WYAS Archaeological Services

A63 Junction Improvements, Brough, East Riding of Yorkshire

Geophysical Survey

Report no. 3416
April 2020

Client: ERI&F East Riding of Yorkshire Council

West Yorkshire Joint Services

A63 Junction Improvements, Brough, East Riding of Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey was undertaken on approximately 2.1 hectares of land located to the south of the A63, Brough, East Riding of Yorkshire. Anomalies of a possible archaeological origin have been detected, but are tentative. Modern ploughing, geological responses and magnetic disturbance have also been recorded. Based on the results of the geophysical survey alone the archaeological potential of the site is deemed low. Although, as the site is in such a rich archaeological landscape with surrounding cropmarks and the Roman town of Brough the confidence level is therefore moderate to high.

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WYAS Archaeological Services

Report Information

Client:	ERI & F
Address:	East Riding of Yorkshire Council, County Hall, Beverley, HU17 9BA
Report Type:	Geophysical Survey
Location:	Brough
County:	East Riding of Yorkshire
Grid Reference:	SE 9537 2696
Period(s) of activity:	?Romano-British / Modern
Report Number:	3416
Project Number:	X153
Site Code:	JIB20
OASIS ID:	archaeol1-xxxxxxxx
Date of fieldwork:	April 2020
Date of report:	April 2020
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Document Issue Record

Ver	Status	Author(s)	Reviewer	Approver	Date
1.0	Draft	EB	DW	DW	April 2020
2.0	Final	EB			April 2020

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services ASWYAS has been commissioned by ERI&F (East Riding of Yorkshire Council Infrastructure & Facilities) Limited to undertake a geophysical survey at Brough, East Riding of Yorkshire in advance of junction improvements. This was undertaken in line with current best practice (CIfA 2014; Schmidt *et al.* 2015). The survey was carried out on the 6th April 2020 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The site is located at SE 9537 2696 (approximate centre), comprising *c*. 2.1ha in a single field situated to the northeast of Brough (see Fig. 1).

The site is situated to the south of the A63 on land consisting of scrub and rough ground. It is bounded to the north by Water Lane, to the east by Stanley Jackson Way and a cricket ground, to the south by a pasture field and to the west by Welton Road. The site lies at 18m (above Ordnance Datum) aOD in the north, falling to approximately 16m aOD in the south.

Soils and geology

The recorded bedrock geology comprise of the Brantingham Member – interbedded sandstone and siltstone, a sedimentary bedrock that formed approximately 157 to 164 million years ago in the Jurassic Period. Superficial deposits have been recorded as belonging to the Bielby sand member consisting of sand and gravels (BGS 2020). Soils are described as freely draining lime-rich loamy soils of the Soilscape 5 classification (CSAI 2020).

2 Archaeological Background

A Desk Based Assessment is being prepared by ASWYAS as part of the works for the junction improvement scheme (Horn *forthcoming*) which will supplement this geophysical report. The following information is a summary from Heritage Gateway (HG 2020) and the Internet Archaeology journal.

The small Roman town of Brough-on-Humber (*Petuaria*) (Scheduled Monument list entry 1005219) is situated close to the north bank of the Humber estuary, approximately 1.4km to the southwest of the survey area. During the Roman period Brough was well situated on the main road south from York (Eboracum) and at the northern end of the ferry route across the Humber towards Lincoln (*Lindum*) (Hunter-Mann *et al* 2000).

To the east of Brough is the Iron Age site settlement and trading port at Redclife. Redcliffe had a flourish of Roman activity in the Claudio-Neronian periods but declined rapidly with an alternative river crossing at Brough (Hunter-Mann *et al* 2000).

Brough was located within the territory of the Iron Age tribe the *Parisi*, who occupied East Yorkshire at the time of the Roman conquest. Their territory is probably reflected by the highly distinctive cemeteries of the Arras culture. These clusters of square barrows are distributed widely across the chalk uplands of the Yorkshire Wolds, and several more have been identified on the southern slopes of the North Yorkshire Moors (Hunter-Mann *et al* 2000).

Approximately 250m to the southeast of the survey area nine trenches were excavated in advance of residential development, no significant archaeological activity was recorded (HER ref. EHU22514).

