these anomalies cannot be obtained from the geophysical data alone, therefore further investigation would be required. It is also possible that these anomalies are in fact related to the former RAF base located within the site.

Extensive areas of increased magnetic response were evident across the entirety of the site. These correspond to former airfield infrastructure, such as runways, taxiways, aircraft stands, and services. The former airfield infrastructure was identified through a mixture of historic aerial photography and OS mapping. Any extant airfield infrastructure was identified from satellite imagery and ground features noted at the time of the survey.

One isolated area of ridge and furrow has also been identified in addition to multiple examples of modern ploughing practices. Two modern services have also been identified in the eastern portion of the site.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of ENT486, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (ENT486, ENT1034, ENT3871, ENT3756 and ENT3888).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (ENT738 and ENT1125). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in section 4.3.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in section 4.3 below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (MNT5596 and MNT11139). The only other Palaeolithic dated material is a handaxe found 1.5 km north-west of the site (MNT4164).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces. The

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)

[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (MNT3597, MNT14748, MNT17094, MNT17127, and MNT8542; NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (MNT17099). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (MNT17097, MNT14313, MNT17091, MNT11991, and MNT14315), while an isolated small riverside settlement was found near Cromwell (MNT25849). The Cromwell barrow cemetery also remained in use during the Iron Age (MNT15145). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (MNT17089, MNT17090, MNT8243, MNT8265, MNT17098, MNT8290, and MNT14318). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (MNT8243, MNT8265, and MNT17089), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (MNT11098, MNT11050, MNT11732, MNT11047, MNT8286, MNT2881,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and MNT3098) and Kneesall (MNT12174, MNT8556, MNT17128, and MNT12172). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (MNT14312; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (MNT26679), Kelham Hall (MNT26671), Averham Park (MNT26653), Winkburn Park (MNT26694), and Beesthorpe Hall (MNT26658).

Of the parks discussed above, Averham Park falls within the site (MNT26653). The park is first shown on Chapman's map of 1774 and was described in 1835 as "park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion ... on it remains the keeper's house and a few of the park fence". Little is known of the original layout of the parkland as Chapman's map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (MNT14403). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (MNT14432). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken between between 14 – 16 December 2022. Of the total 83.5 ha site, an overall coverage of 23.3 ha was achieved. The remaining Fields 34 – 38 were under plough or crop, at the time which the works were being undertaken.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 WARD LAND FIELD 34 – 40

7.1 Site details

A detailed gradiometer survey was carried out over Field 34-40, Ossington (centred on NGR 474742 365152) (Figure 4 – 11).

This survey comprises several arable and pasture fields. The survey area is bisected into northern and southern areas by the North wood and Speaker's plantation. The entire survey area is bounded by Ossington road to the east. The fields north of the woodland area (34 and 35) are bounded by tree-lined field boundaries to the north and the woodland to the west and south. The fields south of the woodland (36 – 40) are bounded by small sections of woodland to south-east, and more fields leading to Ossington village and Main street to the south.

The survey area is on a steep incline, at 30 m aOD in the eastern side increasing to 60 m in the west.

The underlying geology across the survey area is recorded as Mudstone of the Mercia Mudstone Group with thick halite-bearing units in some basinal areas. Thin beds of gypsum/anhydrite are widespread; thin sandstones are also present.[10].

The soils underlying the main portion of this survey area are likely to comprise argillic pelosols of the Worcester (431) association[11]. With a band of pelo-alluvial gley soils of the Compton (813e) association transecting across the north of the area. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed Buildings

There are 13 listed buildings within 2 km of the parcel and one scheduled monument. To the north in the hamlet of Moorhouse are two Grade II listed structures, Aggrie House (1302636), Church Farmhouse (1045632), and one Grade II* listed building, Moorhouse Chapel (1045631) all 2 km north of the parcel. To the east of the parcel, along the Ossington road there is one Grade II listed building, North Park Farmhouse (1179405). There is one Grade I listed building, Church of the Holy Rood (1045958), one Grade II listed building, Boundary wall and gate at the Church of the Holy Rood (1045957), and one Grade II* listed building, Sundial 50 meters east of the Church of Holy Rood (1301995), all clustered together to the south-east of the parcel. To the west, there is one Grade II listed building – Primrose Farmhouse (1179405). In the village of Ossington which lies to the south of the parcel, are three Grade II listed buildings, Ossington House (1045961), War memorial (1301970), and an unnamed monument listed as 3, Main street (1045960). Further eastwards to Ossington village, lie two Grade II listed buildings, Monumental well at Ossington Hall (1045959) and Boundary wall, railing, gate piers and gate at Ossington hall (1369971).

7.2.2 Prehistoric

Evidence of prehistoric activity in the immediate vicinity is minimal consisting of an axe hammer (HER L4171) dated between Neolithic to Late Bronze Age discovered immediately north of Field 34. Outside of the survey extents, findspots include a Middle Palaeolithic to Late Bronze Age flint scraper (HER L9026) and a Bronze age flint arrowhead (HER L4185) were discovered in and around Ossington.

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[11] Soil Survey of England and Wales, 1983

7.2.3 Iron Age – Roman

The is little evidence of Iron Age activity in the study area though there are Roman findspots. A collection of Roman greyware sherds (HER L4170) were discovered a few kilometres north of the parcel, near Moorhouse. Further south of Ossington, a mixed collection of artefacts containing pot sherds and a moratorium (HER L9024) was discovered.

7.2.4 Medieval

There is little evidence of medieval era activity around the parcel. The only features include the Ossington Perceptory (M8960) which belonged to the Knights Hospitaller and a deserted settlement identified as Oschintone or Ossington (M4218) in the Feet of Fines (1190 – 1760), both of which lie to the east of Ossington road. A medieval pot sherd (HER L9025) was discovered during field observations near Ossington.

7.2.5 Post-medieval

Fields 36 and 37 are in the post-medieval Park/garden at Ossington Hall (MNT26679). The park extends further in all directions for a few kilometres. Within the park's area eastwards, there are several post-medieval features and monuments including a Decoy Pond (MNT26590) belonging to the Victorian period, a demolished stable (M11654), a sundial (M13800) from the Georgian times and the listed buildings located east and south-east of the parcel.

To the north of the parcel, a post-medieval tyg (HER L8594) with two handles, covered with a thick brown glaze dated between 1600 AD to 1699 was found at Moorhouse. A disused Primitive Methodist Chapel is located near Moorhouse. A sluice (HER L6711) dated pre-1920 is found east of Moorhouse, along the Moorhouse Beck.

To the south, along the Main Street, a pre-1835 post-medieval bridge (MNT26550) can be seen which is currently out of use. A disused brickyard (HER M6649) dated between the Georgian era to early 20th Century lies around 840 m south of Field 40.

Two World War II structures are located within the southern portion of the parcel, RAF Ossington Airfield (HER L10557) and its associated structures extend into south of Fields 37 and 40 and a standard 11008/41 Battle Headquarters (HER L10566) west of Field 40. First opened in 1941, the runways associated with RAF Ossington were broken up for the construction of the A1

A post-medieval house with outbuildings (M6572) that was possibly destroyed during the construction of the Ossington airfield lies west of Field 37.

7.2.6 Undated

Several undated features can be seen within a radius of 2 kms of the parcel. A terraced ground (HER L4250) at Moorhouse Thorpe farm is located immediately north of Fields 34 – 35. An earthwork complex consisting of a building platform, hollow, and mound (HER L7850) was discovered at Moorhouse. Three Hollow ways (HER L9947, L7849, L6694) lie in and around Moorhouse.

To the south, two undated earthworks lie in the village of Ossington. One of the earthworks consists a hollow, once a pond, and the field to the north of the pond contains distinct north – south aligned ridge and furrow (HER L7845). The other earthwork was possibly a former quarry (HER L7844) which lies immediately to the south of Main Street. Further south of Ossington, a four sided rectilinear enclosure with subdivisions, one side of which is formed by a small stream and a ditch (HER L9953), and a field system (HER L9954) lie 1.3 km south of Field 37. Further undated features have been identified around 1 km

south-east of Ossington village, a scarp along the north-east side of Lady Elinor's plantation (HER L6646) and a hollow way (HER L6647).

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out between 14 – 16 December 2022 and covered 23.3 ha of the 83.5 ha survey area. The survey has identified a small number of possibly archaeological ditches, relating to an enclosure and former field boundaries. It has also highlighted indications of the former RAF Ossington and associated infrastructure.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (Figures 4 – 11). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (Figure 3).

7.3.1 Interpretation: Possible Archaeology

In the western portion of the parcel an assortment of positive linear and rectilinear anomalies have been recorded in Field 40 at WRD-0001 (Figure 5). The anomalies are 2 m wide on a coaxial alignment, either orientated north-east to south-west or north-west to south-east. The main grouping of anomalies to the east, combine to form a fragmented 30 m square. A singular linear extends south-west from the square's south-western corner.

It is possible that these anomalies are remnants of archaeological ditches that combine to form an enclosure of unknown origin. Given these findings were recorded over a known taxiway linked to the former RAF Ossington, however, these anomalies could relate to infrastructure associated with the former airbase.

Two very straight, positive linear anomalies have been identified in the north-western portion of the parcel in Field 39 at WRD-0002 (Figure 5). The western anomaly is 3 m wide by 145 m long, orientated north-east to south-west. Whilst the eastern linear is 2 m wide by 110 m long orientated north-east to south-west. The longer western linear is truncated at its north-eastern end by the shorter eastern linear. Although both anomalies could possibly relate to ditches of archaeological origin, given their straight form they could relate to former field boundaries not recorded on OS mapping. Alternatively, the anomalies could have been access tracks associated with the former airbase, as they share a broadly similar alignment to the recorded runway 50 m to the south.

An additional linear anomaly has been identified 40 m west of WRD-0002 in Field 39 at WRD-0003 (Figure 5). The dipolar anomaly is 2 m wide by 50 m long, orientated NNE – SSW. This is indicative of a ditch and may be archaeological in origin. However, given its dipolar nature, it is also possible that it represents a modern land drain. An access track associated with the airbase has also been noted on OS mapping in proximity and similar orientation. It is possible that the anomaly is linked to said track.

7.3.2 Interpretation: Historical Agriculture

Across the parcel numerous indications of former airfield and associated infrastructure have been recorded. These have been characterised as multiple areas of historic landscape features WRD-0004 – WRD-0010 (Figures 5 – 7, and 11). These areas correlate with numerous features pertaining to former airfield infrastructure viewed on OS mapping from 1961. Types of these airfield infrastructure features identified from the geophysical survey include taxiways (WRD-0004 – WRD-0007), former hangars and buildings (WRD-0008 – WRD-0009), and runways (WRD-0010). A strong dipolar response has also been identified centrally in Field 40 at WRD-0011 (Figure 5). This is visible on satellite mapping as an area removed of crop. It is likely, that it related to a manhole cover or similar infrastructure associated with the former airbase.

An area of weak, positive, parallel, linear anomalies have been identified in Field 36 at WRD-0012 (Figure 9). The average distance between lines is 6 m, orientated east – west, with a slight curvature in form. These anomalies have been interpreted as areas of ridge and furrow. Given their spacing and curved form, it is possible that these anomalies are medieval in date.

7.3.3 Interpretation: Modern Agriculture

Evidence of modern agriculture has been recorded across the parcel as enhanced linear trends. The majority of these trends are likely associated with modern ploughing.

7.3.4 Interpretation: Natural

There are multiple large bands of low magnitude positive and negative anomalies across the south of the parcel. Due to their lack of clear shape or pattern, these have been interpreted as natural geological variations, thought to be caused by variations in the depth and composition of the soils and the superficial deposits from which they derive. A speckled example has been identified in Field 36 (Figure 11), which could possibly be attributed to made ground.

7.3.5 Interpretation: Modern

Several negative linear trends have been identified a across the parcel. Due to their straight form and negative magnetic properties, these negative trends have been interpreted as modern land drains.

Numerous small, isolated, dipolar anomalies have been recorded throughout the survey, typically caused by ferrous material, either on the ground surface or in the plough soil. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough soil. Further examples of ferrous responses have been identified around the periphery of certain areas. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks.

Two strong dipolar linear anomalies are present within this survey at WRD-0013 – WRD-0014 (Figures 7 and 9). They are 3 – 4 m wide orientated ENE – WSW (WRD-0013) and north – south (WRD-0014), surrounded by ferrous disturbance. These anomalies are indicative of modern services, such as pipes or cables.

7.3.6 Interpretation: Unknown

Isolated linear and curvilinear anomalies have been recorded across the parcel. These anomalies are of unknown origin, due to their faint magnetic properties. It is possible that some may be associated with possible archaeological features when identified in proximity. The majority, however, are likely geological in origin or the result of modern agricultural practices.

