Great North Road Solar and Biodiversity Park

Environmental Statement

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Interrim Geophysical Survey Report

Great North Road Solar Farm, Staythorpe

For

York Archaeology

On Behalf Of

Elements Green Trent Limited

Magnitude Surveys Ref: MSSK1838

OASIS Number: TBC

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c.635 ha of Great North Road Solar Scheme in Staythorpe, Nottinghamshire. A fluxgate gradiometer survey was successfully completed on a 515ha area of land, with the remainder of the survey area unable to be surveyed due to unsuitable ground conditions, overgrown vegetation. The survey responded well to the environment of the survey area with a range of anomalies of archaeological, agricultural, modern, natural and undetermined origin identified throughout. Increased magnetic response was visible at field perimeters and in proximity to farming equipment, pylons, overhead cables, extant structures and buried services. A number of possible and probable archaeological anomalies have been identified, within three areas of archaeological activity. The majority of these areas appear to form isolated Iron Age/Romano-British enclosures in close proximity to the River Trent, Kersall and North Muskham. Anomalies relating to the historical and modern agricultural use of the landscape are evident across the survey area in the form of ridge and furrow cultivation regimes, modern ploughing trends, mapped and unmapped former field boundaries and drainage systems. A number of geological variations have been detected across the survey area that may indicate the presence of colluvial and alluvial material. In addition, a number of anomalies have been classified as undetermined, these are of uncertain date and function and have little supporting context.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by York Archaeology on behalf of Elements Green Trent Limited to undertake a geophysical survey over a c. 635ha area of land at Great North Road Solar Farm, Staythorpe, Nottinghamshire (SK 70958 61456). The following interim report covers an area of c. 515ha.

1.2. The geophysical survey comprised hand-pulled/quad-towed, cart-mounted and hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken featured buildings (SFBs) and industrial activity (David *et al*., 2008).

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David *et al*., 2008), the Chartered Institute for Archaeologists (CIfA, 2020) and the European Archaeological Council (Schmidt *et al.,* 2015).

1.4. It was conducted in line with a WSI produced by MS (Dyulgerski, 2024).

1.5. The first stage of the survey commenced on 09/09/2024 and took 7 weeks to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society for Archaeological Prospection).

2.2. The directors of MS are involved in cutting edge research and the development of guidance/policy. Specifically, Dr Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London and a Member of CIfA, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

2.3. All MS managers, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

3. Objectives

3.1. The following present the aims and objectives established in the previously approved WSI (ERM,2022).

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

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

3.2. 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.

4. Geographic Background

4.1. 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 7 km long, extending from Staythorpe and running towards the villages of North Muskam, and Cromwell. The north-west route is 11 km long extending from Staythorpe towards Kersall, and heading towards Kneesall Wood.

4.2. The survey area for this stage of the project consists of 78 previously unsurveyed land parcels measuring (c. 625ha) located north of Ossington, east of Kersall, west of Maplebeck and north of Averham (Figure 1-4).

4.3. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Arable, Flat.	The area had no physical boundary to the north and northwest and was bordered by a treeline and hedgerows in all other directions.
2	Arable, Flat.	The area had no physical boundary to the southwest and was bordered by a treeline and hedgerows in all other directions.
3	Arable, Flat.	The area had no physical boundary to the south and east and was bordered by a treeline and hedgerows in all other directions.
4	Arable, Flat.	The area had no physical boundary to the east and south and was bordered by a treeline and hedgerows in all other directions.
5	Arable, Flat.	The area had no physical boundary to the east and north and was bordered by hedgerows in all other directions.
6	Arable, Flat.	The area was bordered by a ditch to the west, by a treeline to the east and by hedgerows in all other directions. Deep tractor ruts were present parallel to the eastern and western boundaries and were unable to be surveyed.

7	Arable, Flat.	The area was bordered by hedgerows and a treeline in all directions.
8	Arable, sloping down to the south.	The area was bordered by a treeline and vegetation to the south and by hedgerows in all other directions.
9	Arable, Flat.	The area was bordered by a treeline and vegetation to the south and by hedgerows in all other directions.
10	Arable, Flat.	The area was bordered by hedgerows in all directions.
11	Arable, Flat.	The area had no physical boundary to the southwest and was bordered by a treeline and vegetation in all other directions.
12	Arable, Flat.	The area had no physical boundary to the north and was bordered by a treeline and vegetation in all other directions.
13	Arable, Flat.	The area had no physical boundary to the north and was bordered by a treeline and vegetation in all other directions.
14	Arable, Flat.	The area was bordered by a trackway to the southwest and by hedgerows and a treeline in all other directions.
15	Arable, Flat.	The area was bordered by a trackway to the east and west and had no physical boundary in all other directions.an area in the east weas unable to be surveyed due to overgrown vegetation.
16	Overgrown grassland, Flat.	The area was bordered by a trackway to the north and had no physical boundary in all other directions. A large majority of this area was unable to be surveyed due to overgrown vegetation.
17	Arable, Flat.	The area was bordered by a trackway to the east and by hedgerows and a treeline in all other directions.
18	Arable, Flat.	The area was bordered by hedgerows and a treeline in all directions.
19	Arable, Flat.	The area was bordered by hedgerows and a treeline in all directions.
20	Arable, Flat.	The area had no physical boundary to the south and was bordered by hedgerows in all other directions.
21	Arable, Flat.	The area was bordered by hedgerows and a ditch in all directions.
22	Arable, Flat.	The area was bordered by hedgerows and a ditch in all directions.
23	Arable, Flat.	The area was bordered by hedgerows and a ditch in all directions.
24	Arable, sloping down to the east.	The area had no physical boundary to the southeast and was bordered by hedgerows in all other directions.