Aerial photography to the west of site show a cropmark complex possibly of a Late Iron Age to Roman date (HER ref. 10837) and can also be seen as an extension to a Roman road leading from the walled settlement on a north eastern projection (Stoerz 1997) . Further to the northwest, approximately 450m, archaeological evaluations at Welton Low Road were undertaken. Remains discovered included ditches flanking the Roman Road including 2nd century pottery (HER ref. EHU6495).

3 Aims, Methodology and Presentation

The aims and objectives of the programme of geophysical survey were to gather sufficient information to establish the presence/absence, character and extent, of any archaeological remains within the specific area and to inform an assessment of the archaeological potential of the site. To achieve this aim, a magnetometer survey covering all amenable parts of the Site was undertaken (see Fig. 2).

The general objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble R6 model). The survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed taking readings at 0.25m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for

processing and interpretation. Bespoke in-house software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 displays processed magnetometer data at a scale of 1:2500 whilst. Processed and minimally processed data, together with interpretation of the survey results are presented in Figures 3 to 5 inclusive at a scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1. Technical information on locating the survey area is provided in Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 4.

The survey methodology, report and any recommendations comply with guidelines outlined by the European Archaeological Council (Schmidt *et al*. 2015) and by the Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figures 3 to 5)

Ferrous anomalies and magnetic disturbance

Ferrous anomalies, as individual 'spikes', or as large discrete areas are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. 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.

Magnetic disturbance along the limits of the survey areas are due to be linked to metal fencing within the field boundaries and interference from the adjacent roads.

Geological anomalies

The survey has detected a band of anomalies which run on a northeast to southwest alignment that have been interpreted as geological in origin. It is thought that the responses have been detected because of the variation in the composition and depth of the deposits of superficial material in which they derive.

Agricultural anomalies

Parallel linear trends can be seen on a north to south alignment and are associated with modern ploughing.