7.4 Preliminary Conclusions

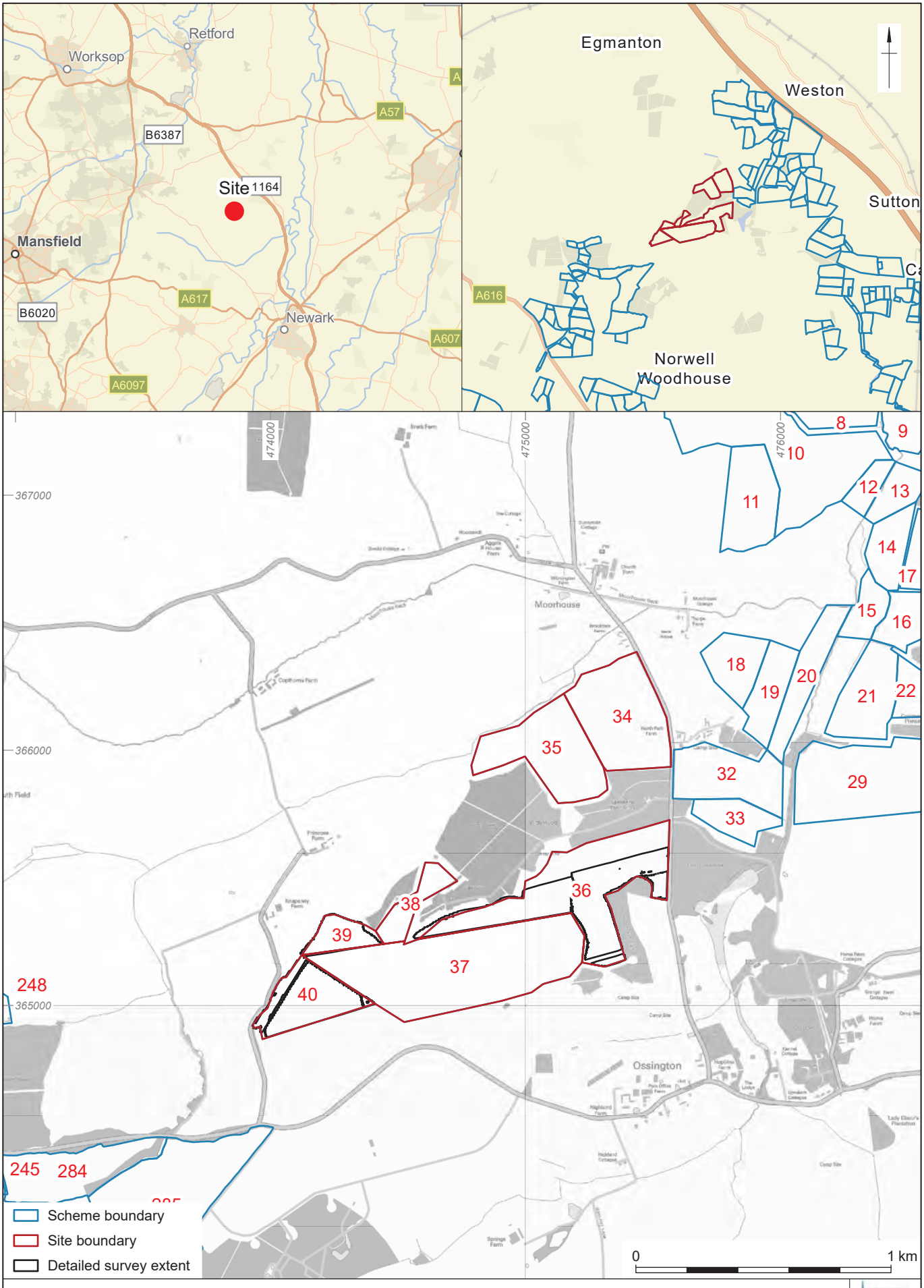
The gradiometer survey has been successful in detecting anomalies of possible archaeological origin in the western portion of the parcel. These anomalies are expected to be ditches of possibly archaeological origin. One assortment of ditches could combine to form a small square-shaped enclosure. Chronological information about these anomalies cannot be obtained from the geophysical data alone, therefore further investigation would be required. It is possible that these anomalies are related to the former RAF base located within the parcel.

Extensive areas of increased magnetic response were evident across the entirety of the parcel. These correspond to former airfield infrastructure, such as runways, taxiways,

aircraft stands, and services. The former airfield infrastructure was identified through a mixture of historic aerial photography and OS mapping. Any extant airfield infrastructure was identified from satellite imagery and ground features noted at the time of the survey.

One isolated area of ridge and furrow has also been identified in addition to multiple examples of modern ploughing practices. Two modern services have also been identified in the eastern portion of the parcel.

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Figure 1: Site location and survey extents

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367000
366000
365000
474000
475000
476000

The Cottage
Woodstock
Brecks Cottage
Aggrie House Farm
Sunnyside Cottage
PW
Church Farm
Wilmington Farm
GREEN LANE
Moorhouse
Moorhouse Beck
Moorhouse Grange
Thorpe Farm
Brookdale Farm
Beck House
Copthorne Farm
North Park Farm
Camp Site
Speaker's Plantation
North Wood
Primrose Farm
Knapeney Farm
Primrose Plantation
Lake Plantation
Parnila Plantation
Home Farm Cottages
Kennel Cottage
Ossington
Post Office Farm
Hall
MAIN STREET
Hopbine Farm
The Lodge
Speakers Cottages
Highland Farm
Highland Cottages

Figure 4
Figure 6
Figure 8
Figure 10

ERM

Site boundary
Detailed survey extent

-2 nT
3 nT

0
500 m

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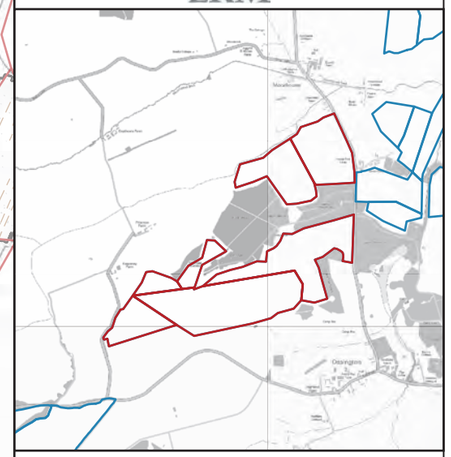
Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

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367000
366000
365000
474000
475000
476000

The Cottage
Woodstock
Brecks Cottage
Aggrie House Farm
Sunnyside Cottage
PW
Church Farm
Wilmington Farm
GREEN LANE
Moorhouse
Moorhouse Beck
Moorhouse Grange
Thorpe Farm
Brookdale Farm
Beck House
Copthorne Farm
North Park Farm
Camp Site
Speaker's Plantation
North Wood
Primrose Farm
Knapeney Farm
Primrose Plantation
Lake Plantation
Pamphill Plantation
Home Farm Cottages
Kennel Cottage
Ossington
Hopbine Farm
Post Office Farm
Hall
MAIN STREET
The Lodge
Speakers Cottages
Highland Farm
Highland Cottages

Figure 5
Figure 7
Figure 9
Figure 11



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 500 m

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Figure 3: Detailed gradiometer survey results: overall interpretation

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Farm

474000

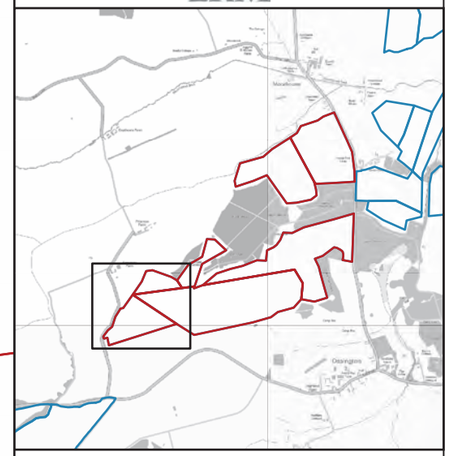
474200

474400

365200

365000

ERM



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 4: Detailed gradiometer survey results: greyscale plot (39 - 40)

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Farm

474000

474200

474400

365200

365000

WRD-0003

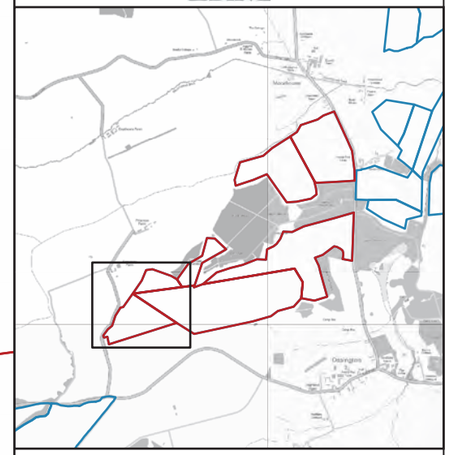
WRD-0002

WRD-0007

WRD-0001

WRD-0011

WRD-0010



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 5: Detailed gradiometer survey results: interpretation (39 - 40)

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474600

474800

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365600

365400

365200

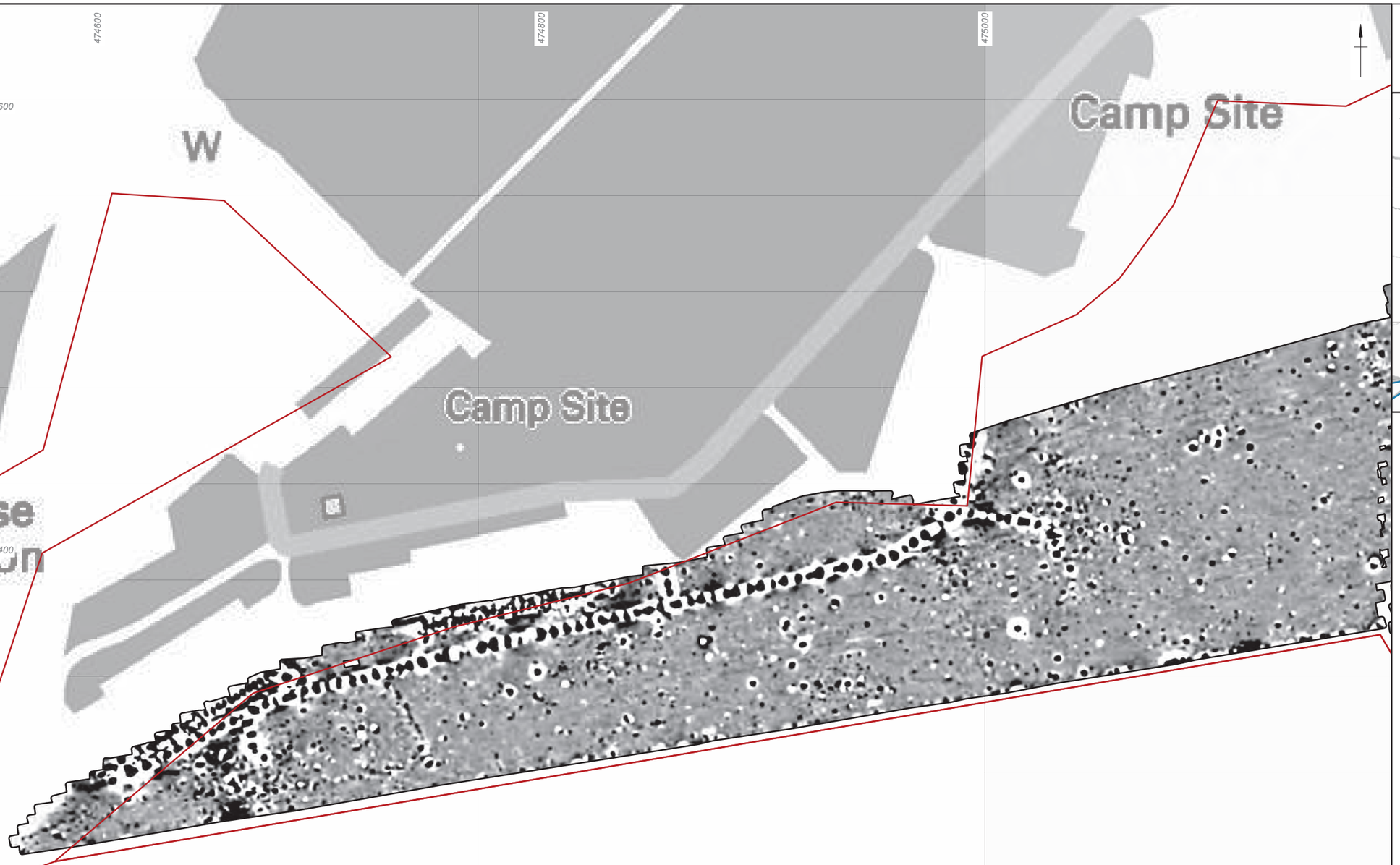
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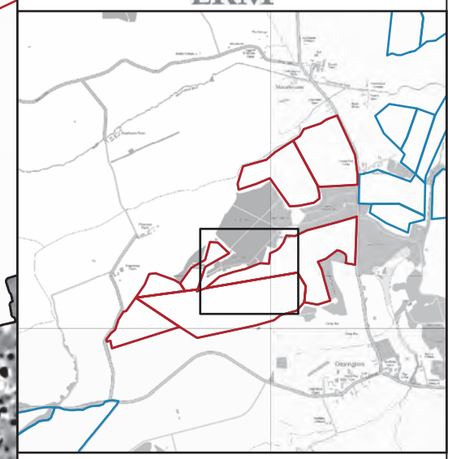
Camp Site

Camp Site

ose

tion





Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid

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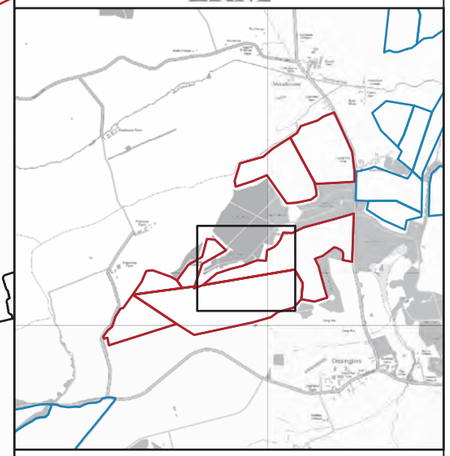
Figure 6: Detailed gradiometer survey results: greyscale plot (36)

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474600
474800
475000
365600
365400
365200

Camp Site
Camp Site
W
WRD-0009
WRD-0013
WRD-0008
WRD-0006
WRD-0005

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Figure 7: Detailed gradiometer survey results: interpretation (36)

