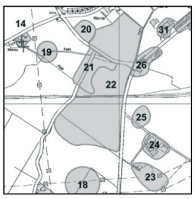
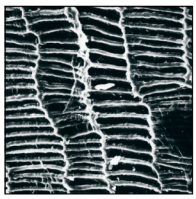
SKEY/01








LAND EAST OF KEYINGHAM, EAST YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by SLR Consulting

July 2017

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

LAND EAST OF KEYINGHAM, EAST YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by SLR Consulting

July 2017

project info

HA JOB NO.	SKEY/01
NGR	TA 2593 2551
PARISH	Ottringham
LOCAL AUTHORITY	East Riding of Yorkshire
OASIS REF.	headland5-291105

project team

PROJECT MANAGER	Sam Harrison
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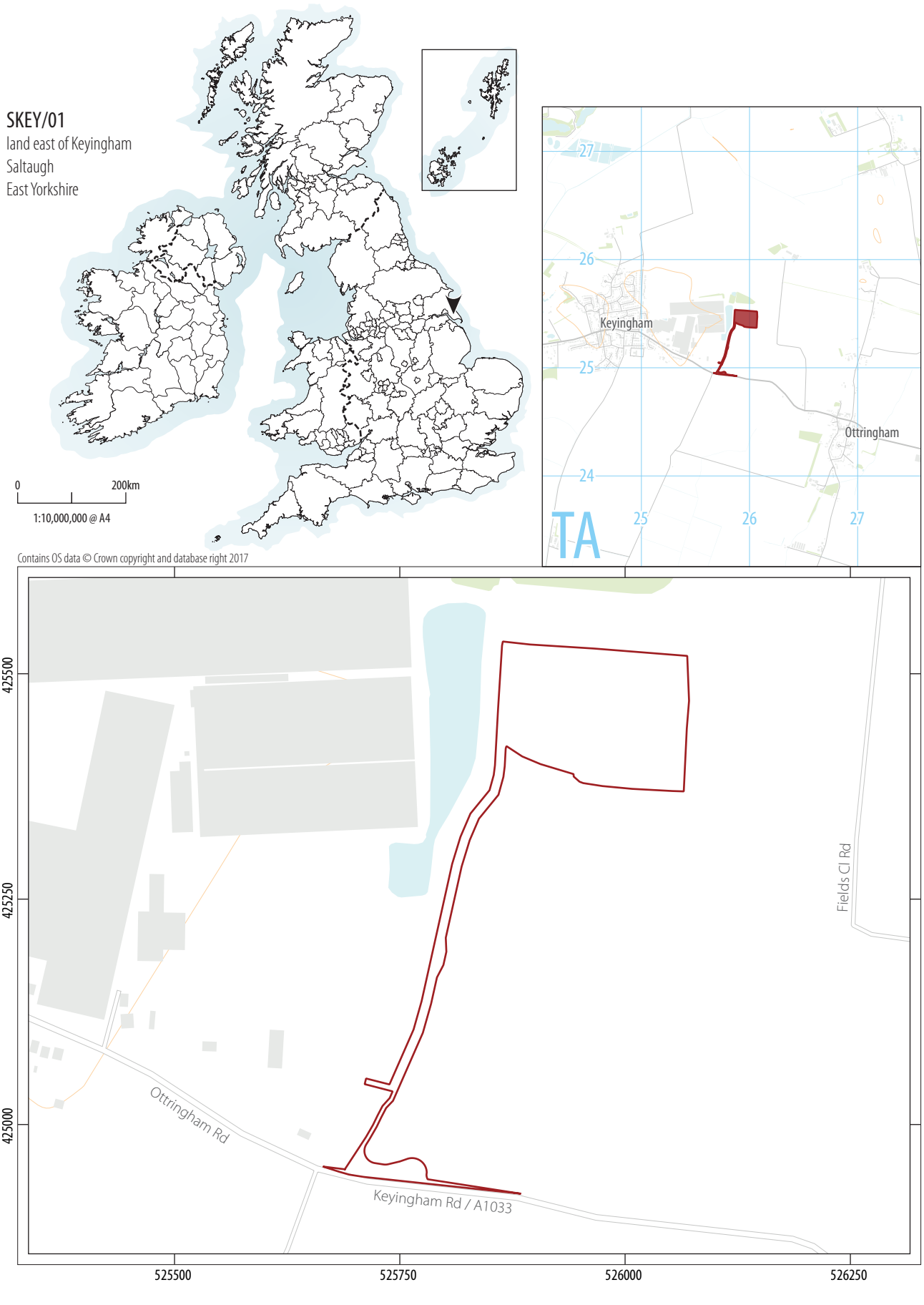
PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 3.7 hectare site on land east of Keyingham, East Yorkshire, to inform planning proposals for a proposed agricultural anaerobic digestion facility. The survey has successfully evaluated the site and identified three possible ditches along the proposed access corridor in the south-west of the site. Due to the narrow survey width along the access corridor no clear pattern is discernible in the magnetic dataset and the anomalies may be modern or agricultural in origin. However, they are interpreted as potentially archaeological due to their proximity to prehistoric and/or Roman cropmarks which are recorded on the Humber Historic Environment Record (HER). No other anomalies of likely archaeological potential have been identified across the site and therefore, on the basis of the geophysical survey, the archaeological potential of the site is assessed as low and locally moderate around the three ditches, broadly corroborating the conclusions of an earlier heritage assessment.