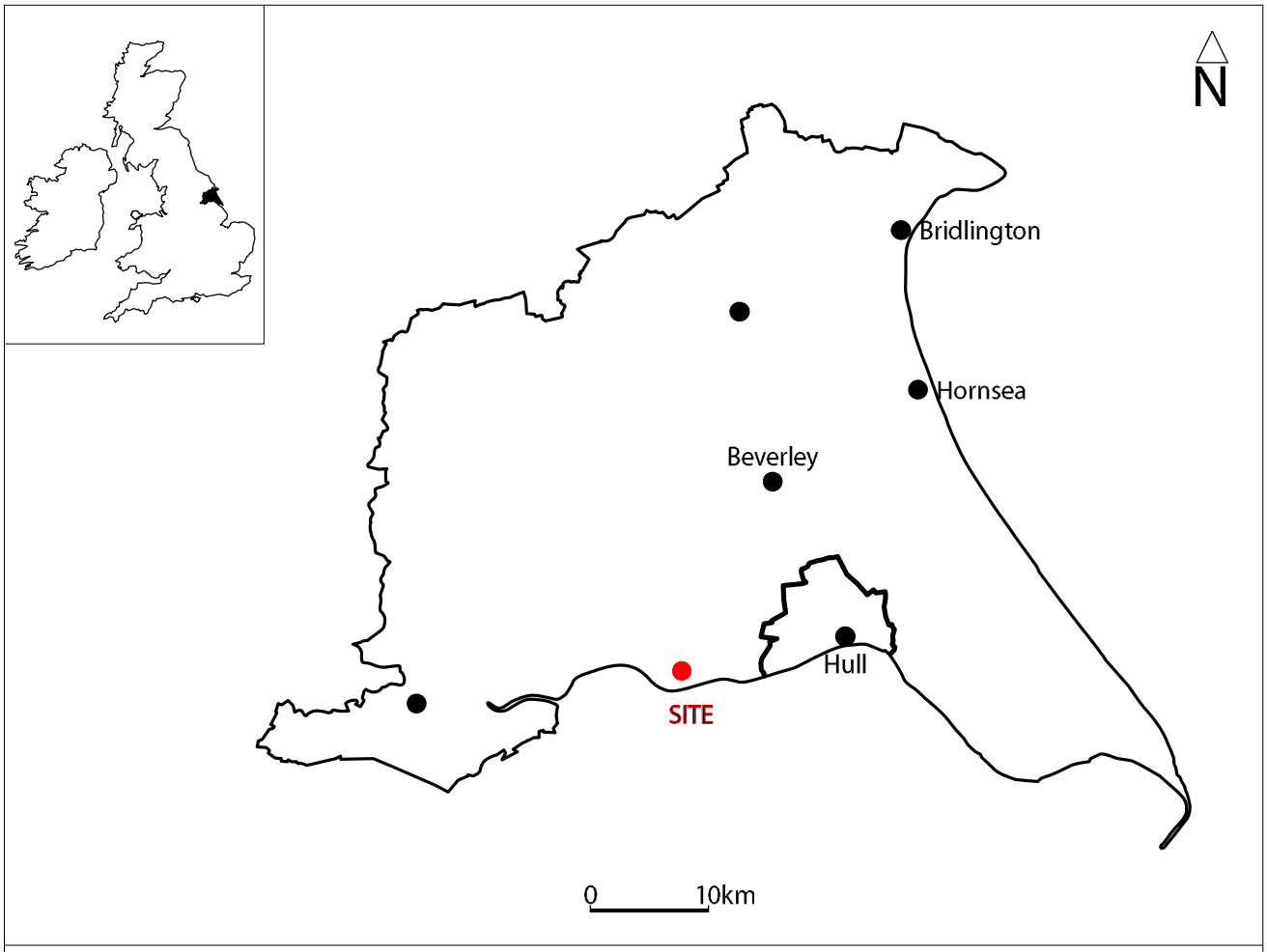
Possible archaeological anomalies

Two magnetically weak linear trends have been recorded on a northeast to southwest alignment, differing to that of the cultivation trends. An archaeological origin is possible given that the site lies within an archaeologically rich area – on the south of the Yorkshire Wolds and also the cropmark features lying to the immediate west (see Figure 2). These parallel linear cropmarks are thought to be a Roman road running from the eastern entrance of the walled settlement of *Petuaria* on a northeast trajectory. The possible archaeological trends are approximately 200m away but lie on the same orientation.

However, it has been noted that on aerial imagery a footpath can be seen crossing the site on roughly the same alignment as these possible linear trends. As such, this is a tentative interpretation.

5 Conclusions

The geophysical survey has detected linear trends which may have an archaeological origin of an uncertain date and function. Modern ploughing trends and a band of geological responses have also been recorded. Magnetic disturbance around the periphery of the survey are due to metal fencing within the boundaries and interference from the adjacent roads. Based on the results and interpretation of the geophysical survey alone, the archaeological potential is deemed to be low. However, as the site is in such a rich archaeological landscape with surrounding cropmarks and the Roman town of Brough the confidence level is therefore moderate to high.