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475200

475400

475600

365800

Speaker's Plantation

orth Wood

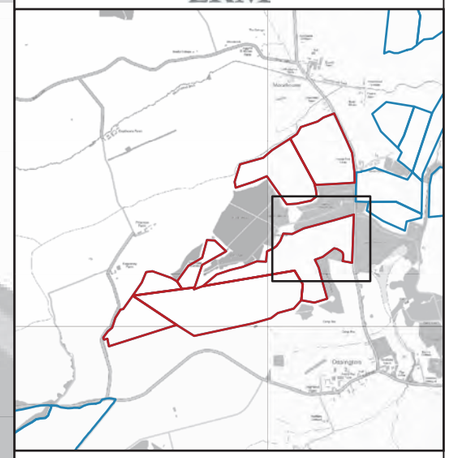
Camp Site

365600

365400

Lake

Pamela Plantation



Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

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Figure 8: Detailed gradiometer survey results: greyscale plot (36)

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475200

475400

475600

365800

365600

365400

Speaker's Plantation

orth Wood

Camp Site

Lake

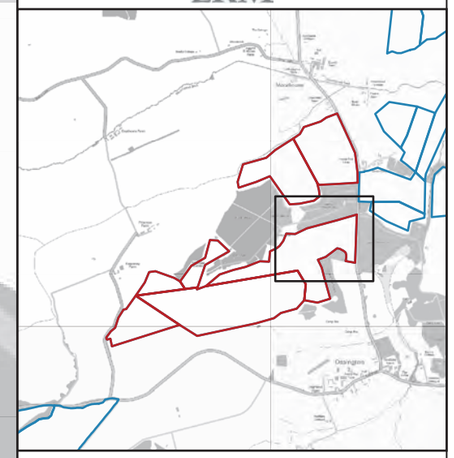
Pamela Pl

WRD-0014

WRD-0012

WRD-0004

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

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Scale: 1:2000 | Revision: 0

Figure 9: Detailed gradiometer survey results: interpretation (36)

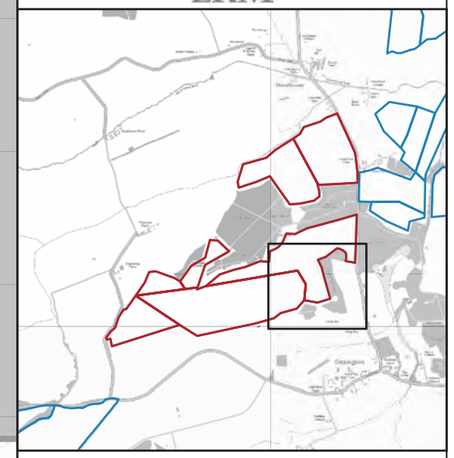
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475000
475200
475400
475600
365400
365200
365000

Pamela Plantation

Camp Site

ERM



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

Coordinate system: OSGB 1936 British National Grid
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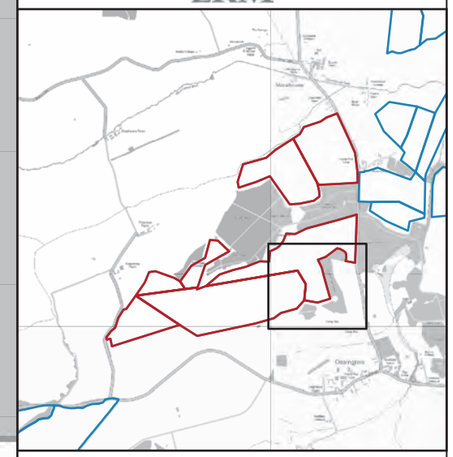
Figure 10: Detailed gradiometer survey results: greyscale plot (36)

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475000
475200
475400
475600
365400
365200
365000

WRD-0012
WRD-0004
WRD-0005
Pamela Plantation
Camp Site

ERM



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

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Figure 11: Detailed gradiometer survey results: interpretation (36)

8 APPENDICES

8.1 Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 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 0.6 m 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 ±8 µT over ±1000 nT range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FMG650/3 probes at a rate of 20 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 Captivate system with a 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 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the survey is downloaded from the 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 to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

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

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.

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

Typical displays of the data used during processing and analysis:

Greyscale – Presents the data in plan view 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 the analysis of the data.

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.

8.2 Appendix 2: Geophysical Interpretation

The following categories have been used for interpretation of the data throughout the report.

Archaeology

Used 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.

Possible Archaeology

Used for anomalies that conform to the Archaeology category but have a lower level of confidence due to lack of form, pattern, or nature.

Historic Landscape Feature

Used for anomalies that correspond with features other than historic field boundaries on available mapping. This can include, but is not limited to, park and garden features, areas of woodland, ponds, and extraction pits.

Historic Cultivation

Used to denote historic cultivation regimes that differ from existing modern cultivation. They may differ due to size, orientation, or distribution in the landscape. If possible, LiDAR, aerial, and HER data should be consulted to corroborate results.

Former Field Boundary

Used anomalies that correspond to the position of boundaries marked on available mapping, visible on aerial photographs, or form clear extensions of existing boundaries.

Modern Agricultural feature

Used to identify any anomalies that are representative of modern ploughing or agricultural activity.

Geology

Used to denote natural variations is soils, superficial geology, or bedrock.

Geomorphology

Used to identify anomalies associated with more coherent geomorphological features. This may include, but is not limited to, paleochannels, solution hollows, and former high ground.

Increased Magnetic Response

Used for areas dominated by indistinct anomalies with increased magnetic values. While these may have some archaeological potential they may also relate to natural or modern features.

Modern Service

Used for anomalies indicative of services or service trenches. These are usually magnetically strong linear anomalies but can also be seen as weak anomalies in the case of plastic services where only disturbance associated with the trench is visible.

Drain

Used for anomalies thought to relate to drainage features either due to their nature or corresponding with features on available mapping.

Ferrous

Used for anomalies caused by ferrous material. These anomalies are likely to be of modern origin.

Unknown Feature

Used for anomalies that, due to their nature, pattern, or form, cannot be confidently interpreted. These may have some archaeological potential.

Trend

Used for low amplitude or indistinct linear anomalies that cannot be confidently interpreted. These may have some archaeological potential.

DETAILED GRADIOMETER SURVEY REPORT

LAND TO THE WEST OF A1, NORTH OF STAYTHORPE, NOTTINGHAMSHIRE

CULTURAL HERITAGE REPORT NUMBER: 268310
(JACKSON LAND)

DATE: JULY 2023

Prepared By:

Environmental Resources Management

Exchequer court
33 St Mary Axe
London
EC3A 8AA

T +44 (0) 20 3206 5200 l E erm.information@erm.com
w www.erm.com

Registered in England & Wales No. 1014622

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1 EXECUTIVE SUMMARY

The document comprises a report on detailed gradiometer surveys on the site north of Staythorpe over multiple developments between 17 October – 9 November, 12 – 14 December 2022, 3 – 4 January and 5 – 13 April 2023. The project was commissioned by ERM with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features to assess the archaeological potential of land parcels and their suitability for development.

The site at 'Jackson Land' comprises several arable and pasture fields immediately west of the village hamlet of Carlton-on-Trent. This comprises a mixture of agricultural land located north-west of Newton on Trent, covering an area of 83.5 ha.

The gradiometer survey has been successful in detecting anomalies of archaeological origin in the southern portion of the site. Numerous ditches have been identified associated with large-scale multi-phase activity. Ditches linked with former land divisions, boundaries and multi-phase enclosures associated with settlement activity in the area have been identified in both the southwest and south-eastern corners of the site. Although a definitive chronology is difficult to determine due to the impact of ridge and furrow in the area, it is proposed that the activity is possibly dated between Iron-Age and Post-medieval. A more definitive origin cannot be categorised from geophysical data alone and further investigation would be required.

Anomalies identified in the south-western portion of the sight are more rectilinear in form, whilst those identified amongst the south-eastern anomalies are more curvilinear, relating to ring-ditches, roundhouses, sub-rounded enclosures, and possible Bronze age Barrows. Some of these anomalies have been partially identified previously via cropmarks visible on aerial photography of the area, identified as complex enclosure activity near Cromwell.

Several isolated, linear, and discrete positive anomalies have also been identified across the site. These anomalies could possibly relate to archaeological activity in area in the form of ditches. Although an archaeological origin cannot be ruled out entirely, it is also possible that the anomalies are geological in origin or related to modern agricultural practices.

Evidence of the sites historical past has also been identified in the form of former field boundaries recorded across the site. Most anomalies were visible on OS mapping dating from 1888 and last visible in 1961. No historical landscape features have been identified.

Indication of large-scale geological variation has also been highlighted to the south, with a small complex of paleochannels located centrally on site. Isolated areas of ridge and furrow have also been identified in addition to multiple examples of modern ploughing practices. Multiple modern services have also been identified across the site as well as evidence of increased magnetic response.

2 INTRODUCTION

2.1 Project Background

ERM commissioned a geophysical survey on land to the north of A167 and the west of A1, Nottinghamshire. The survey area covers approximately 2100 ha and comprise a detailed gradiometer survey intended to assess the archaeological potential of land parcels and their suitability for development.

2.2 Scope of document

This report presents a brief description of the overall site details, archaeological background, and methodology. This is followed by detailed survey results and the archaeological interpretation of the geophysical data for each land parcel.

3 SITE LOCATION, GEOLOGY AND TOPOGRAPHY

The following gives an overview of the site, with further details presented for the individual land parcels.

The site consists of multiple land parcels extending along two arms, north-east and north-west of Staythorpe, in the county of Nottinghamshire, west of the River Trent and extending from 4 km north-west of Newark-on-Trent. The north-east route of the survey is 16 km long, extending from Staythorpe and running towards the villages of North Muskam, Carlton-on-Trent, Ossington and Moorhouse. The north-west route is shorter, extending for 9 km from Staythorpe towards Kersall, before bifurcating and heading towards Eakring and Kneesall.

The bedrock geology across the site is principally Mercia Mudstone but the area around Eakring at the western end of the site is recorded as Siltstone of the Tarporley formation[1]. Superficial deposits comprising Holme Pierrepont sand and gravel, and undifferentiated Alluvium are recorded on the western edge of the River Trent floodplain. Alluvial deposits are also recorded adjacent to Moorhouse Beck, at the northern end of the eastern route, and between Caunton and Kersall in the west. In addition, Diamicton Till and Glaciofluvial Deposits are also recorded at the northern end of the north-west cable route around Buckshaw farm.

Soils derived from the above geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. However, in areas where thick deposits of superficial material (e.g. Alluvium) are recorded, archaeological remains may be too deeply buried to be identified through this geophysical technique.

The general topography varies of across the site, but the slope is generally gradual in most areas. The lowest-lying region is the area associated with the floodplain of the River Trent at the eastern extent of the survey area, which ranges between 10 and 16 m above Ordnance Datum (aOD)[2]. The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Moorhouse Beck. Adjacent to these, are several highpoints (>75 m aOD) at Eakring, Kneesall and Laxton.

[1] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)

[2] United Kingdom Topographic Map. https://en-gb.topographic-map.com/maps/iu/United-Kingdom/ (Accessed 12/09/2022

4 ARCHAEOLOGICAL BACKGROUND

4.1 Introduction

No desk-based assessment of the survey area has yet been undertaken. However, HER data for the survey site and a 1.5 km study area around the survey site has been obtained. The following gives an overview of the site, with further details presented for the individual land parcels.

4.2 Previous Investigations

There are few records of previous intrusive investigations within the site. With the exception of ENT486, which encountered post-medieval remains, none of the other intrusive surveys found evidence of archaeology (ENT486, ENT1034, ENT3871, ENT3756 and ENT3888).

A detailed survey aerial photograph analysis exercise was undertaken along the route of the A1 and main settlements within the region (ENT738 and ENT1125). A wealth of potential archaeological features were identified that reside within the site boundary or lie adjacent to it [3]. These are discussed in section 4.3.

Many archaeological surveys have been completed within the study area with concentrations found within the historic settlements of North Muskham, South Muskham, Little Carlton, Averham, and Cromwell. Some of the investigations have uncovered archaeological remains, which are discussed in section 4.3 below.

4.3 Historical and archaeological background

4.3.1 Prehistoric

The Nottingham Historic Environment Record (NHER) holds limited evidence of Palaeolithic activity, mainly confined to Staythorpe to the south of the site, comprising the recovery of worked antler and bison bones (MNT5596 and MNT11139). The only other Palaeolithic dated material is a handaxe found 1.5 km north-west of the site (MNT4164).

With the exception of the possible site of a Neolithic henge, all of the NHER records for the Neolithic comprise of lithic (flint) finds, with a particular concentration on land directly west of the site just north of North Muskham. The quantity of material recovered would imply a permanent presence within the landscape rather than reflecting seasonal migration of peoples. This fits with the current historical narrative, which indicates that the River Trent Valley was a focus of activity during the period[4]. However, it is possible that fine-grained minerogenic deposits of Holocene alluvium that are likely located within the floodplain of the River Trent, may have deeply buried further evidence of this.

Alluvium is recorded in the eastern part of the site, on the floodplain of the River Trent. Previous studies within the Trent valley on alluvial deposits confirmed the presence of deeply buried organic material, offering the potential for the preservation of paleoenvironmental evidence[5]. Trenching around Staythorpe Power Station identified three paleochannels that, based on recovered organic evidence, provided four dates of between 6640 ± 60 BP. Together with pollen and insect data, this show that during the latter half of the Mesolithic period, the area was a mixture of alder, willow, and aspen carr, with limited grassland and a background of oak, elm, and lime on the adjacent gravel terraces.

[3] Historic England, Aerial Archaeology Mapping Explorer, https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/ (Accessed 12/09/2022)
[4] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/
[5] The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/ (Accessed on 12/09/2022)

The later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

For the Bronze Age, there is a more defined permanent presence evidenced by the construction of several barrow cemeteries (MNT3597, MNT14748, MNT17094, MNT17127, and MNT8542; NHLE list entry 1003492) and the identification of enclosures, hut circles/ring ditches and other features associated with land management during the aerial photography mapping exercises. These features are found on both sides of the river.