25	Arable, undulating.	The area was bordered by hedgerows and a ditch in all directions.
26	Arable, undulating.	The area had no physical boundary to the northeast and was bordered by hedgerows in all other directions. Overhead cables and telegraph poles were oriented along the western boundary.
27	Arable, undulating.	The area had no physical boundary to the east and west and was bordered by hedgerows and a ditch in all other directions.
28	Arable, undulating.	The area had no physical boundary to the east and west and was bordered by hedgerows and a ditch in all other directions.
29	Arable, undulating.	The area had no physical boundary to the northwest and was bordered by hedgerows in all other directions.
30	Arable, undulating.	The area was bordered by hedgerows and a ditch in all directions. Overhead cables and telegraph poles were oriented northwest to southeast through the survey area.
31	Arable, undulating.	The area was bordered by hedgerows in all directions.
32	Arable, undulating.	The area was bordered by hedgerows in all directions.
33	Arable, undulating.	The area had no physical boundary to the south and was bordered by hedgerows in all other directions.
34	Arable, undulating.	The area had no physical boundary to the southwest and was bordered by hedgerows in all other directions.
35	Arable, undulating.	The area had no physical boundary to the south and was bordered by hedgerows in all other directions
36	Arable, undulating.	The area had no physical boundary to the south and was bordered by hedgerows and a ditch in all other directions. Overhead cables and a telegraph pole were oriented northwest to southeast through the survey area and were oriented along the eastern boundary.
37	Arable, Flat.	The area was bordered by hedgerows in all directions. Overhead cables and a telegraph pole were oriented northeast to southwest through the northwest of the survey area.
38	Arable, Flat.	The area was bordered by hedgerows and a ditch in all directions.
39	Arable, Flat.	The area was bordered by a trackway and hedgerows to the west, and by hedgerows in all other directions.
40	Arable, Flat.	The area had no physical boundary to the southeast and was bordered by hedgerows in all other directions.

41	Arable, sloping down to the southwest.	The area had no physical boundary to the southeast and east and was bordered by hedgerows in all other directions.
42	Arable, undulating.	The area had no physical boundary to the southwest, was bordered by a grass verge to the east and was bordered by hedgerows in all other directions.
43	Arable, undulating.	The area was bordered by hedgerows in all directions.
44	Arable, Flat.	The area was bordered by hedgerows to the north and west and had no physical boundary in all other directions.
45	Arable, Flat.	The area was bordered by hedgerows to the south and had no physical boundary in all other directions.
46	Arable, sloping down to the northwest.	The area was bordered by hedgerows to the northwest and had no physical boundary in all other directions.
47	Arable, Flat.	The area was bordered by hedgerows in all directions.
48	Arable, Flat.	The area had no physical boundary to the west and was bordered by hedgerows in all other directions.
49	Arable, Flat.	The area had no physical boundary to the north and was bordered by hedgerows in all other directions.
50	Arable, undulating.	The area had no physical boundary to the north and was bordered by hedgerows in all other directions. Overhead cables and telegraph poles were oriented northwest to southeast through the centre of the survey area.
51	Arable, sloping down to the east.	The area had no physical boundary to the west and was bordered by hedgerows in all other directions. Overhead cables were oriented north to south through the east of the area.
52	Arable, Flat.	The area had no physical boundary to the east and west and was bordered by hedgerows in all other directions.
53	Arable, Flat.	The area was bordered by a ditch and hedgerows to the north and south and had no physical boundary in all other directions. The field was also bisected by a hedgerow-oriented east to west through the centre of the field.
54	Arable, Flat.	The area was bordered by hedgerows and a ditch to the east, and by hedgerows in all other directions.
55	Arable, undulating.	The area was bordered by hedgerows and a ditch to the west, and by hedgerows in all other directions.

56	Arable, undulating.	The area was bordered by hedgerows and a ditch to the south, and by hedgerows in all other directions.
57	Arable, undulating.	The area was bordered by hedgerows and a ditch to the north and east, and by hedgerows in all directions. Overhead cables and telegraph poles were oriented northeast to southwest through the west of the survey area.
58	Arable, undulating.	The area was bordered by a treeline to the west, and by hedgerows in all other directions.
59	Arable, Flat.	The area was bordered by hedgerows in all directions.
60	Arable, Flat.	The area was bordered by hedgerows in all directions.
61	Arable, Flat.	The area was bordered by hedgerows in all directions. Overhead cables and a pylon were oriented north to south through the east of the field.
62	Arable, Flat.	The area had no physical boundary to the southwest, was bordered by hedgerows in all other directions.
63	Arable, Flat.	The area had no physical boundary to the east, was bordered by a treeline to the north and by hedgerows in all other directions.
64	Arable, Flat.	The area was bordered by hedgerows in all directions.
65	Arable, Flat.	The area had no physical boundary to the west, was bordered by hedgerows in all other directions.
66	Arable, Flat.	The area was bordered by hedgerows in all directions.
67	Arable, Flat.	The area was bordered by hedgerows in all directions.
68	Arable, sloping down from the northwest.	The area was bordered by hedgerows in all directions. Overhead cables and a telegraph pole were oriented east to west through the southeast of the survey area.
69	Arable, Flat.	The area was bordered by hedgerows to the north and by a trackway to the south and had no physical boundary in all other directions.
70	Arable, Flat.	The area was bordered by overgrown vegetation to the south, and by hedgerows in all other directions.
71	Arable, Flat.	The area had no physical boundary to the southwest and northeast and was bordered by hedgerows in all other directions.
72	Arable, Flat.	The area had no physical boundary to the south and east and was bordered by hedgerows in all other directions.
73	Arable, Flat.	The area had no physical boundary to the west and was bordered by hedgerows to the north