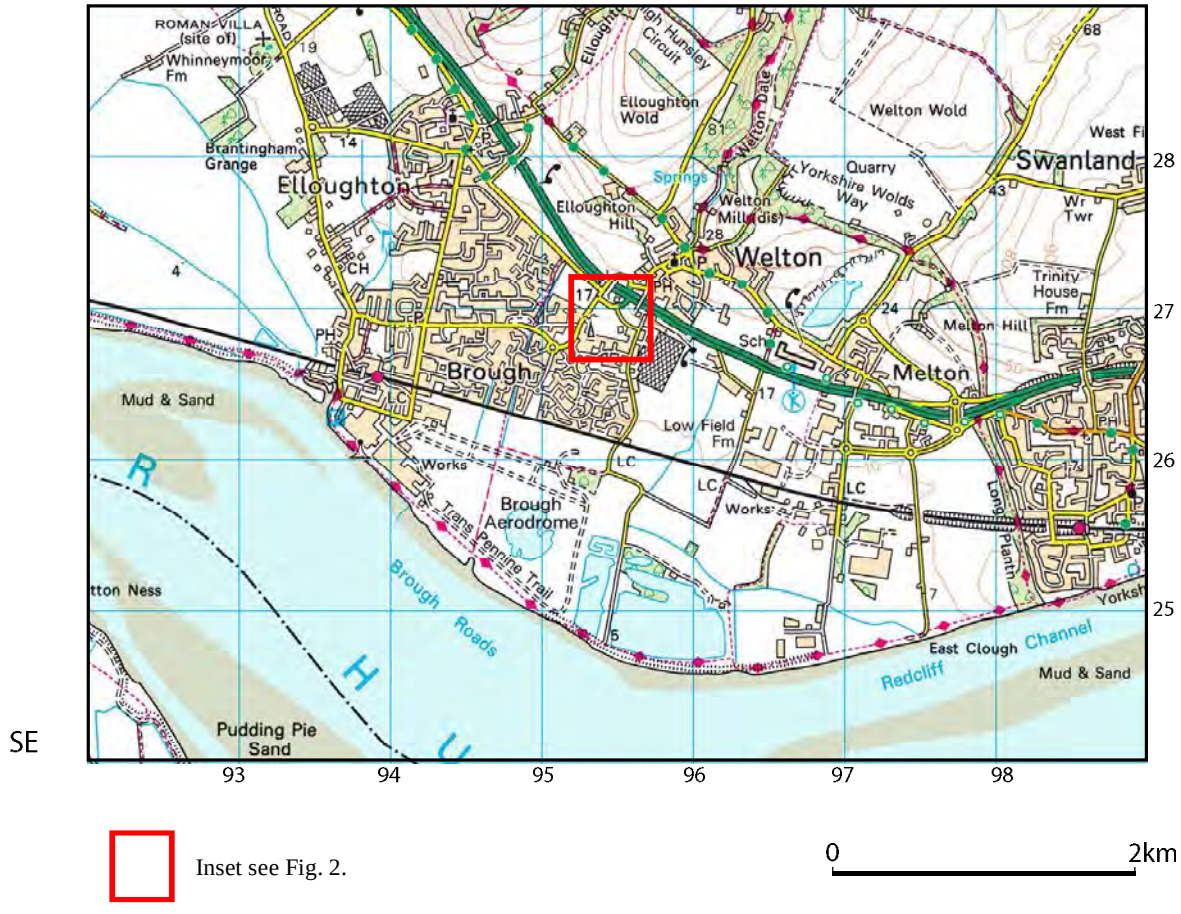


Fig. 1. Site location

PROJECT ID: X153_JIB20

SURVEY AREA

PHOTO LOCATIONS

CROPMARKS

N

Welton Grange

Hall

Playing Field

Cricket Ground

Pol Sta

Mast

Pav

Pond

A63

WELTON LOW ROAD

WELTON ROAD

WATER LANE

STANLEY JACKSON WAY

COMMON LANE

COWGATE

LASTINGHAM

RYEDALE

SWALEDALE

LOWERDALE

HIGHAM WAY

BROADACRE PK

ROBIN CL

RYE CRES

BECKSIDE

BARTRAMS

GALLAND ROA

BELL SHAW AVE

DANE GELD

THE

FB

22m

20m

19m

Drain

2.0

-1.0

nT

4272000

4270000

4268000

4950000

4952000

4954000

4956000

4958000

0

100m

Fig. 2. Survey location showing processed greyscale of magnetometer data (1:2500 @ A3)