100 m to the east of the site lies the Site of Pit Alignments scheduled monument (NHLE list entry 1003493). The listing of the scheduled monument is based on the old county number (OCN) scheduling record and provides no further information on the pit alignment itself. The recent arial photography mapping exercise has, however, identified further pits around the scheduled monument (MNT17099). Although the pits have not been intrusively investigated, such features are typically of late prehistoric origin, although their use remains poorly understood[6].

The exploitation of the River Trent Valley becomes clearer with the transition into the Iron Age. Several settlements, including a scheduled monument (NHLE list entry 1003494), have been found close to South and North Muskham (MNT17097, MNT14313, MNT17091, MNT11991, and MNT14315), while an isolated small riverside settlement was found near Cromwell (MNT25849). The Cromwell barrow cemetery also remained in use during the Iron Age (MNT15145). In addition to the above, the aerial mapping exercises have also recorded a plethora of field enclosures, boundaries, pit alignments, hut circles/ring ditches, and linear features that may be of late prehistoric origin. Overall, there is a wealth of evidence that shows that this part of the River Trent Valley was heavily settled and exploited during the Iron Age.

4.3.2 Romano-British

Based on the current evidence, the Romano-British period is marked by a general abandonment of the earlier settlement pattern and establishment of new settlements within the landscape. The land around South Muskham, North Muskham, and Little Carlton continued to be the focus for habitation with seven settlements discovered (MNT17089, MNT17090, MNT8243, MNT8265, MNT17098, MNT8290, and MNT14318). However, similar levels of activity appear around Cromwell with a possible Romano-British villa located 430 m to the east of the site and an extra-mural settlement, designated a scheduled monument (NHLE list entry 1003490), discovered 60 m west of the site.

Four of the settlements discussed above fall within the site (MNT8243, MNT8265, and MNT17089), including the Scheduled settlement discussed above (NHLE list entry 1003490). However, the aerial mapping exercises also identified a large number of regular enclosures which could be of Romano-British origin within the site's boundaries.

4.3.3 Anglo-Saxon

The Domesday Book of 1086 can be used to identify settlements that existed prior to the Norman Conquest. South Muskham, North Muskham, Little Carlton, Cromwell, Kneesall (referred to as 'Cauton'), Kelham, and Averham, all of which sit with the 1.5 km study area, are documented as being in existence in 1066 and would have had their origins in at least the Late Anglo-Saxon period.

Most of the NHER records relate to finds recovered during fieldwalking exercises completed on the fields that surround known Anglo-Saxon centres, such as North Muskham and South Muskham (MNT11098, MNT11050, MNT11732, MNT11047, MNT8286, MNT2881,

[6] Cooper, N (ed) 2006. The Archaeology of the East Midlands. Available at: https://researchframeworks.org/emherf/

MNT11042, and MNT3098) and Kneesall (MNT12174, MNT8556, MNT17128, and MNT12172). The recovery of the material helps define the main areas of activity during the period showing that landscape use may have been confined to the immediate hinterland of known settlements.

4.3.4 Medieval

The medieval period is characterised by an intensification in settlement activity and landscape use within the River Trent valley. The NHER has mapped many former medieval villages/hamlets located in the study area, most represented as shrunken or deserted villages, alongside known sites of medieval manors and deer parks (some of the manor sites are designated as Scheduled Monuments). One of these, the medieval deserted village of Little Carlton, which is a scheduled monument, falls partially within the site (MNT14312; NHLE list entry 1019870).

Similar to the proceeding periods, most of the archaeological evidence for medieval activity takes the form of finds recovered during fieldwalking exercises. While the material could reflect further areas of settlement, it was common practice to add pottery to fields as part of the arable farming regime. This data at least shows a wider utilisation of the study area for agricultural uses, and it is possible that some of the features identified during the aerial mapping exercises are of medieval origin.

4.3.5 Post-medieval and Modern

The post-medieval period was a time of continuity and development for the River Trent valley. Until the passing of Enclosures Acts, much of the landscape was not too dissimilar to what had been created during the medieval period. The medieval interspersed settlement pattern remained with the local peoples still relying on agriculture for employment. However, the period was also marked by the rise of the landed gentry and development of large estates. Within the study area are four parks of varying size associated with an existing or former large country house, and include Ossington Hall (MNT26679), Kelham Hall (MNT26671), Averham Park (MNT26653), Winkburn Park (MNT26694), and Beesthorpe Hall (MNT26658).

Of the parks discussed above, Averham Park falls within the site (MNT26653). The park is first shown on Chapman's map of 1774 and was described in 1835 as “park which was heretofore an ornament to the neighbourhood, and a splendid appendage to the mansion … on it remains the keeper's house and a few of the park fence”. Little is known of the original layout of the parkland as Chapman’s map is of limited detail and later Ordnance Survey (OS) mapping shows the land as fields. Lost parkland features may fall within the site.

According to the NHER, two brick yards fell within the site. The first brick yard is located south-west of Little Carlton and was created during the post-medieval period (MNT14403). After it fell out use, woodland was planted over the brick yard, which is first shown on the 1st edition OS map. The second brick yard is of modern date and located northeast of Upton (MNT14432). The brickworks fell out of use by 1915.

Post-medieval mapping shows that the site was located within post-enclosure field systems by the end of the 19th century. Few changes have occurred to the field system since. In the study area, the main changes illustrated comprise the construction of the Great Northern Railway line, development of industrial sites and expansion of the villages/settlements.

The majority of the NHER records of post-medieval and modern date relate to former or existing structures found throughout the study area. They comprise of farmsteads, residential buildings, structures associated with the railway, estate structures, and former industrial sites.

4.3.6 Undated

As discussed above, aerial mapping exercises have identified a large number of cropmarks/features within the study area, many of which fall within the site's boundaries. The NHER entries for each designated set of cropmarks provided little detail about them, other than their general shape and form (i.e., regular enclosures, hut circles, linear etc). Apart from the hut circles/ring ditches, which are associated with prehistoric settlement practices, the rest of the cropmarks/features could be of any date prior to the establishment of the post-enclosure field systems.

5 METHODOLOGY

5.1 Introduction

The geophysical survey was undertaken between 17 October – 9 November, 12 – 14 December 2022, 3 – 4 January and 5 – 13 April 2023. Of the total 19.7 ha site, an overall coverage of 147.8 ha was achieved. The remaining Fields 50, 99, 112 and C100 were under plough or crop, at the time which the works were being carried out.

The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation[7] (WSI), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists'[8] and European Archaeologiae Consilium[9].

5.2 Aims and objectives

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.

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.

5.3 Fieldwork Methodology

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).

The detailed gradiometer survey was undertaken using four SenSys FGM650/3 gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were

[7] ERM, 2022 Written Scheme of Investigation: Geophysical Survey Land to the West of A1, North of Staythorpe, Nottinghamshire. Report ref. 22036

[8] Chartered Institute for Archaeologists [CIfA] 2014a Standards and guidance for archaeological geophysical survey. Reading, CIfA

[9] Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2, Belgium: European Archaeological Council.

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.

5.4 Data processing

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.

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

6 DATA PRESENTATION

The processed data are exported as georeferenced TIFF files. The interpretation layers are digitised as ESRI shapefiles. The images and interpretation shapefiles are then used to produce the final figures in a GIS.

The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image.

7 JACKSON LAND 47-50, 65, 84-85, 90, 93, 96, 97-99, 102-107, 112-114, 64(C), C69, C71, C89, 95(C) AND C100

7.1 Site details

A detailed gradiometer survey was carried out over a parcel of land located between the A1 to the south-east and the village of Ossington to the north-west. The parcel comprises 28 fields, with the survey area divided in the centre by agricultural land. For this report, therefore, the parcel has been split into two distinct areas. Area 1, to the north, is composed of Fields 47 – 50, 65, 84 – 85, 90, 93, 96, 64 (C), C89, and 95 (C) and centred on NGR SK 77903 63653. Area 2 is to the south and is composed of fields 97 – 99, 102 – 107, 112 – 114, C69, and C71, centred on NGR SK 79055 61049 (Figure 4 – 11).

7.1.1 Area 1

Area 1 comprises 11 arable fields and two pasture fields (Fields 64 (C) and 65). Field 47 is the most northerly and is bounded on its most northern side by Ossington Rd and Carlton Wood. Field 96 is the most southerly and is bounded on all sides by hedgerow which open out onto agricultural land. Hedgerows separate many of the fields in this area, and agricultural land bounds almost all of Area 1 in this way. A small farm track runs through the centre of Area 1, dividing Fields 90 and C89 to the north from 95 (C) to the south. The track leads north to Jackson's farm, which abuts Fields 49 from the south and 64 (C) from the west. A collection of farm buildings abuts Field C89 from the west. Some small, wooded areas are also present in Area 1, primarily to the north and east of Field 64 (C), and to the south-east of Field 85, where the wooded area to the south separates it from Field 93.

The survey area is sloping, with a general trend towards higher elevations in the west and lower elevations in the east. At its most northern point, Area 1 is 50 m aOD, however at the most south-eastern point it is 18 m aOD. Other elevations recorded throughout the area generally vary between 20 – 40 m aOD. The most significant slope is present in Field 47, with a decrease of 17 m from 50 m aOD in the west to 33 m aOD in the east.

The underlying geology across the area is recorded as Mudstone from the Mercia Mudstone Group, with thin strips of Dolomitic Siltstone of the same group running through Fields 49, 50, 64 (C), C89, 90, and 84. Field 95 (C) also contains some superficial deposits of clay, silt, and gravel alluvium, which run across its northern edge [10].

The soils underlying this survey area are likely to comprise argillic pelosols of the Worcester (431) association[11]. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.1.2 Area 2

Area 2 comprises 12 arable fields and three pasture fields (105, C69 and C71). Field 97 is the most northerly and is bounded to the north and west by a small stream called 'The Beck', and by further agricultural land to the east. The Beck continues south, also bounding Field 98 directly to the west. Hedgerows surround many of the fields in this area. These frequently open out onto further agricultural land, which bounds much of Area 2.

Area 2 is also affected by two roads and a major trainline. Norwell Lane runs through the centre of the area on an east – west alignment, separating Field C71 in the north from C69 to the south. The A1 directly abuts Fields 113 and 114 to the east and provides the eastern-most boundary of the whole area. A trainline runs through centre of the a on a north – south alignment and separates Field 112 on its eastern side from Fields 105 and 107 in the

[10] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)
[11] Soil Survey of England and Wales, 1983

west. The northern edge of Field 112 is further bounded by Sapphire Lakes, a collection of modern fishing ponds.

Area 2 is generally quite flat, with elevations between 10 – 20 m aOD. Both Area 2's most northern and southern points have elevations of 12 m aOD. The most western point of Field 15 is 20 m aOD, and the most eastern point of the area, in Field 22, is at 10 m aOD.

The underlying geology across the area is recorded as Mudstone from the Mercia Mudstone Group. Superficial deposits of clay, silt, and gravel alluvium are recorded in Fields 97 – 99, 104 – 106, 107, 112, C67, C69, and C71, with further superficial deposits of sand and gravel from a Holme Pierrepont Sand and Gravel Member recorded in Fields 103, 105, 20, 112 – 114[12].

The soils underlying this survey area vary, with the western portion likely to comprise stagnogleyic argillic brown earths of the Whimple 3 (572f) association[13] and the eastern portion comprising gleyic brown earths of the Arrow (543) association, with a band of Pelo-alluvial gley soils of the Fladbury 2 (813c) association transecting across the north of the area. Soils in such geological settings have been demonstrated to produce magnetic contrasts suitable for the detection of anomalies through gradiometer survey.

7.2 Archaeological background

7.2.1 Listed buildings

Area 1

There are 16 listed buildings within 1 km of Area 1. These are mainly situated within the village of Norwell. One building is listed as Grade I; the Church of St Lawrence (NHLE 1369970). This parish church was restored in 1874 by Ewan Christian but retains elements dating from the 13th century until the 18th century.

The remaining 13 buildings are listed as Grade II comprising residential and agricultural dwellings. These buildings date from the 18th century onward. Several other listed buildings are located elsewhere in the village of Norwell, just outside the 1 km study radius.

Area 2

There are 19 listed buildings within 1 km of Area 2. Many are similar to Area 1, such as the 10 residential and agricultural dwellings located within the village of Norwell. An additional four listed buildings are located in the village of Cromwell, to the west of Area 2. One, the Church of St Giles (NHLE 1369982), is Grade I listed. The church was partly restored in 1873 – 76 by Ewan Christian but retains many of its earlier features which date from the 13th century to the 15th century. The remaining three are Grade II listed residential buildings and date from the 17th century onward. A further five listed buildings are located in the northern edge of the village of North Muskam, a village to the south of Area 2.

7.2.2 Prehistoric

Area 1

No evidence of Prehistoric activity has been recorded within the immediate vicinity of Area 1.

Area 2

Contrastingly, a range of Prehistoric features have been recorded within and around Area 2. Field 113 contains the remains of a Bronze Age Round Barrow. This example was excavated in the 1950s, when a slight mound was still visible. A probable burial pit was

[12] Geology of Britain viewer. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed on 01/04/2022)
[13] Soil Survey of England and Wales, 1983

located centrally, thought to have been originally lined with clay but damaged by later grave robbers. Pottery associated with the period and with the later Roman period was also found. Aerial photographs associated with this example show strong remains of the surrounding ring ditch. The mound was potentially converted for use by a mill during the post-medieval period.