		and south, and by overgrown vegetation to the east.
74	Arable, Flat.	The area had no physical boundary in all directions.
75	Arable, Flat.	The area was bordered by a ditch to the west, fencing to the northeast, and had no physical boundary in all other directions. Some areas were unable to be surveyed due to overgrown vegetation.
76	Arable, Flat.	The area was bordered by hedgerows to the northwest and southwest and had no physical boundary in all other directions.
77	Arable, undulating.	The area was bordered by hedgerows and a ditch to the north and by hedgerows in all other directions. Hay bales were present in the northeast of the survey area, and a section in the south was unable to be surveyed due to overgrown vegetation.
78	Arable, Flat.	The area was bordered by hedgerows to the north and south and had no physical boundary in all other directions.

4.4. The underlying bedrock geology across the site is principally Mercia Mudstone. 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 (BGS 2025). 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.

4.5. The soils consist of slightly acid loam and clayey soils with impeded drainage across the majority of the survey area. Loam and clayey floodplain soils with naturally high ground water were identified along the course of the Beck near Kersall and Maplebeck (Soilscapes, 2025).

4.6. 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). The minor tributaries extending west from this also occupy moderately low-lying areas (30 – 45 m aOD), between Kersall and Caunton and alongside Maplebeck.

5. Archaeological Background

5.1. 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 and collated in a Written Scheme of Investigation for the entire project (ERM, 2022). The following gives an brief overview of the above data set.

5.2. 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.

5.3. 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). 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 evidence4. 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 shows 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 later Mesolithic deposits also yielded a human femur and animal bones from a range of species including roe deer and aurochs.

5.4. 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.

5.5. 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.

5.6. 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.

5.7. 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.

5.8. 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).

5.9. 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).

6. Methodology

6.1. Data Collection

6.1.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

6.1.2. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.3. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.4. The magnetic data were collected using MS' bespoke hand-pulled/quad-towed cart system OR hand-carried GNSS-positioned system.

6.1.4.1. MS' cart OR hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK

GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.4.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.4.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2.Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.2 in David *et al.,* 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen *et al*. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3.Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figures 67 to 211). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2025) was also consulted, to compare the results with recent land use.

6.3.3. Geodetic position of results – All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data/vector mapping.

7. Results

7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible, an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports, as well as reports from further work, in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in combination with satellite imagery and historical maps (Figures 6 to 64).

7.2.2. A fluxgate gradiometer survey was carried out at Great North Road Solar Scheme, Staythorpe. An area of approximately c. 515ha has been surveyed during this phase of the project (Figures 2-4). The survey has generally responded well to the environment of the survey area. Areas of magnetic disturbance from modern activity are present at the edges of the survey areas. Further interference is present from, agricultural equipment, along the routes of buried services, and underneath overhead cables and pylons. The effect on the data caused by this interference is limited but locally significant. Despite this, the survey has identified numerous anomalies of archaeological, agricultural, modern, natural and undetermined anomalies.

7.2.3. The survey has expanded upon the current available HER evidence within the scope of the proposed solar farm. It has identified three main areas of archaeological activity and corroborated and expanded on cropmark evidence within the area. The three foci of activity generally consist of weak positive magnetic anomalies emblematic of cut features with magnetically enhanced fill such as ditches and pits. While the weak magnetic signature presented in the gradient figures (Figures 5 to 63) is not optimal for the identification of the full extent of these anomalies, the Total field Plot figure presented in the report have been used in the interpretation to better differentiate the archaeological anomalies from the general magnetic background.

7.2.4. The morphology of some of the identified anomalies have been distinctive enough to allow for a tentative dating of the anomalies. In Areas 34-39 (Figures 123 to 135) a general later Iron Age/Romano British date is suggested for the identified enclosure complexes based on their morphological characteristics such as their well-defined rectilinear structure and ring ditch anomalies.

7.2.5. In the western and southwestern part of the survey area additional rectilinear anomalies have been identified in Areas 58 and 62 (Figure 50 and 61). These appear to form partial rectilinear anomalies that corelate with cropmarks identified on the satellite imagery. Even though these anomalies do not have any identifiable characteristics they are likely associated with previously recorded Romano/British settlements around North Muskam and the River Trent valley (See section 5.6).

7.2.6. Anomalies exhibiting properties less-clearly characteristic of anthropogenic activity, yet with some potential to be the result of human actions in antiquity have been detected throughout the survey area and characterised as 'possible archaeology' (Figures 126 to 195). These anomalies are mostly linear or curvilinear and appear representative of cut features with magnetically enhanced infill. Although these anomalies are most likely to result from the presence of archaeological features, a clear origin cannot be determined through the morphology and signal of these anomalies alone.

7.2.7. Located in Areas 35, 39 and 138 numerous strong positive anomalies and spreads of strongly enhanced magnetic material have been identified (Figures 146, 149 and 152). These anomalies roughly correspond to the remains of the former RAF Ossington visible on satellite imagery (Figure 83).

7.2.8. Former field boundaries have been identified throughout the survey area. These are identified as both strong and weak, linear anomalies and as spreads of magnetically enhanced material, some of which align with features marked on 2nd Edition OS mapping (Figures 6 to 48). The magnetically enhanced anomalies are likely to represent former field boundaries that are indicated through the presence of concentrations of ferrous material. Those that do not correspond with known former boundaries present a similar magnetic signal or follow similar alignments and are therefore likely to be unmapped former field boundaries.