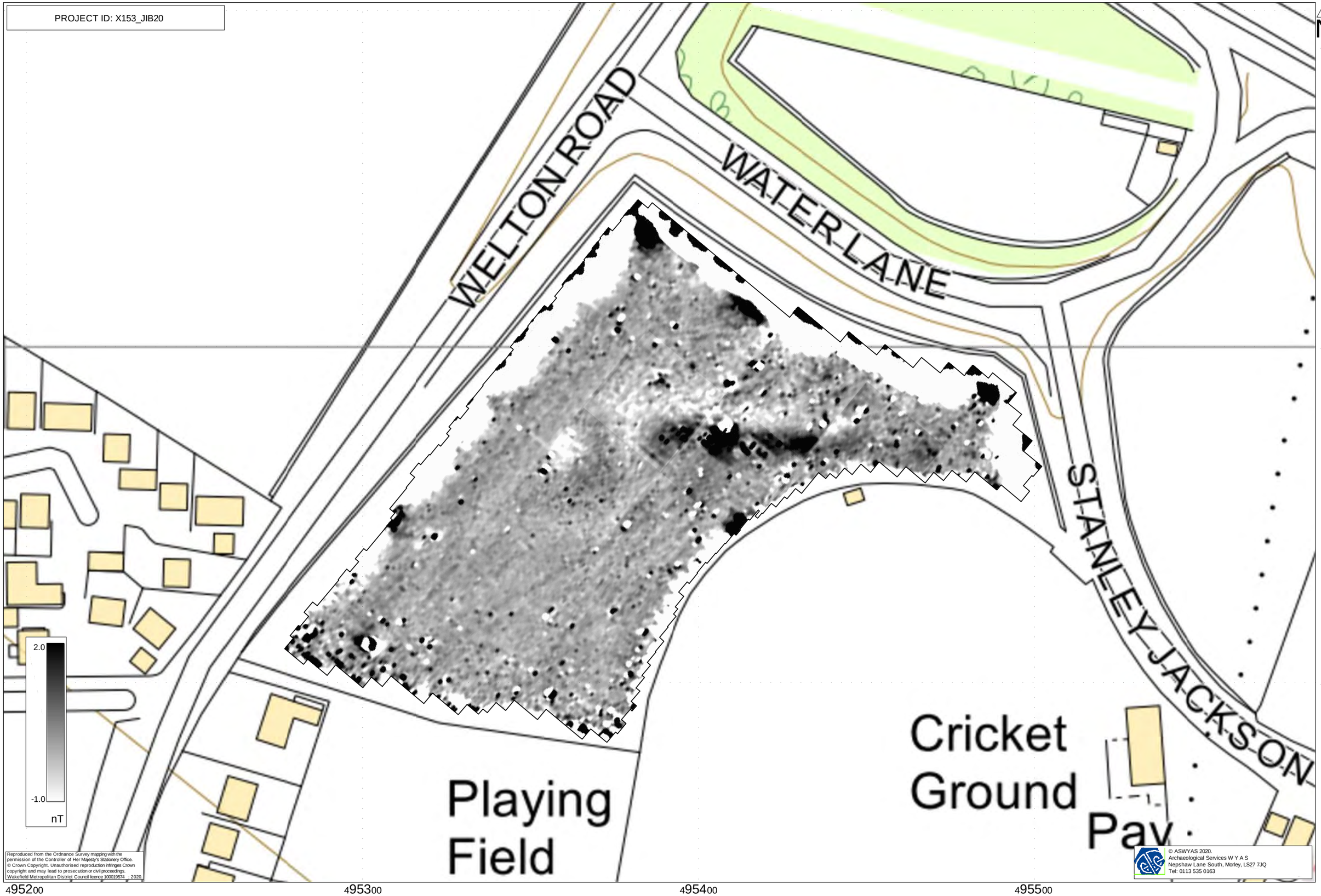


Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

PROJECT ID: X153_JIB20

15.0 nT/cm

N

WELTON ROAD

WATER LANE

STANLEY JACKSON

Playing Field

Cricket Ground

Pav

427100

427000

426900

495200

495300

495400

495500

0 50m

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Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

PROJECT ID: X153_JIB20

TYPE OF ANOMALY		INTERPRETATION
	DIPOLAR ISOLATED	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	MAGNETIC ENHANCEMENT	GEOLOGY
	LINEAR TREND	AGRICULTURAL
	LINEAR TREND	ARCHAEOLOGY?