An additional Neolithic – Bronze Age Mortuary enclosure (MNT 17126) is located nearby in Field 113. Aerial photographs document the ring ditch of a barrow and other rectangular systems close to it, including D-shaped cropmarks. Elsewhere in the field, linear features, pit alignments, and a circular enclose are continued as crop marks. These cropmarks have been interpreted as potential hut circles and enclosures. Cropmarks displaying similar characteristics also continue into the surrounding fields to the north of Field 113. Together these may be representative of a settlement.

Nearby, an undated ring ditch identified via aerial photography is located within Field 49. Ring ditches are commonly associated with this period, and as such may represent activity from the period.

Possible prehistoric circular enclosures may also underlie a later settlement visible at the scheduled monument Settlement 1.2 km west of Cromwell Village (NHLE 1003490), located immediately south of Field C69, although not enough archaeological work has been done at the site to properly understand the relationships between the material here.

A Neolithic – Bronze Age flint scatter is recorded on agricultural land 40 m south of Field 98.

Additional flint artifacts, including a core and flake were found as part of archaeological trenching in fields directly south of Field 107. A sherd of prehistoric pottery was also found in a trench dug as part of these excavations. In a field 600 m south-west of Field 107, a 21.5 cm long perforated Bronze Age axe hammer was retrieved by a farmer whilst ploughing.

7.2.3 Iron Age – Roman

Area 1

Little evidence of activity securely dated to the Iron Age or Roman periods is visible within the study radius for Area 1.

Area 2

Several areas of possible Iron Age and Roman activity are located within the search radius for Area 2.

The scheduled Rectangular Barrows at North Muskam (NHLE 1003492) is located 440 m east of Field 114. Up to 10 barrows have been identified within the scheduled area, possibly representing a barrow cemetery. This style of barrow dates to the Iron Age and is generally rare outside of the east of Yorkshire and Humberside. This cemetery sits within a wider landscape of cropmarks and linear features that may be temporally related.

1.8 km north of the rectangular barrows are the probable remains of an Iron Age settlement. This lies just outside the search radius at 1.1 km to the north of Field 97. At the site, several small enclosures are situated over an area measuring 600 m north – south on the site of the old river scarp. These are visible as cropmarks.

This settlement abuts and partially underlies the scheduled site discovered by Aerial Photography NNE of Village (Cromwell Villa) (NHLE 1003487). This monument is located 1 km to the east of Field 97. The site is thought to contain evidence of a Roman portico villa and double ditched enclosure situated on the western bank of the River Trent. The site was trenched in 1949 but little formal archaeological work has been done at the site since. These early excavations recovered Roman tile, stone debris, and pottery.

A second potential Roman villa is located 200 m north of Field 113. This is visible as a large cropmark complex on aerial photographs but no further archaeological work has been done. Alternative interpretations may be of very regular farming enclosures.

The scheduled Settlement 1.2 km west of Cromwell Village (NHLE 1003490), located across Field C69 and the field immediately to the west of C69, is similarly visible as a large cropmark complex but has had little archaeological investigation. Some interpretations of the cropmarks infer that they may be representative of a Romano-British settlement.

Examples of Roman pottery have been found in the nearby Field 113. Additional examples have been retrieved as part of archaeological excavations in fields immediately south of Field 107. Possible Roman pits, gullies, ditches, and post holes were also found as part of these excavations.

7.2.4 Medieval

Area 1

The scheduled Willoughby DMV (NHLE 1013884) is located 300 m east of Field 95 (C) and is part of the modern agricultural land separating Area 1 and Area 2. The DMV comprises significant earthwork remains of the village, including a square moated platform, a holloway, six fishponds, and visible ridge and furrow, which probably spread further into the surrounding landscape. Geophysical analysis (gradiometer and resistance surveys) undertaken at the site by Cranfield in 2012 found numerous archaeological anomalies. These anomalies matched the extant earthworks and included a holloway, ditch and kiln. Remains of walled buildings were found in throughout the DMV. These included the remains of a potential chapel.

The Old Hall Moat and Two Fishponds are a scheduled monument 900 m to the south of Field 96 (NHLE 1009153). Moat building in this style was popular from 1250 – 1350, although were continually built into the later medieval period. Old Hall Moat includes a rectangular island measuring 50 m north – south and 30 m east – west. The moat, unusually, still contains water and is considered to contain well-preserved organic material such as wood, leather, and plant remains. A causeway on the west side allows access to the central island and represents the original entrance. The moat was the site of a possible siege during the Civil War of the 1640s. The moat sits on the eastern edge of the village of Norwell.

On the western side of the village of Norwell is another example of a medieval moat. This is 1 km south of Field 96. This example of a moat is in worse condition than the Old Hall Moat, having been partially destroyed, but includes some slight indications of building foundations on the island.

Norwell is represented in the 1086 Domesday book and so is likely to have had origins at least into the Anglo-Saxon period.

Area 2

The Willoughby DMV is also located close to Area 2, at 130 m to the north of Field 97. The Old Hall moat and two fishponds are located 630 m to the south-west of Field 98.

A large curvilinear ditch containing animal bones and a sherd of medieval pottery was uncovered in archaeological trenching in the fields immediately to the south of Field 107.

The scheduled Settlement 3/4 mile (1198 m) W of Cromwell Village (NHLE 1003490), located across Field C69 and the field immediately to the west of C69, has been interpreted as a possible medieval settlement, however, later visits to the site have not found any evidence to support this interpretation.

The nearby towns of Cromwell and North Muskam are both represented in the 1086 Domesday book and so are likely to have had origins at least into the Anglo-Saxon period.

7.2.5 Post-Medieval

Area 1

Both the moated manor platforms in Willoughby DMV and at the Old Hall were in use through to the post-medieval period, though there are no building remains now above ground.

Much of Norwell village and the buildings closest to the road at Willoughby Farm were also constructed during this period and into the early modern period. Many of these buildings are covered in the listed buildings section above.

The post-medieval period also saw the development of country manor houses and parklands in the area. Carlton Hall, located just outside the study area, 1.6 km north-east of Field 90, is dated to 1765 and is now a Grade II* listed building (NHLE 1046012) and its associated landscape park (450 m north-east of Field 90 at its closest point), which began as a small garden terrace and expanded to large parkland by 1885, are good examples of this trend. A similar manor and parkland were built nearby at Ossington.

Area 2

Similarly to Area 1, the post-medieval period saw the establishment of many of the current buildings in the area, including many of the buildings in the village of Cromwell.

Muskam House and Gardens, a large country mansion, was built in the village of North Muskam in 1793. The house was left unoccupied by 1932 and completely demolished in the late 1830s. A lodge cottage and farm now exist on the site.

A number of small chance finds dated to the period, including pottery and clay pipes, are located across Area 2.

In 1846, the Great Northern Railway company was founded, and the railway line that runs through the centre of Area 2 was established. This railway line is a key element of existing OS maps from the period.

7.2.6 Undated

A large number of undated features identified through aerial photography are visible within the study areas. These include settlements, enclosures, ditches, linear features, and pit alignments.

7.3 Detailed gradiometer survey results

The detailed gradiometer survey was carried out on multiple deployments between 17 October – 9 November, 12 – 14 December 2022, 3 – 4 January and 5 – 13 April 2023and covered 147.9 ha of the 192.7 ha survey area. The survey has identified evidence of archaeology across the southern portion of the parcel in the form of large-scale multi-phase settlement activity.

Results are presented as a series of greyscale plots and archaeological interpretations, at a scale of 1:2000 (Figures 4 – 37). The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous, burnt or fired objects, and magnetic trends (Figure 3).

7.3.1 Interpretation: Archaeology and Possible Archaeology

A series of complex positive linear and rectilinear anomalies has been identified in the southern portion of the parcel in Fields 102 and 103. The anomalies are extremely densely packed across the two fields and have been heavily impacted by ridge and furrow. Although they cover a wide area, the anomalies can be grouped into five main areas at JKN-0001 – JKN-0005 (Figure 29).

The central anomalies at JKN-0001 are located where Fields 102 and 103 meet, covering an area 200 m wide by 150 m long. The majority of anomalies are between 1 – 3 m wide on a co-axial north – south by east – west orientation. This area can be subdivided into five smaller areas of anomalies at a – e. The most central of these areas is a, whilst areas b – e appear to form a protective boarder, surrounding a in all directions. The anomalies at a are a collection of thin rectangular anomalies 7 m wide by 20 m long, with additional anomalies extending from them in all directions. It is likely that the anomalies at a are ditches that are interconnected to form a series of weakly positive enclosures. Areas b and c to the west and east respectively contain wider, mirrored parallel anomalies, 50 – 60 m long orientated broadly north – south. These anomalies possibly relate to trackways or protective boundary ditches. Area d to the north-east has the strongest magnetic properties and similarly consists of parallel linear anomalies orientated east – west, possibly relating to a further trackway. It also looks to contain an additional 20 m square enclosure. Area e to the north-west is likely a continuation of d, containing additional linear anomalies representative of boundary ditches. The longest is 120 m long orientated east – west.

Immediately south of JKN-0001 in the south-eastern corner of Field 102 are several positive, fragmented linear and curvilinear anomalies at JKN-0002 (Figure 29). The anomalies are 2 – 3 m wide, broadly orientated north – south over an area 50 m wide and 60 m long. Although these anomalies are heavily fragmented, their strong magnetic properties and rich archaeological surroundings mean they are expected to be ditches. It is possible that they pertain to further enclosures or protective boundary ditches associated with JKN-0001. The same can be said for JKN-0003 70 m east in Field 103.

Three mildly positive linear anomalies have been identified 30 m east of JKN-0001 at JKN-0004 in the eastern portion of Field 103 (Figure 29). All three anomalies are 2 m wide. The southern two linears are parallel to one another orientated east – west, separated by 6 m. Whilst the northern anomaly is orientated north-east to south-west. Both the northern and southern-most linears also extend 15 m south at their western-most points. It is expected that these three anomalies are representative of ditches, with the southern pair forming a trackway possibly for access to JKN-0001. The northern anomaly is likely a protective boundary ditch.

Additional strongly positive linear and rectilinear anomalies have been identified 30 m north of JKN-0004 at JKN-0005 (Figure 29). The anomalies at JKN-0005 in the north-eastern corner of Field 103, are orientated on a similar co-axial orientation over an area 140 m wide by 110 m long. Like their surroundings to the south-west, these anomalies likely represent ditches or former land divisions associated with archaeological activity. The rectilinear anomaly to the north-west possibly forms the remains of an additional enclosure.

The wealth of anomalies at JKN-0001 – JKN-0005 are expected to be ditches linked with former land divisions, boundaries and multi-phase enclosures associated with settlement activity in the area. Although a definitive chronology is difficult to determine due to the impact of ridge and furrow, it is proposed that the activity is dated between Iron Age and post-medieval, with it being likely that multiple phases of use are present. A more definitive origin cannot be categorised from geophysical data alone and further investigation would be required. This area has been recorded previously from cropmarks from aerial photography as the ‘Enclosure Complex, Cromwell’ (MNT8520). It is also located immediately south of a scheduled possible medieval settlement (NHLE 1003490), listed as a Settlement west of Cromwell.

A series of positive linear and curvilinear anomalies have been identified in the south-eastern portion of the parcel in Fields 113 and 114 at JKN-0006 (Figure 35). This collection of anomalies are between 1 – 2 m wide and can be separated into five areas at a – e.

Anomalies a and b are orientated north – south across Fields 113 and 114, with 114 being completely emersed in magnetic disturbance likely associated with modern agricultural

fertiliser. The anomalies would likely combine for a length 195 m, although their continuation has been disrupted by a modern service cross-cutting the linear at its mid-point. Anomalies located in area c, extend to the west of a via a 50 m linear anomaly that eventually diverts south an additional 50 m. Three penannular anomalies have also been identified, two are interlocking internally within this area with 15 m and 13 m diameters respectively. Whilst the smaller third anomaly is 1 m wide with a 7 m. The southern two anomalies have a slight break to the east and north respectively. The smaller southern anomaly has a break to the east. Anomalies identified at d almost mirrors those at c, although instead of interconnected penannular anomalies there is a 50 m long 'L' shaped anomaly orientated north – south and east – west. A further isolated cluster of rectilinear anomalies has been located to the central-north-east of the series at e. The grouping is contained in a square-shaped rectilinear 14 m wide by 10 m long orientated north-west to south-east.

The anomalies identified at JKN-0006 are expected to be ditches relating to archaeological activity of an unknown origin. The central linear at a and b may represent a former land division, whilst the smaller areas at c and d likely relate to enclosed areas. The ring ditches in area c may relate to hut circles or drip gullies associated with Iron Age round houses. The isolated area e likely forms the remains of an additional enclosure. It is also possible that the disturbance recorded in Field 113 to the north may have masked additional anomalies related to the activity. Like JKN-0001 – JKN-0005 the anomalies at JKN-0006 have also been recorded from aerial photography, listed as 'A Cropmark Complex at Cromwell' (MNT8540).

In the eastern portion of Field 113, a combination of positive linear and curvilinear anomalies have been recorded at JKN-0007 (Figure 35). Although most of Field 113 has been affected by magnetic disturbance, there are some elements of archaeological remains still visible in the data. The main body of these anomalies covers an area 65 m wide by 110 m long, orientated north – south parallel to Field 113's eastern limits. The anomalies consist of a central grouping of larger anomalies at a – d and several smaller, more isolated anomalies in the surrounding proximity at e – h.

Area a consists of 1 m wide rectilinear anomalies, orientated coaxially north – south and east – west. The anomalies combine to form a rectangular anomaly 40 m wide by 60 m long, with a break along the southern side. These anomalies are likely ditches relating to an enclosure with an opening to the south. The anomaly also contains internal linear anomalies likely relating to internal sub-divisions.

Immediately south of a, is the anomaly at b, a moderately sized penannular anomaly, 2 m wide with a 30 m diameter and break to the east. This is associated with a known Bronze Age round barrow (MNT 17127) excavated in 1950.