7.2.9. Groups of parallel linear and curvilinear anomalies occur across the survey area and have been interpreted as ridge and furrow cultivation. These have multiple different orientations and differences in spacing and morphology, all of which suggest they are from different periods of agricultural use. Some of these appear to cross probable archaeological anomalies and may obscure smaller or weaker anthropogenic evidence (Figures 4 to 201). A large number of these ridge and furrow regimes also appear to have the magnetic characteristics of ceramic drainage features, which might suggest a later reuse (Figures 6, 26, 38, 42, 58, and 86).

7.2.10. The survey area is extensively covered by a series of drainage regimes predominantly in low lying areas in the topography. This suggests the presence of a seasonally waterlogged landscape that, on the evidence of the types of drains present in the geophysical results has been drained in the post-medieval and modern periods. Information from the Soilscapes database (Section 4.6) corroborates this, with floodplain soils in the southwest, and seasonally wet soils with impeded drainage across the remainder of the survey area.

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Data Artefact** – Data artefacts usually occur in conjunction with anomalies with strong magnetic signals due to the way in which the sensors respond to very strong point sources. They are usually visible as minor 'streaking' following the line of data collection. While these artefacts can be reduced in post-processing through data filtering, this would risk removing 'real' anomalies. These artefacts are therefore indicated as necessary in order to preserve the data as 'minimally processed'.

7.3.1.3. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.

7.3.1.4. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentration of multiple discrete, dipolar anomalies usually resulting from highly magnetic material such as rubble containing ceramic building materials and ferrous rubbish.

7.3.1.5. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.

7.3.1.6. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Probable Archaeology (Strong/Weak**) – In Areas 36, well-defined positive linear and discrete anomalies have been identified forming a rectilinear enclosure measuring c.46 by 47m. The enclosure, which is most evident on the TF plot (Figures 125 & 126) has internal divisions exhibiting the morphological characteristics of ring ditches. Directly to the north, east and west, the enclosure is bordered by several rectilinear anomalies which appear to form further partial enclosures. However, their full extent cannot be established due to their proximity to the field borders and the presence of a drainage system obscuring some of these anomalies. To the west and east, in Areas 34, 37, 38 and 39 (Figures 125, 129, 132 & 135), further rectilinear enclosures with internal divisions have been identified. These anomalies are of similar size and alignment; however they have weaker magnetic signal which prevents the identification of their full extent. Some of the enclosures also have linear anomalies extending away from them which might suggest the presence of former field systems. Overall, the anomalies have been interpreted as small scale enclosure complexes from an Iron Age/ Romano-British origin.

7.3.2.2. Probable Archaeology (Strong/Weak) – In Area 76 a number of weak positive linear and curvilinear anomalies have been identified. In isolation these anomalies do not appear to form any characteristic shapes, however they correlate well with enclosure cropmarks visible on the satellite imagery (Figure 207). The anomalies are also likely to be associated with previously recorded Roman/British features identified in the vicinity of North Muskam (See sec. 5.6).

7.3.2.3. Possible Archaeology (Strong/Weak) – Located in the north of Area 58 a small group of weak linear and curvilinear anomalies have been detected (Figures 177 & 180). Some of the anomalies appear to form partial enclosures. However their shape does not allow for a more confident classification.

7.3.2.4. **Possible Archaeology (Strong/Weak)** - Across the survey area several positive, weak, linear, curvilinear, rectilinear, penannular, and strong, discrete anomalies have been identified (Figures 126, 135, 138, 174, 189 & 195). Most of these anomalies have the potential to be anthropogenic in origin, and therefore a possible archaeological categorisation has been given. These anomalies could form part of a former field system, parts of enclosures, or be indicative of ring ditches, yet they lack clear characteristics or context that would allow for a confident interpretation.

7.3.2.5. **Industrial/Modern –** Located in Areas 14, 15, 16 and 17 are a multitude of strong positive anomalies (Figures 87, 90 and 93). These anomalies correlate with the remains of the former airfield and runway at RAF Ossington. These anomalies lie within various spreads of strong dipolar anomalies, indicative of ferrous debris. These spreads of material are likely to indicate made-ground, and the debris of infrastructure removed from the former RAF airfield. As a result, these anomalies have been given the ''Industrial/Modern'' categorisation.

7.3.2.6. **Natural (Strong/Weak/Spread) –** In Areas 7, 25, 26, 32, 33, 44, 45, 71 various anomalies have been identified that relate to variations within the geological background. These variations are most evident in the Total Field data (Figures 66-201). Some of the more coherent geomorphological anomalies for example alluvial deposits and colluvial material have been identified near river channels and in the low-lying areas of the topography respectively.

7.3.2.7. **Agricultural (Strong/Weak/Spread)** – Across the survey area a multitude of strong and weak linear anomalies and linear spreads of ferrous material have been identified. (Figures 6 to 207). The majority of these roughly correspond with field boundaries recorded on 2nd Edition Ordnance Survey (OS) mapping, or with footpaths visible on satellite images (Figures 6 to 48). Others have been interpreted as being unmapped field boundaries due to their similarities in magnetic signal and alignment to the mapped field boundaries.

7.3.2.8. **Agricultural (Trend)** - Weak linear trends have been identified across the survey area. These anomalies correspond with modern ploughing visible on satellite imagery, in many parts of the survey area it was difficult to distinguish them from drainage and ridge and furrow cultivation (Figures 75 to 210). Due to the large volume of anomalies across the survey areas, only a representative sample has been drawn.

7.3.2.9. **Ridge and Furrow (Trend)** – Arrangements of regularly-spaced weak linear and curvilinear anomalies have been identified across the survey area (Figures 84 to 198). These anomalies are indicative of ridge-and-furrow regimes following numerous different alignments, that for the most part do not align with modern field boundaries and crop directions.