CONTENTS

LIST OF ILLUSTRATIONS

SKEY/01
land east of Keyingham
Saltaugh
East Yorkshire



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ILLUS 1 Site location

LAND EAST OF KEYINGHAM, EAST YORKSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by SLR Consulting (The Client), to undertake a geophysical (magnetometer) survey of land east of Keyingham, East Yorkshire, where an agricultural anaerobic digestion facility is being proposed. The survey was carried out in order to inform planning proposals by assessing the heritage potential of the proposed development area (PDA) and therefore the impact of the proposed development on the historic environment.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2017) and in accordance with guidance contained in the National Planning Policy Framework (DCLG 2012). All work was undertaken in line with current best practice (Chartered Institute for Archaeologists 2014, English Heritage 2008).

The survey was carried out on July 18th 2017.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The PDA is located within a single field on the eastern periphery of the village of Keyingham, 16km east of Kingston upon Hull, East Yorkshire (see Illus 1). It comprises a rectangular block of land within the north-west corner of the field (centred at TA 2593 2551) with a narrow corridor extending southwards along the western field boundary providing access off the A1033 Keyingham Road.

At the time of the survey the site was under a mature wheat crop (see Illus 2).

The site was relatively flat at between 5m and 8m Above Ordnance Datum (AOD).

1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises Flamborough Chalk which is overlain by Devensian Till (NERC 2017).

The soils are classified in the Soilscape 8 association being characterised as slightly acid loams and clays with impeded drainage (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

Baseline information collected as part of a Heritage Assessment (RPS 2017) has identified that there are no previously recorded designated or non-designated heritage assets within the PDA.

There is evidence for prehistoric and/or Roman settlement and/or agricultural activity 200m south of the PDA in the form of cropmarks suggestive of boundaries, trackways and enclosures (MHU5403; see Illus 3). An undated linear cropmark (MHU19249) located immediately adjacent to the PDA (north) may be associated with MHU5403. A possible Romano-British enclosure (MHU19251/MHU22050) is also recorded abutting the south side of Keyingham Road.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the PDA. This will therefore enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

ILLUS 2 Survey area, looking west

The specific archaeological objectives of the geophysical survey were:

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

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney and Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:6,000. Illus 2 is a site condition photograph. Illus 3 is a 1:5000 scale survey location plan showing the GPS swath data and the Humber HER data overlying the 1888–1913 six inch OS map. Detailed data plots of the fully processed data (greyscale), the minimally processed data (XY traceplot) and an accompanying interpretative plot, are presented at a scale of 1:2,000 in Illus 4–6 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes

the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2017) and guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

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

4 RESULTS AND DISCUSSION

Despite the presence of a mature wheat crop across the survey area it has been possible, using Headlands' unique hand carry system, to collect a high quality data set on challenging ground conditions.