The anomalies at **c** and **d** are adjacent to **a** in the north-east. Both appear to be fragmented extensions of **a**, with **c** forming an almost penannular shape and **d** appearing to form the western end of a square, likely continuing east out of the parcel limits. The curved form of anomaly **c** is 1 m wide and 65 m long, whilst **d** is the same width, but 35 m long orientated coaxially, north – south and east – west. Although they are heavily distorted, both anomalies are likely ditches forming enclosures of unknown origin.

The remaining penannular anomalies at **e** – **h** are all 1 m wide with diameters between 10 – 15 m. These anomalies have the potential to be drip gullies or hut-circles associated with round houses or small enclosures, possibly originating from the Iron Age.

The series of anomalies recorded at JKN-0007 are likely to be ditches associated with multi-phase settlement activity in the area. The survey has identified several enclosures and possible roundhouses. In the south of the series the remains of a possible Bronze Age round barrow has also been identified. According to aerial photography records from the area, the large rectangular enclosure, located centrally is thought to relate to a Neolithic – Bronze Age Mortuary enclosure (MNT 17126), whilst the penannular anomaly to the south

is classed as a Bronze Age round barrow (MNT 17127). The barrow was excavated in 1950 by an unlisted source when the mound was still visible. Several Bronze Age material culture artefacts were recorded during the excavation.

Immediately south of JKN-0007 in the south-eastern corner of the parcel, a group of positive anomalies has been recorded in Field 114 at JKN-0008 (Figure 35). The anomalies are made up of one penannular anomaly at a, and one sub-rounded rectangular anomaly at b. Anomaly a is 2 m wide, with a diameter of 34 m and a small break to the south-east. Anomaly b appears to be a series of interconnected linears that combined to form a sub-rounded rectangular shape with a break to the east. The extent of the anomaly is 20 m wide by 40 m long orientated north-south.

It is expected that the anomalies at JKN-0008 are representative of ditches relating to enclosures like those identified to the north at JKN-0007. The penannular anomaly at a is consistent with a Bronze Age round barrow, such as that to the north at JKN-0007b. Whilst the anomaly at **b** is likely a rectangular enclosure from a similar period of activity. The area has again been recorded on aerial photography as undated circular and rectangular enclosures (**MNT8874**).

A series of positive linear and rectilinear anomalies have been identified in the southern portion of the parcel, along the eastern extent of Field 103 at JKN-0009 (Figure 31). The anomalies are confined within an area 55 m wide and 80 m long, broadly orientated north – south. The individual linears are between 1 – 2 m wide and aligned on a coaxial north – south and east – west orientation. The linears are interconnected to form two broadly rectangular and square shaped anomalies at a and b respectively. The southern rectangular anomaly at a is 30m wide by 45 m long, whilst the adjacent squared shaped b to the north is 25 m wide by 35 m long. Whilst, both areas have additional linears extending west from their south-western corners, only b contains additional internal linears.

The anomalies at JKN-0009 are expected to be related to ditches combining to form a series of interconnected enclosures. Given their form and orientation, it is possible that they relate to settlement activity indicative of Romano-British origin. This activity could also be related to that recorded 400 m west at JKN-0001. Aerial photography has identified a 'Settlement complex at Cromwell' (MNT17123) immediately east of JKN-0009. It is expected that the findings from this survey are an extension of the complex recorded in aerial photography.

Several positive linear and curvilinear anomalies have been identified 130 m south-west of JKN-0009 at JKN-0010 across Fields 105 – 107 (Figures 31 and 33). The anomalies are between 1 – 3 m wide orientated north-west to south-east and of varying lengths. It is possible that these are representative of ditches associated with the wealth of surrounding archaeological findings in the area. It is also possible, however, that they are related to natural variations in the soil relating to paleochannels or enhanced agricultural trends.

Located centrally in the northern portion of the parcel are several linear and curvilinear anomalies at JKN-0011 (Figure 11) in Field C91. The anomaly is 2 m wide consisting of positive magnetic properties. Anomaly JKN-0011 is 10 m east – west on its southern extent, it then turns north for an additional 25 m and finally returns east for 20 m along its northern extent, possibly forming the western half of a square shaped anomaly. Adjoining the north-western corner is a U-shaped anomaly of similar width with a 15 m diameter. It is possible that both anomalies are ditches of archaeological origin, with the eastern rectilinear anomaly forming the western end of an enclosure. Whilst the western anomaly could form the remains of a more rounded enclosure. Given the anomaly's isolation from any supporting archaeological evidence it is also possible that it is geological in origin or related to modern agricultural practices. Although an archaeological origin cannot be ruled out entirely. It is possible that the anomaly continues north outside of the survey extents.

Several isolated, positive linear and curvilinear anomalies have been recorded across the northern portion of the parcel. These anomalies are between 1 – 3 m wide and are broadly orientated either north – south or east – west. Although it is possible they are archaeological ditches, their relative isolation from any other archaeological anomalies means they are more likely related to modern agricultural practices or geological variations. Linear anomalies JKN-0012 – JKN-0014 all contain slightly dipolar magnetic properties which could be associated with modern drainage, whilst curvilinear anomalies JKN-0015 – JKN-0017 are all more sinuous in form, possibly relating to paleochannels.

7.3.2 Interpretation: Historical Agriculture

Several linear anomalies have been identified across the parcel associated with former field boundaries at JKN-0018 – JKN-0030 (Figures 5, 11 – 13, 23 – 25, 31 - 33). All are first recorded on 1884 OS mapping and most (JKN-0019 – JKN-0030) are last recorded on the 1961 mapping, but no longer visible on satellite mapping dated 2002 (Google Earth 2023). The former boundary in Field 107 at JKN-0031, however, was first recorded in 1884 but was no longer visible on 1888 OS mapping. No evidence of historical landscape features have been identified in this survey.

Additionally, multiple areas of weak, positive, parallel, linear anomalies have been identified across the parcel at JKN-0032 – JKN-0041 (Figures 11 – 15, 23 - 25, 29 and 35). The average distance between lines is 6 m, orientated either north – south or east – west, with a slight curvature in form. These anomalies have been interpreted as ridge and furrow. Given their spacing and curved form, it is possible that these anomalies are of medieval date.

7.3.3 Interpretation: Modern Agriculture

Evidence of modern agriculture has been recorded throughout this survey. Some enhanced linear trends have been identified along the field boundaries, likely associated with headland areas. Whilst the majority of linear trends located centrally within fields are expected to be associated with modern ploughing, matching similar trends visible on satellite mapping of the area. The best examples of this are prevalent in Fields 93 and 96.

7.3.4 Interpretation: Natural

Evidence of large-scale geological variation has been identified within the survey in the southern portion of the parcel in Field 105. The large area identified as geology masks the north-eastern portion of the field. Due to their lack of clear shape or pattern, these have been interpreted as natural geological variations, thought to be caused by variations in the depth and composition of the soils and the superficial deposits from which they derive. Whilst a complex network of negative, interconnected, sinuous anomalies has been identified in the eastern portion of Field 85. The network is confined across an area 50 m wide and 45 m long. The form and magnetic properties of these anomalies is characteristic of paleochannels.

7.3.5 Interpretation: Modern

Several strong dipolar linear anomalies have been identified in Fields 5, 7, 9, 11, 23, 25, 29, and 35 at JKN-0042 – JKN-0050 (Figure 5, 9 – 11, 17, 29 - 33). These anomalies have been recorded on a variety of differing orientations. The linear form and strong magnetic characteristics are indicative of modern services.

Across the parcel, numerous instances of increased magnetic response have been recorded at JKN-0051 – JKN-0056 (Figures 5, 25, 31, and 35). Anomalies JKN-0051 and JKN-0052 are the result of modern infrastructure, with JKN-0051 corresponding to an access track associated with of a wind turbine in Field 5. Whilst the disturbance recorded in Field 21 is likely generated by the metal pylon it surrounds at JKN-0052. Anomalies JKN-0053

– JKN-0055 are small areas of disturbance located up against field boundaries. It is expected that these areas of disturbance are associated with a build-up of magnetic material. The final anomaly at JKN-0056 engulfs the entirely of Field 113 and is likely resulting from modern agricultural activity associated with fertilisation. All these instances mask potential anomalies in the data, therefore limiting the effectiveness of the survey.

Several thin linear anomalies have been identified across the survey area. These anomalies are exclusively highlighted due to their either negative or dipolar magnetic properties, indicative of modern drainage.

The survey has also detected multiple isolated clusters of low magnitude and dipolar anomalies that have been interpreted as ferrous in origin. These likely relate to natural variation in the soils and background geology and are of little archaeological impact. Further examples of ferrous responses have been identified around the periphery of certain fields. This is likely due to metal fencing within the boundaries and interference from the adjacent roads and tracks. No evidence of increased magnetic response has been recorded across the parcel.

7.3.6 Interpretation: Unknown

A series of linear trends have been recorded across the parcel. They have been recorded as such due to their uncertain origin. Whilst the majority are expected to be modern in origin and associated with agricultural activity, a possible archaeological origin cannot be ruled out entirely. Especially those recorded in Fields 102 – 106, 113, and 114.

7.4 Preliminary Conclusions

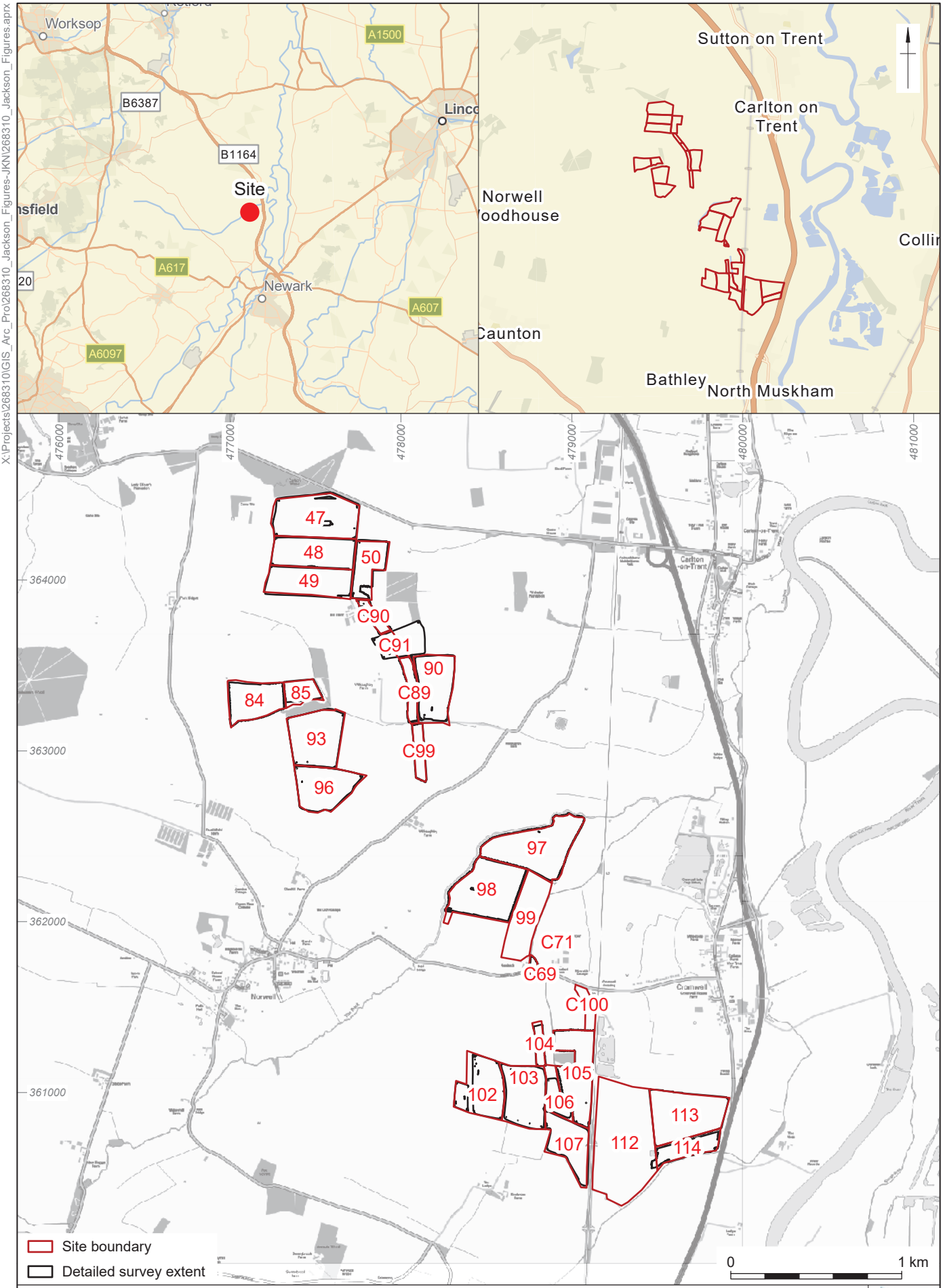
The gradiometer survey has been successful in detecting anomalies of archaeological origin in the southern portion of the parcel. Numerous ditches have been identified associated with large-scale multi-phase activity. Ditches linked with former land divisions, boundaries, and multi-phase enclosures associated with settlement activity in the area have been identified in both the south-west and south-eastern corners of the parcel. Although a definitive chronology is difficult to determine due to the impact of ridge and furrow in the area, it is proposed that the activity is possibly dated between the Iron Age and post-medieval. A more definitive origin cannot be categorised from geophysical data alone and further investigation would be required.

Anomalies identified in the south-western portion of the sight are more rectilinear in form, whilst those identified amongst the south-eastern anomalies are more curvilinear, relating to ring-ditches, roundhouses, sub-rounded enclosures, and possible Bronze Age barrows. Some of these anomalies have been partially identified previously via cropmarks visible on aerial photography of the area, identified as complex enclosure activity near Cromwell.