7.3.2.10. **Drainage Features (Trend) –** A multitude of linear anomalies, on multiple alignments throughout the survey area have been detected. Three types of magnetic responses have been recorded. The first type of response consists of strong, positive, linear signals. The second kind of anomaly consist of weak positive linear signals. The third type of anomalies have a weak, dipolar signal indicative of modern ceramic drains (Figures 4 to 201). The drainage features are arranged on a variety of alignments, ranging from the typical closely-spaced herringbone pattern to wide rectilinear organisation terminating at the field edges. The majority of these drainage features are located in low lying topographical areas and follow the topographical slopes.

7.3.2.11. **Undetermined (Strong)** – In area 50, the survey has identified three strong dipolar circular anomalies. These anomalies do not correlate with any historical or modern features recorded on the OS mapping or satellite imagery (Figures 159 & 162). The anomaly's strong magnetic signal is characteristic of a feature containing ferrous material, however due to the lack of any corroborative evidence it has been given an undetermined origin.

7.3.2.12. **Undetermined (Strong/Weak)** - Multiple linear, curvilinear, and discrete anomalies of variable magnetic signal have been identified across the survey area

(Figures 75 to 210). These anomalies do not have any supporting contextual evidence and may be partially obscured by the spreads of anomalies resulting from geological variation across the area. These anomalies are themselves likely to be the result of geological or agricultural processes, but in these cases an archaeological origin cannot be entirely ruled out.

7.3.2.13. **Service (Trend) -** Buried services have been detected in Areas 2, 14, 26, 34, 41, 42 and 58 (Figures 66 to 195). These linear anomalies, comprising repeating strong dipolar anomalies, are characteristic of buried services; their strength and spread has contributed to the obscuring of probable archaeological anomalies in places and obscuring weaker anomalies if present.

7.3.2.14. **Overhead Cables -** Across Areas 50, 61, 67 & 73 a change in the magnetic background has been detected most visible on the Total Field plots (Figures 158 to 203). This type of specked dipolar background correlates with the presence of overhead electric cables crossing over the survey area. This type of magnetic interference may mask more ephemeral anomalies of anthropogenic origin, if present.

8. Conclusions

8.1. A fluxgate gradiometer survey has successfully been undertaken across c. 515ha of land. The survey responded well to the environment of the survey area with a range of anomalies of archaeological, agricultural, modern and unknown origin identified throughout. Increased magnetic response was visible at field perimeters and in proximity to troughs, farming equipment, pylons, overhead cables, extant structures and buried services.

8.2. The survey has identified three main areas of archaeological activity within the survey area. These areas comprise anomalies indicative of probable cut features, containing anthropogenically enhanced fill. The features include ditched enclosures, ring ditches, former field systems, and discrete pits. These anomalies appear to form Iron Age/Roman/British enclosures with associated field systems. Other more-isolated anomalies have also been interpreted as possible/probable archaeological origin

8.3. Long-term agricultural use of the land within the survey area has been detected in the form of extensive historical cultivation such as ridge and furrow cultivation, former mapped and unmapped historical field boundaries, drainage features, footpaths and ploughing trends identified in the magnetic data.

8.4. The survey has also detected numerous strong anomalies and spreads of strongly enhanced material in the vicinity of the former RAF Ossington. These anomalies have been identified as remnants of a former runway and associated structures from the airbase.

8.5. Natural variations have been detected sporadically throughout the survey area, particularly as geomorphological features such as colluvial deposits and alluvial accumulation near current and former river channels.

8.6. A number of anomalies have been classified as 'Undetermined' due to lack of context, or any clear pattern or morphology which would enable a confident interpretation. Nevertheless, an archaeological origin for these cannot be excluded.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to any dictated time embargoes.