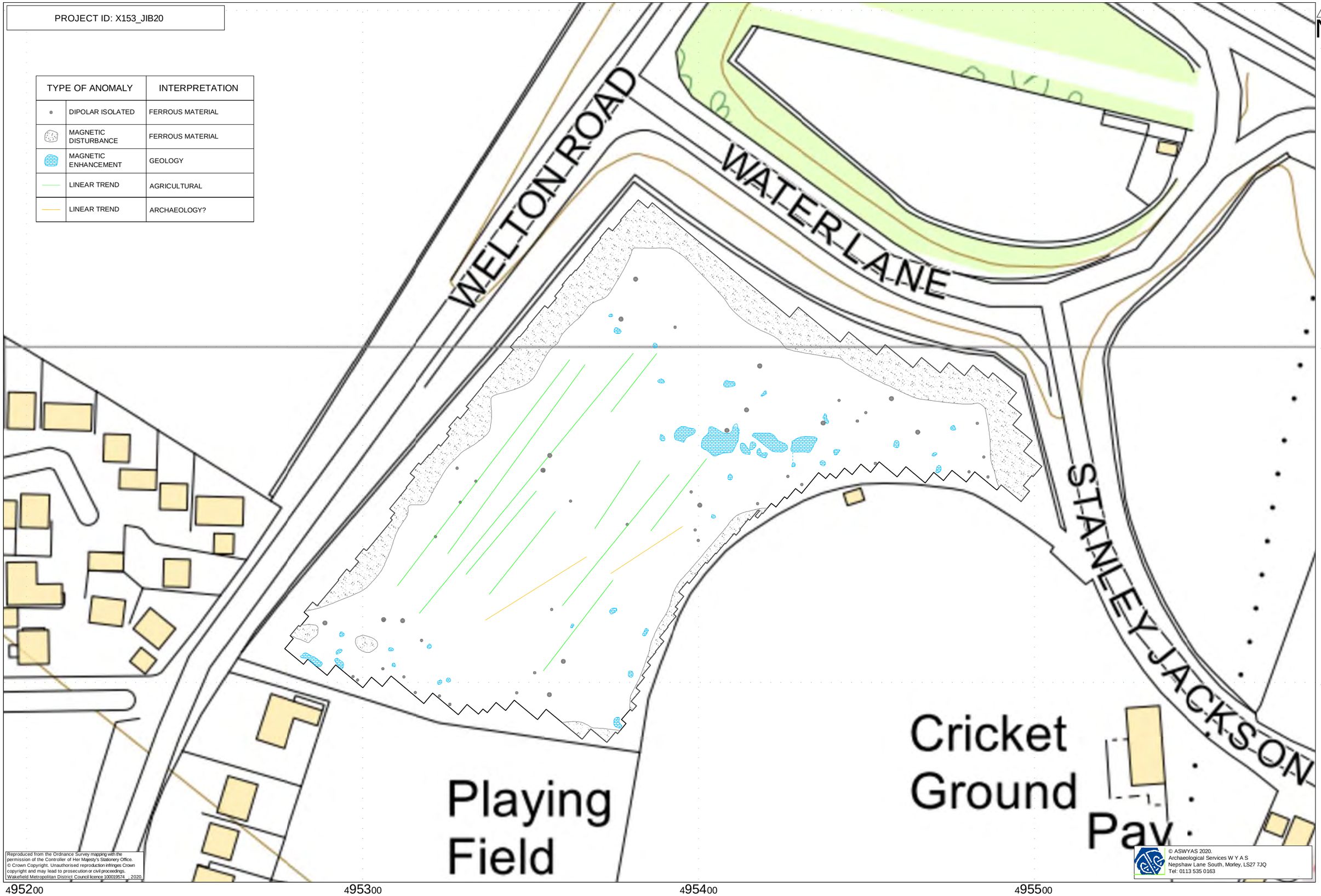

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Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

Plate 1. General view of survey area, facing northeast

Plate 2. General view of survey area, facing southwest

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

Appendix 2: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Humber Historic Environment Record).

Appendix 4: Oasis form

OASIS DATA COLLECTION FORM: England

List of Projects | Manage Projects | Search Projects | New project | Change your details | HER coverage | Change country | Log out

Printable version

OASIS ID: archaeol11-392627

Project details

Project name	A63 Junction Improvements, Brough
Short description of the project	A geophysical (magnetometer) survey was undertaken on approximately 2.1 hectares of land located to the south of the A63, Brough, East Riding of Yorkshire. Anomalies of a possible archaeological origin have been detected, but are tentative. Modern ploughing, geological responses and magnetic disturbance have also been recorded. Based on the results of the geophysical survey alone the archaeological potential of the site is deemed low. Although, as the site is in such a rich archaeological landscape with surrounding cropmarks and the Roman town of Brough the confidence level is therefore moderate to high.
Project dates	Start: 06-04-2020 End: 06-04-2020
Previous/future work	No / Yes
Any associated project reference codes	X153 - Sitecode
Type of project	Field evaluation
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Road scheme (new and widening)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Sandstone, siltstone and mudstones
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

Project location

Country	England
Site location	

	EAST RIDING OF YORKSHIRE EAST RIDING OF YORKSHIRE ELLOUGHTON CUM BROUGH A63 Junction Improvements, Brough
Study area	2.1 Hectares
Site coordinates	SE 9537 2696 53.730076375784 -0.554219701718 53 43 48 N 000 33 15 W Point
Height OD / Depth	Min: 16m Max: 18m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	ERI and F
Project design originator	ERI and F
Project director/manager	E Brunning
Project supervisor	C. Sykes

Project archives

Physical Archive Exists?	No
Digital Archive recipient	ERI and F
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	A63 Junction Improvements, Brough
Author(s)/Editor(s)	Brunning, E
Date	2020
Issuer or publisher	ASWYAS
Place of issue or publication	Leeds
Description	A4 report with A3 figures

Entered by	Emma Brunning (emma.brunning@aswyas.com)
Entered on	24 April 2020

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