Several isolated linear positive anomalies have also been identified across the parcel. These anomalies could possibly relate to archaeological activity in area in the form of ditches. Although an archaeological origin cannot be ruled out entirely, it is also possible that the anomalies are geological in origin or related to modern agricultural practices.

Evidence of the parcel's agricultural past has also been identified in the form of former field boundaries. Most anomalies were visible on OS mapping dating from 1888 and last visible in 1961.

Indication of large-scale geological variation has also been highlighted to the south, with a small complex of paleochannels located centrally in the parcel. Isolated areas of ridge and furrow have also been identified in addition to multiple examples of modern ploughing practices. Multiple modern services have also been identified across the parcel as well as evidence of increased magnetic response.



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Figure 1: Site location and survey extents

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476000 477000 478000 479000 480000 481000

365000 364000 363000 362000 361000 360000

Ossington
Carlton-on-Trent
Norwell
Cromwell

Figure 4
Figure 6
Figure 8
Figure 10
Figure 12
Figure 14
Figure 16
Figure 18
Figure 20
Figure 22
Figure 24
Figure 26
Figure 28
Figure 30
Figure 32
Figure 34

ERM

Site boundary
Detailed survey extent

-2 nT 3 nT

0 1 km

Coordinate system: OSGB 1936 British National Grid
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Date: 05/07/2023	Created by: ADT	
Scale: 1:20,000	Revision: 0	

Figure 2: Detailed gradiometer survey results: overall greyscale plots (-2nT to 3nT)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

476000 477000 478000 479000 480000 481000

365000 364000 363000 362000 361000 360000

Ossington
Carlton-on-Trent
Norwell
Cromwell

Figure 5
Figure 7
Figure 9
Figure 11
Figure 13
Figure 15
Figure 17
Figure 19
Figure 21
Figure 23
Figure 25
Figure 27
Figure 29
Figure 31
Figure 33
Figure 35

ERM

Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 1 km

Coordinate system: OSGB 1936 British National Grid
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Figure 3: Detailed gradiometer survey results: overall interpretation

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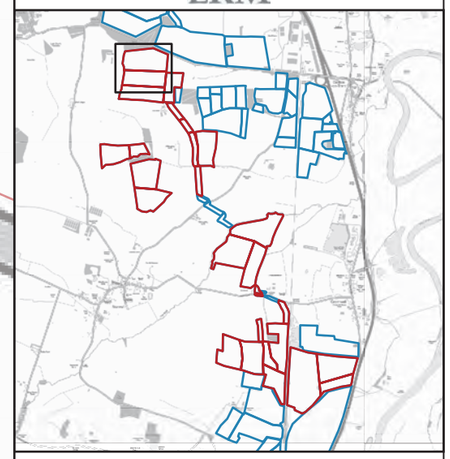
477200

477400

477600

364400

364200



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 4: Detailed gradiometer survey results: greyscale plot (47 - 48)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

477200

477400

477600

364400

364200

JKN-0013

JKN-0041

JKN-0014

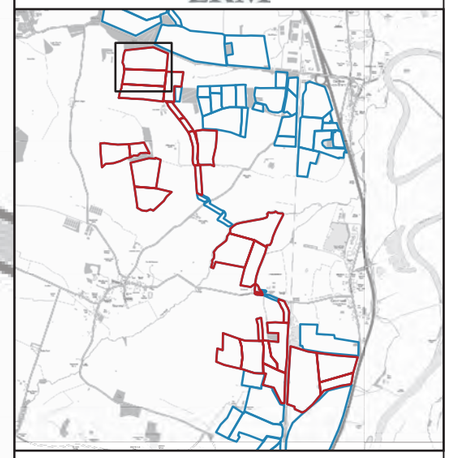
JKN-0018

JKN-0050

JKN-0043

JKN-0016

JKN-0042



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 5: Detailed gradiometer survey results: interpretation (47 - 48)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

477200

477400

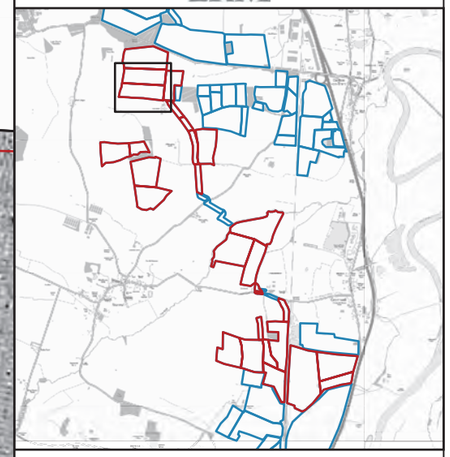
477600

364200

364000

363800

Hill Farm



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 6: Detailed gradiometer survey results: greyscale plot (49)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

477200

477400

477600

364200

364000

363800

JKN-0050

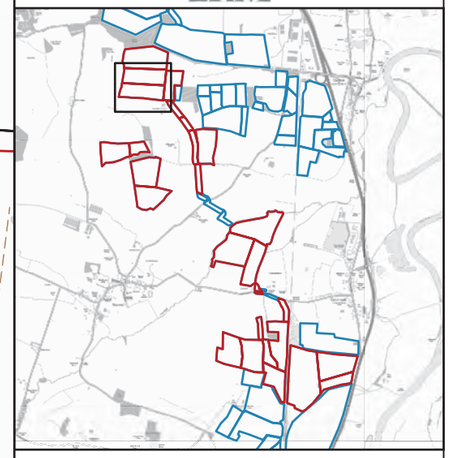
JKN-0043

JKN-0016

JKN-0042

JKN-0044

Hill Farm



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 7: Detailed gradiometer survey results: interpretation (49)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

477600

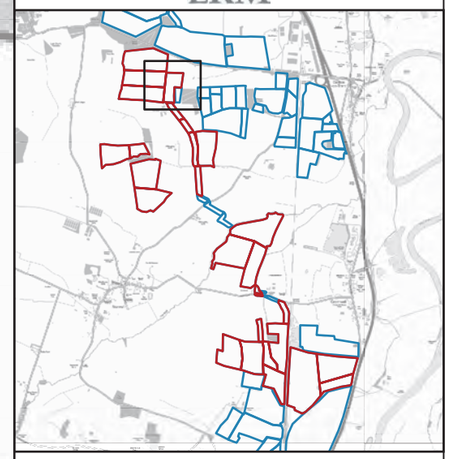
477800

478000

364200

364000

W



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 8: Detailed gradiometer survey results: greyscale plot (50)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

477600

477800

478000

JKN-0050

JKN-0043

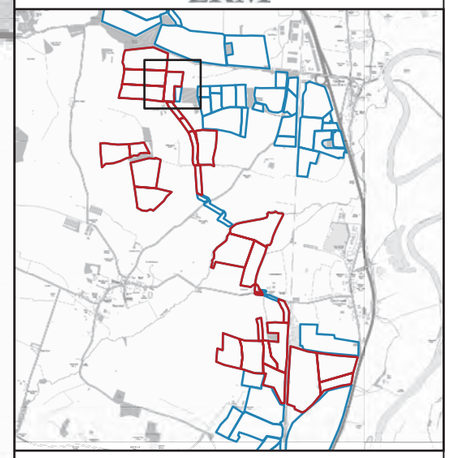
364200

JKN-0042

364000

JKN-0044

W



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 9: Detailed gradiometer survey results: interpretation (50)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

477800

478000

478200

363800

Farm

363600

ERM

Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 10: Detailed gradiometer survey results: greyscale plot (C90 - C91)

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JKN-0044

477800

478000

478200

363800

Farm

JKN-0039

JKN-0027

JKN-0011

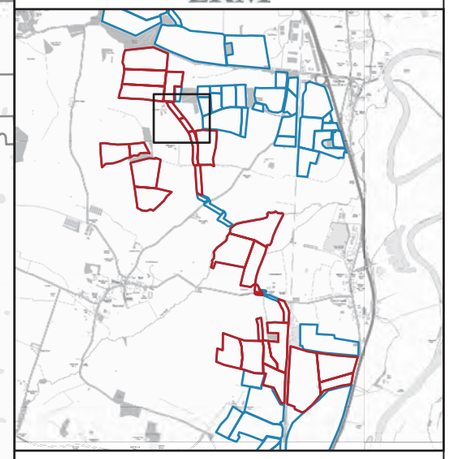
JKN-0049

JKN-0028

JKN-0029

363600

ERM



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

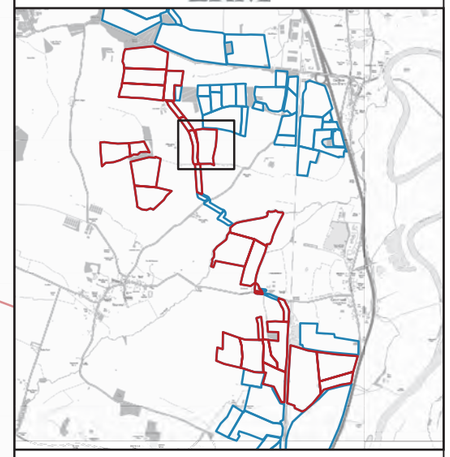
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Figure 11: Detailed gradiometer survey results: interpretation (C90 - C91)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

478000
478200
478400
363600
363400
363200



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 12: Detailed gradiometer survey results: greyscale plot (90 and C89)

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JKN-0020

JKN-0019

478000

478200

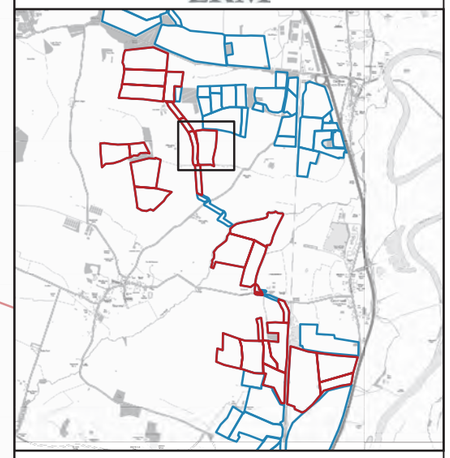
478400

363600

363400

363200

ERM



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 13: Detailed gradiometer survey results: interpretation (90 and C89)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

478000

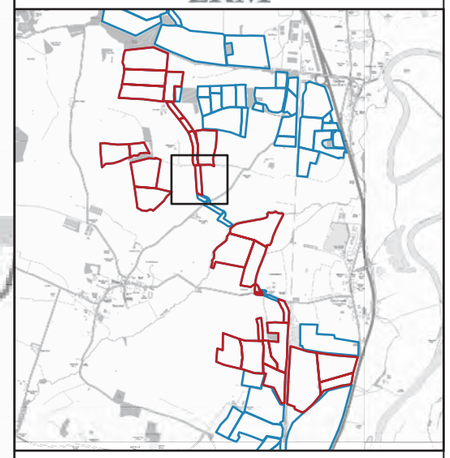
478200

478400

363200

363000

362800



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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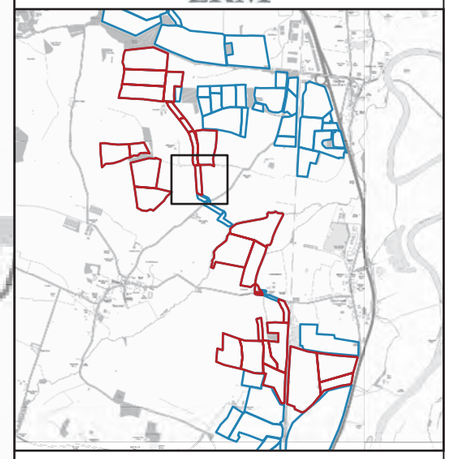
Figure 14: Detailed gradiometer survey results: greyscale plot (C99)

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478000
478200
478400
363200
363000
362800

JKN-0040

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 15: Detailed gradiometer survey results: interpretation (C99)

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363600

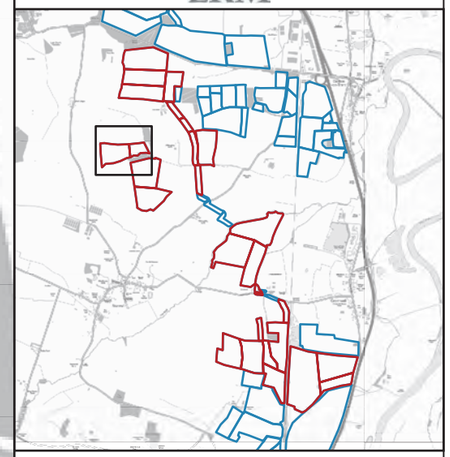
477000

477200

477400

363400

363200



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 16: Detailed gradiometer survey results: greyscale plot (84 - 85)

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363600

477000

477200

477400

363400

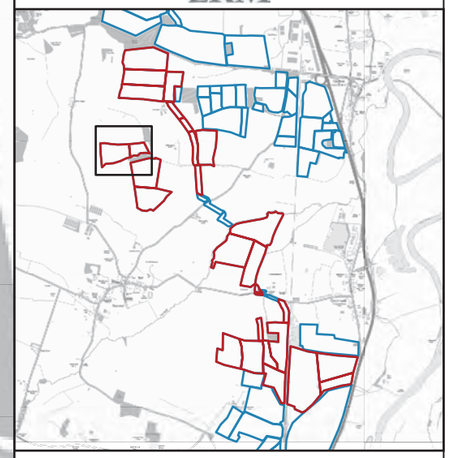
363200

JKN-0046

JKN-0045

JKN-0015

JKN-0012



Site boundary
Detailed survey extent
Archaeology
Possible archaeology
Former field boundary
Historic landscape feature
Geology
Geomorphology
Historic cultivation
Modern service
Increased response
Ferrous
Agricultural feature
Drain
Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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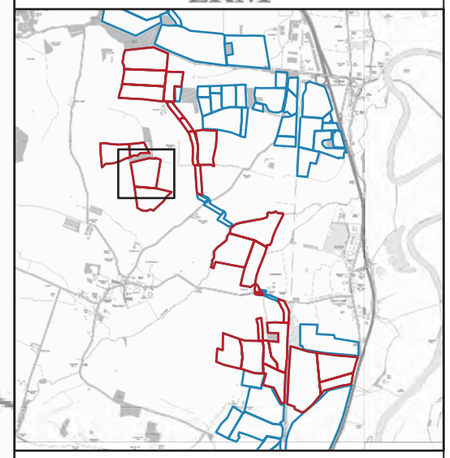
Date: 05/07/2023 | Created by: ADT