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11. References

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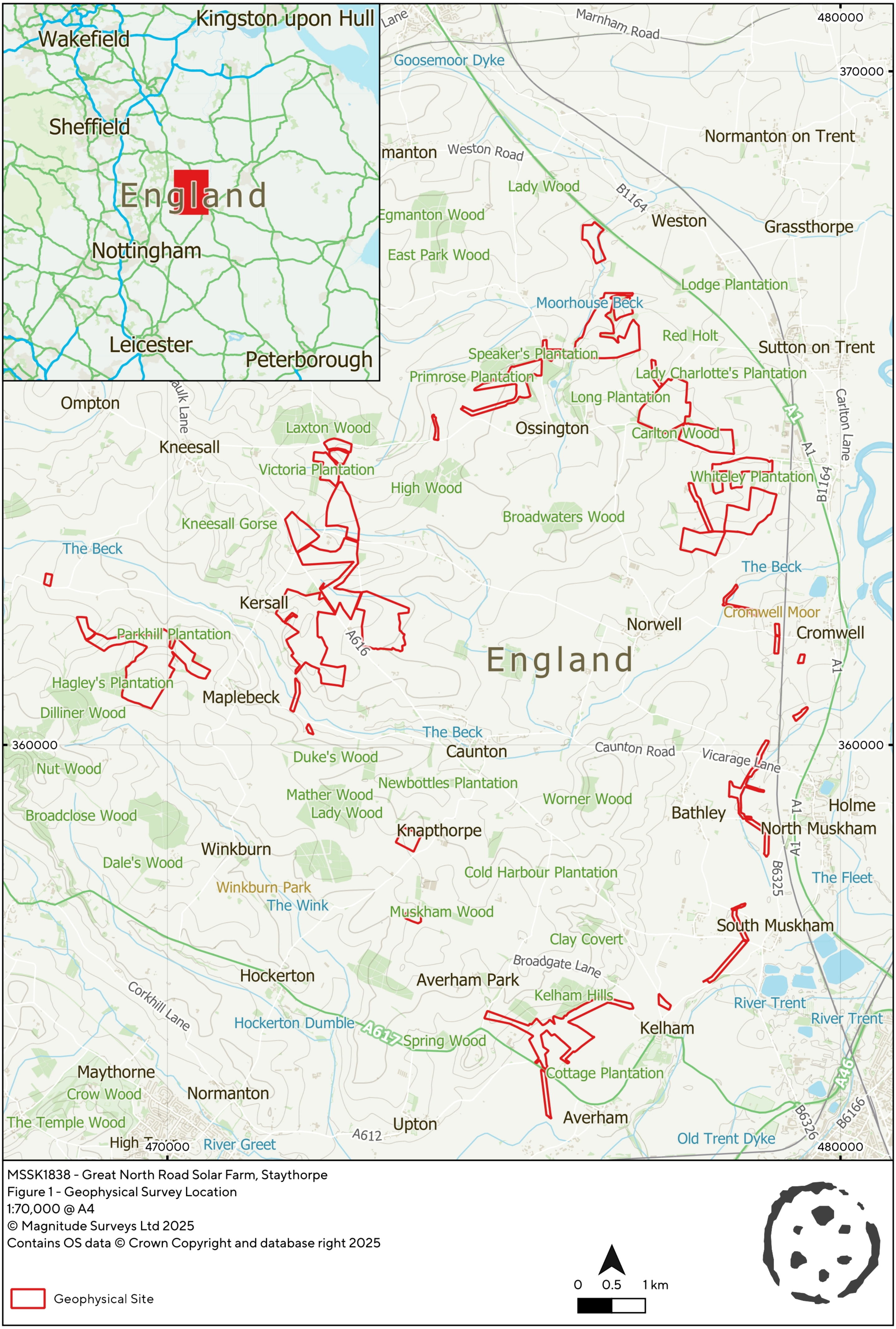
12. Project Metadata

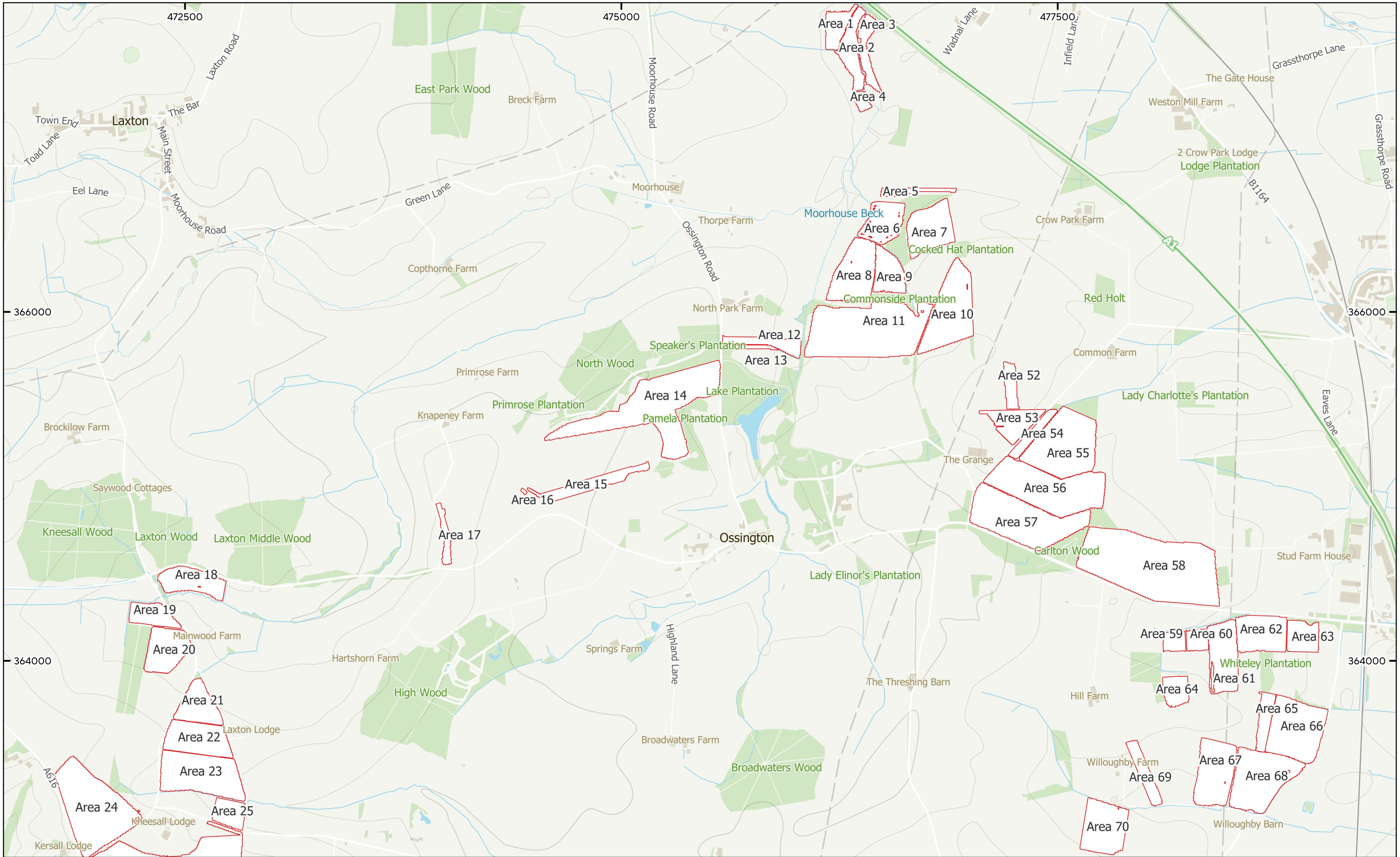
MS Job Code	MSSK1838
Project Name	Great North Road Solar Farm, Staythorpe
Client	York Archaeology
Grid Reference	SK 70958 61456
Survey Techniques	Magnetometry
Survey Size (ha)	712ha (Magnetometry),
Survey Dates	09-09-2024 to 25-10-2024
Project Lead	Krasimir Dyulgerski BA MRes MCIfA
Project Officer	Krasimir Dyulgerski BA MRes MCIfA
HER Event No	TBC
OASIS No	TBC
S42 Licence No	N/A
Report Version	0.3