Scale: 1:2000 | Revision: 0

Figure 17: Detailed gradiometer survey results: interpretation (84 - 85)

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477200
477400
477600
477800
363200
363000
362800



Site boundary
Detailed survey extent

-2 nT
3 nT

0
50 m

Coordinate system: OSGB 1936 British National Grid
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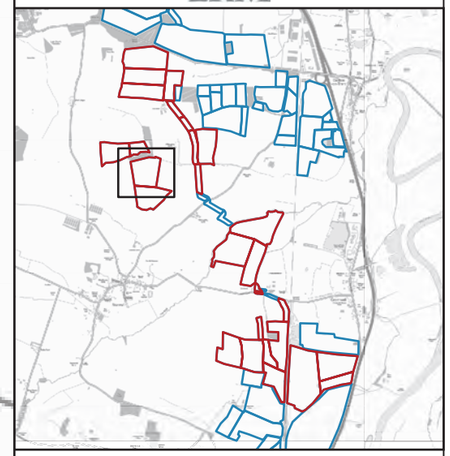
Date: 05/07/2023	Created by: ADT	
Scale: 1:2000	Revision: 0	

Figure 18: Detailed gradiometer survey results: greyscale plot (93)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

477200
477400
477600
477800
363200
363000
362800

JKN-0045
JKN-0020



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

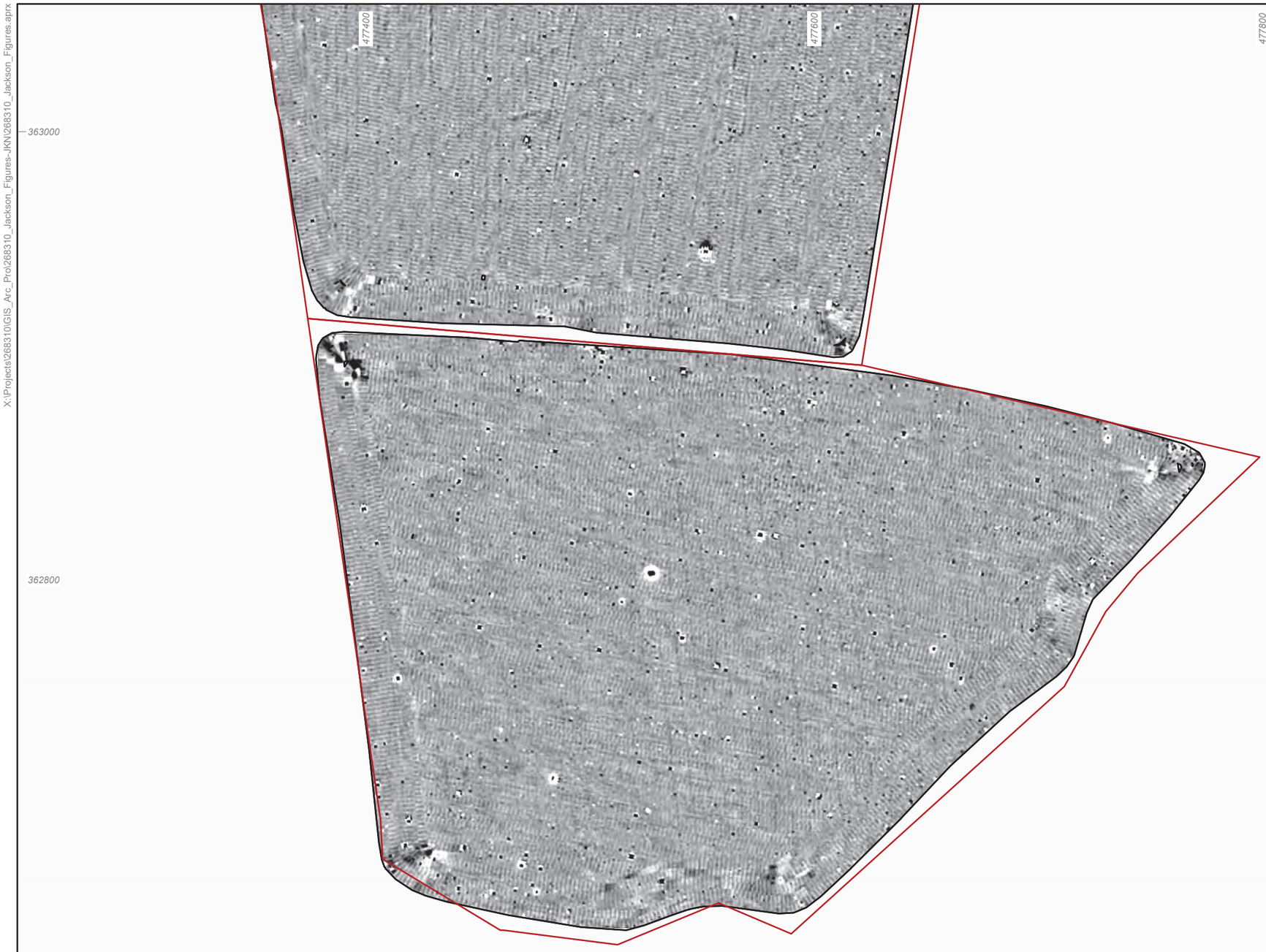
0 50 m

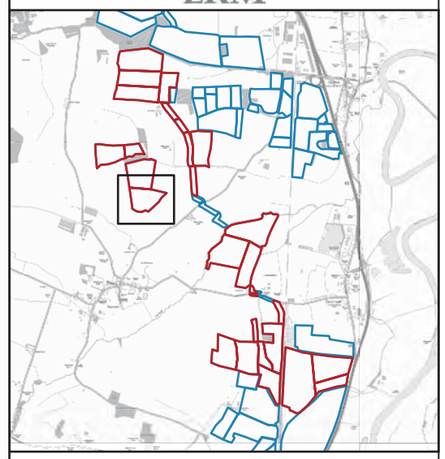
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Figure 19: Detailed gradiometer survey results: interpretation (93)

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Site boundary

Detailed survey extent

-2 nT 3 nT

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 20: Detailed gradiometer survey results: greyscale plot (96)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

477400

477600

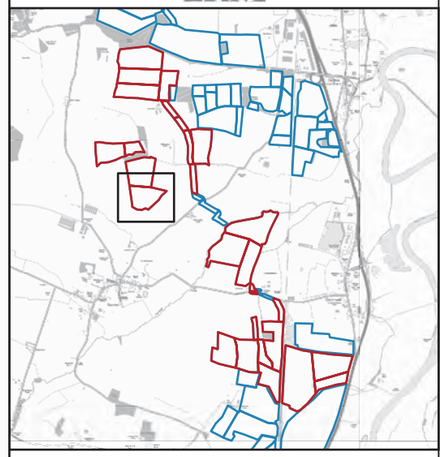
477800

363000

362800

362600

JKN-0020



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 21: Detailed gradiometer survey results: interpretation (96)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

478600

478800

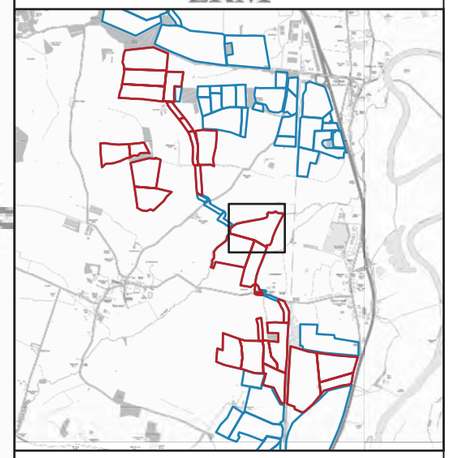
479000

362600

362400

362200

W



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 22: Detailed gradiometer survey results: greyscale plot (97)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

478600

478800

479000

362600

362400

362200

JKN-0021

JKN-0017

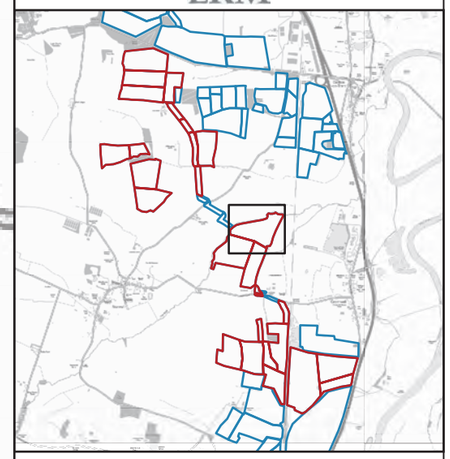
JKN-0022

JKN-0031

JKN-0032

JKN-0023

W



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Scale: 1:2000	Revision: 0

Figure 23: Detailed gradiometer survey results: interpretation (97)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

478200

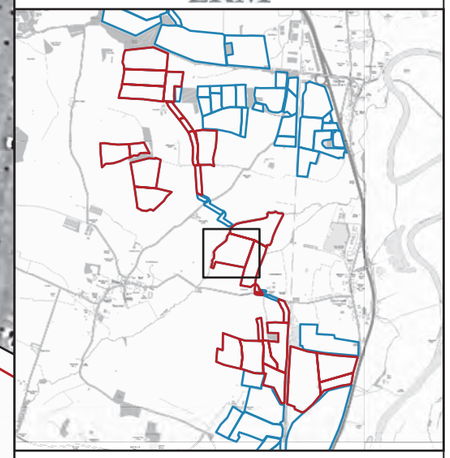
478400

478600

362400

362200

362000



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Date: 05/07/2023	Created by: ADT	
Scale: 1:2000	Revision: 0	

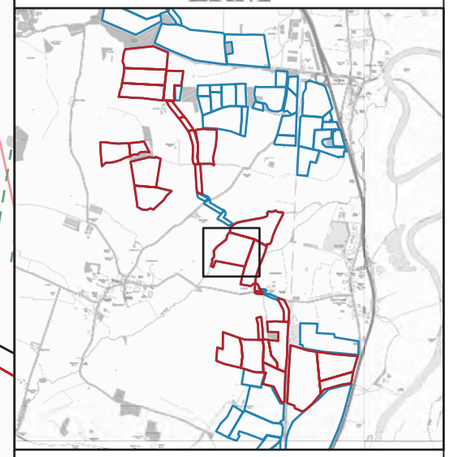
Figure 24: Detailed gradiometer survey results: greyscale plot (98)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-JKN\268310_Jackson_Figures.aprx

478200
478400
478600
362400
362200
362000

JKN-0031
JKN-0032
JKN-0023
JKN-0051
JKN-0024
JKN-0052
JKN-0033

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 25: Detailed gradiometer survey results: interpretation (98)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

478600

478800

479000

361800

361600

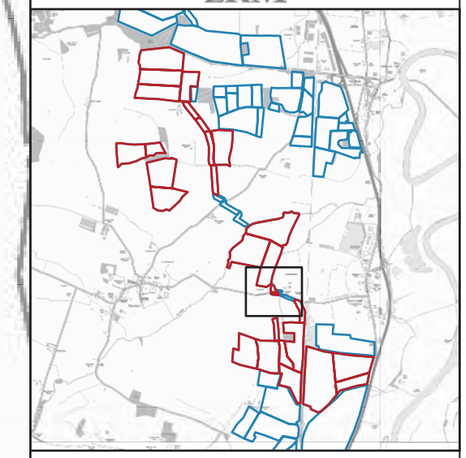
Cromwell Moor

Newlands

Moorfield Farm

Moorside Cottage

NORWELL LANE



Site boundary

Detailed survey extent

-2 nT

3 nT

0

50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 26: Detailed gradiometer survey results: greyscale plot (C69 - C71)

X:\Projects\268310\GIS_Arc_Pro\268310_Jackson_Figures-UKN\268310_Jackson_Figures.aprx

478600

478800

479000

361800

361600

Cromwell Moor

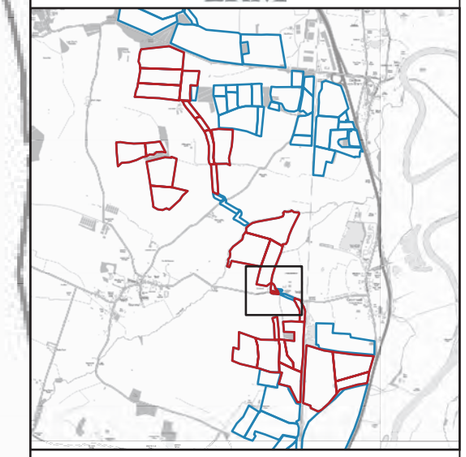
Newlands

Moorfield Farm

Moorside Cottage

NORWELL LANE

ERM



- Site boundary
- Detailed survey extent
- Archaeology
- Possible archaeology
- Former field boundary
- Historic landscape feature
- Geology
- Geomorphology
- Historic cultivation
- Modern service
- Increased response
- Ferrous
- Agricultural feature
- Drain
- Trend

0 50 m

Coordinate system: OSGB 1936 British National Grid
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Figure 27: Detailed gradiometer survey results: interpretation (C69 - C71)