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	KD, AJ, IT	KD	17 February 2025
0.2	Interrim Report for director Sign Off	KD	FP	21 February 2025
0.3	Adding Glossary Page	MS	KD	29 May 2025

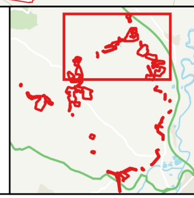


MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 1 - Geophysical Survey Location
1:70,000 @ A4



MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 2 - Geophysical Survey Areas
1:20,000 @ A3

Geophysical Survey Areas



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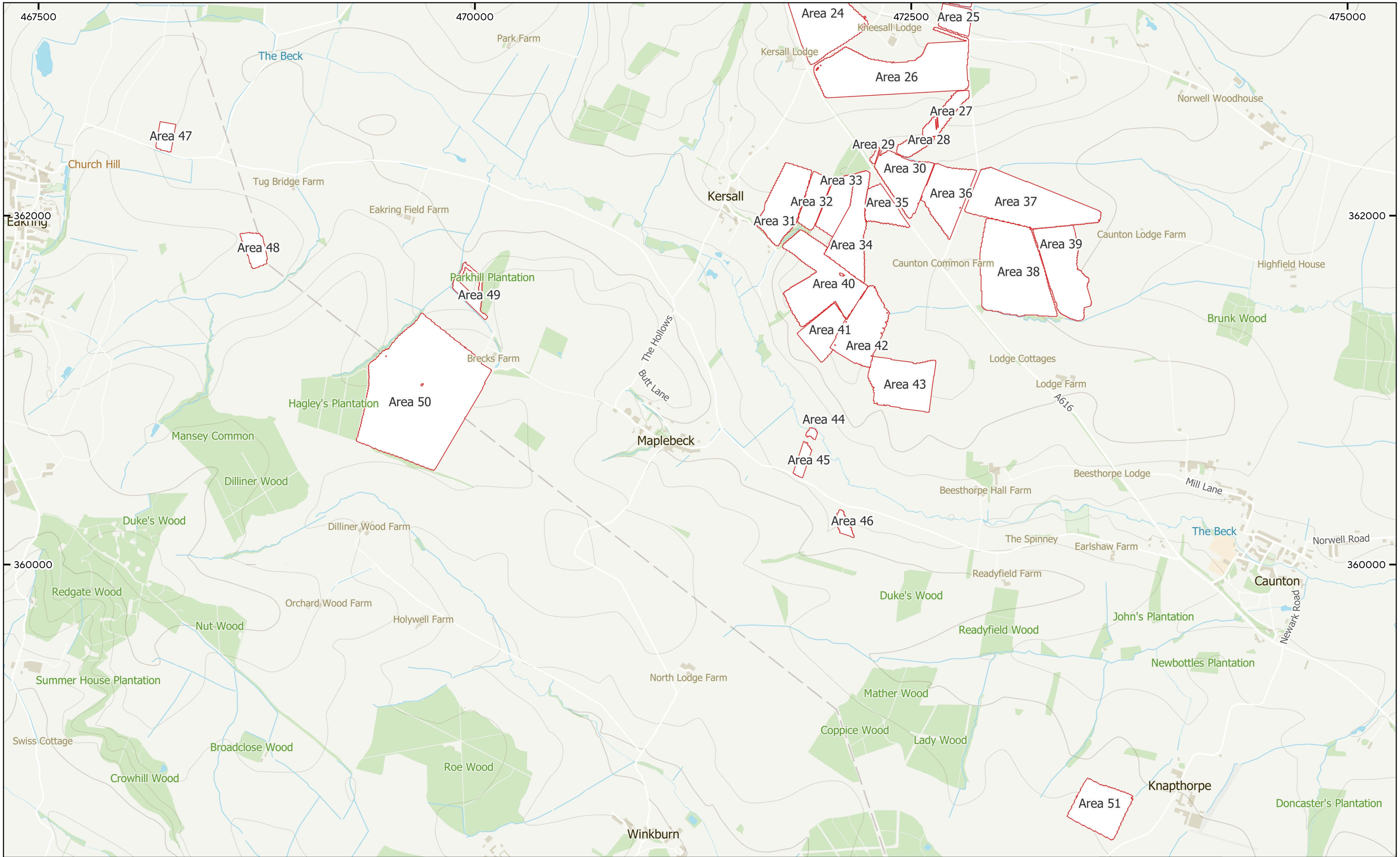

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 3 - Geophysical Survey Areas
1:20,000 @ A3

Geophysical Survey Areas

Magnitude Surveys

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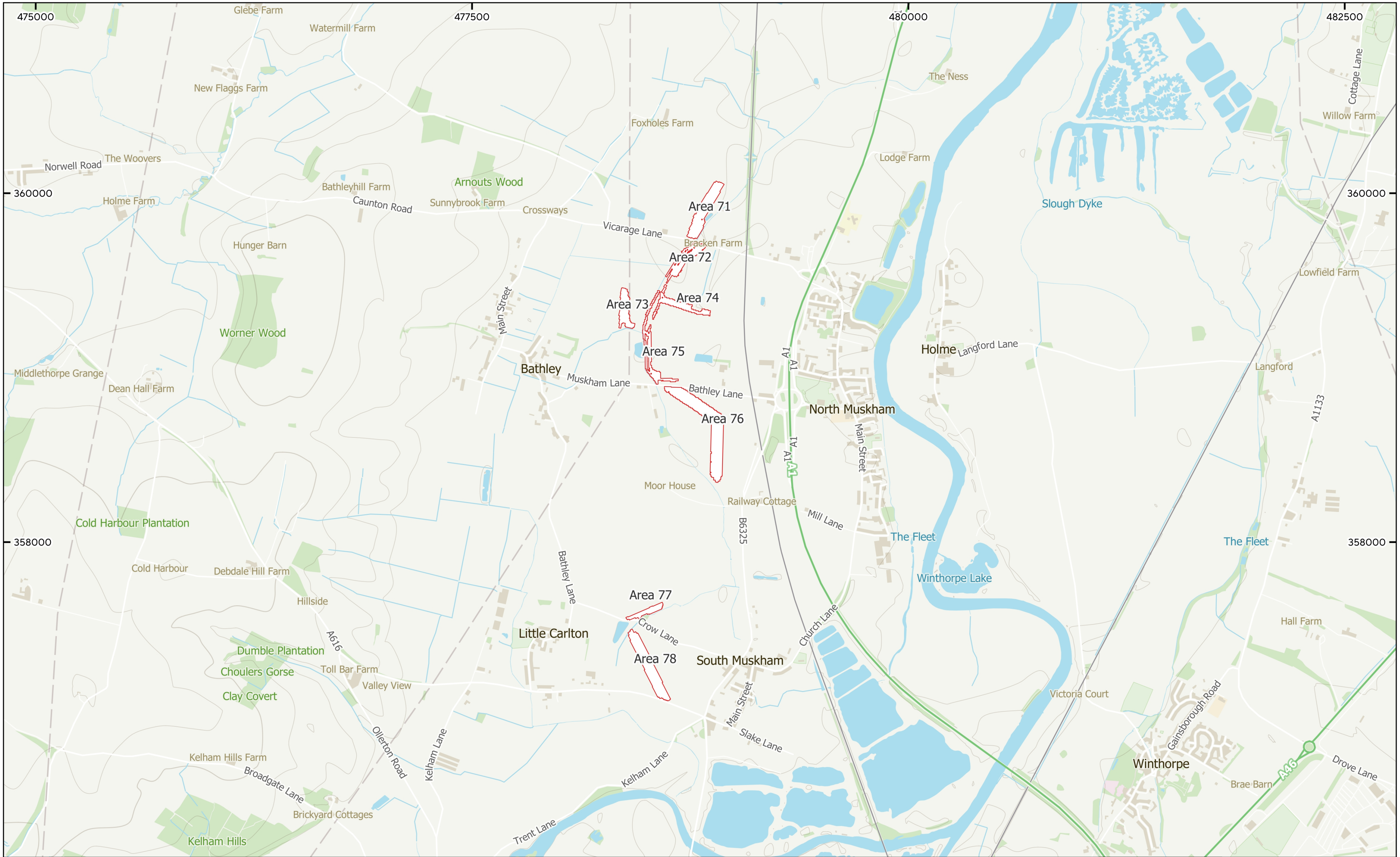

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 4 - Geophysical Survey Areas
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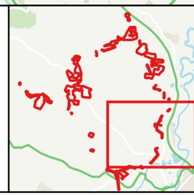
Geophysical Survey Areas



Magnitude Surveys

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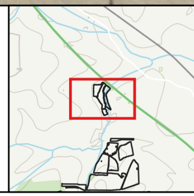
MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 5 - Magnetic Gradient (Areas 1, 2, 3, & 4)
1:3,000 @ A3

Magnitude Surveys

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 6 - Magnetic Interpretation over Historical Mapping (Areas 1, 2, 3, & 4)
1:3,000 @ A3

- Agricultural (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Natural (Spread)
- Undetermined (Weak)
- Service
- Drainage Feature
- Ferrous (Spike)



Magnitude Surveys

0 30 60 90 120 m

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 7 - Magnetic Gradient (Areas 5, 6, 7, 8, & 9)
1:3,000 @ A3

Magnitude Surveys

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 8 - Magnetic Interpretation over Historical Mapping (Areas 5, 6, 7, 8, & 9)
1:3,000 @ A3

Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Natural (Spread)
Undetermined (Weak)
Agricultural (Trend)
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)

Magnitude Surveys

0 30 60 90 120 m

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 9 - Magnetic Gradient (Areas 8, 9, 10, & 11)
1:3,000 @ A3

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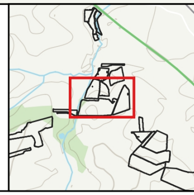

Magnitude Surveys

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MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 10 - Magnetic Interpretation over Historical Mapping (Areas 8, 9, 10, & 11)
1:3,000 @ A3

Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Natural (Spread)
Undetermined (Weak)
Agricultural (Trend)
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)

Magnitude Surveys

0 30 60 90 120 m

MSSK1838 - Great North Road Solar Farm, Staythorpe
Figure 11 - Magnetic Gradient (Areas 12, 13, & 14)
1:3,000 @ A3