The survey has detected a variable magnetic background across the site manifesting in the data as numerous discrete areas of magnetic enhancement, converging locally into broader areas of enhancement. This is thought to be due to the heterogeneous composition of the underlying till deposits. Against this background numerous magnetic anomalies have been detected. Those anomalies with modern, agricultural or geological origins are discussed first followed by those anomalies with a possible or archaeological cause. All are cross-referenced to specific anomalies on the interpretative drawing, where appropriate.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', 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 is common on most sites, often being present as a consequence of manuring or tipping/infilling.

Magnetic disturbance around the field edge is due to ferrous material within or close to the adjacent field boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical Ordnance Survey mapping indicates that the division of land within the PDA has changed since the publication of the first edition map in 1855 with the removal of four field boundaries, three along the route of the new access road (see Illus 3). Only one of these former field boundaries, FB1, manifests clearly within the magnetic dataset as a north-west/south-east aligned linear anomaly. The anomaly is caused by a soil-filled ditch. A second former field boundary, FB2, is identified within the north of the PDA as a discontinuous north/south alignment of ferrous anomalies. It is possible that subsequent ploughing activity may have partially or completely removed some of the former boundaries, or that there is insufficient magnetic contrast in the prevailing soils for the remaining former boundaries to manifest as magnetic anomalies.

A number of faint linear trends have been identified across the northern part of the PDA. All are aligned parallel with the extant field boundaries and are due to modern cultivation.

4.3 GEOLOGICAL ANOMALIES

As discussed, a variable magnetic background has been detected across the PDA manifesting in the data as numerous amorphous and localised areas of magnetic enhancement. These broad variations are due to changes in the depth and composition of the soils and the glacial till superficial deposits from which they derive.

4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

No anomalies of definite archaeological potential have been identified across the PDA. However, three linear anomalies, D1-D3, have been identified along the proposed access track in the south-west of the site. D1 and D3 are aligned broadly north-west/south-east with D2 aligned north-south. All are aligned oblique to the historical and extant pattern of land division. It is difficult due to the very narrow corridor width (10m) to confidently interpret these anomalies as either modern, geological or agricultural in origin. Equally, an archaeological origin cannot be dismissed, particularly given the presence locally of cropmarks of possible prehistoric and/or Roman origin.

5 CONCLUSION

The survey has successfully evaluated the site and identified three possible ditches along the proposed access corridor in the south-west of the site. Due to the narrow survey width along the access corridor no clear pattern is discernible in the magnetic dataset and the anomalies may be modern or agricultural in origin. However, they are interpreted as potentially archaeological due to their proximity to prehistoric and/or Roman cropmarks which are recorded on the Humber Historic Environment Record (HER). No other anomalies of likely archaeological potential have been identified across the site and therefore, on the basis of the geophysical survey, the archaeological potential of the site is assessed as low and locally moderate around the three possible ditches, broadly corroborating the conclusions of an earlier heritage assessment.

6 REFERENCES

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RPS Group 2017 ***Desk based heritage assessment in connection with the proposed development of an agricultural anaerobic digestion facility at Saltaugh, East Riding of Yorkshire*** [unpublished RPS report ref JAC23119]

proposed development area
GPS swaths
HER data line
HER data point
location and direction of ILLUS 2

N
0 100m
scale 1:5,000 @ A4

PROJECT SKEY/01
Land east of Keyingham
Saltaugh
East Yorkshire

CLIENT SLR Consulting Ltd

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ILLUS 3 Survey location showing GPS swaths overlying 1888-1913 six inch OS map (1:5,000)

425400
425200
425000
525800
526000

-1.0 nT 2.0

N

0 50m

scale 1:2,000 @ A3

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Saltaugh
East Yorkshire

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ILLUS 4 Processed greyscale magnetometer data

425400

425200

425000

525800

526000

25.0nT/cm

N

0 50m

scale 1:2,000 @ A3

PROJECT SKEY/01
Land east of Keyingham
Saltaugh
East Yorkshire

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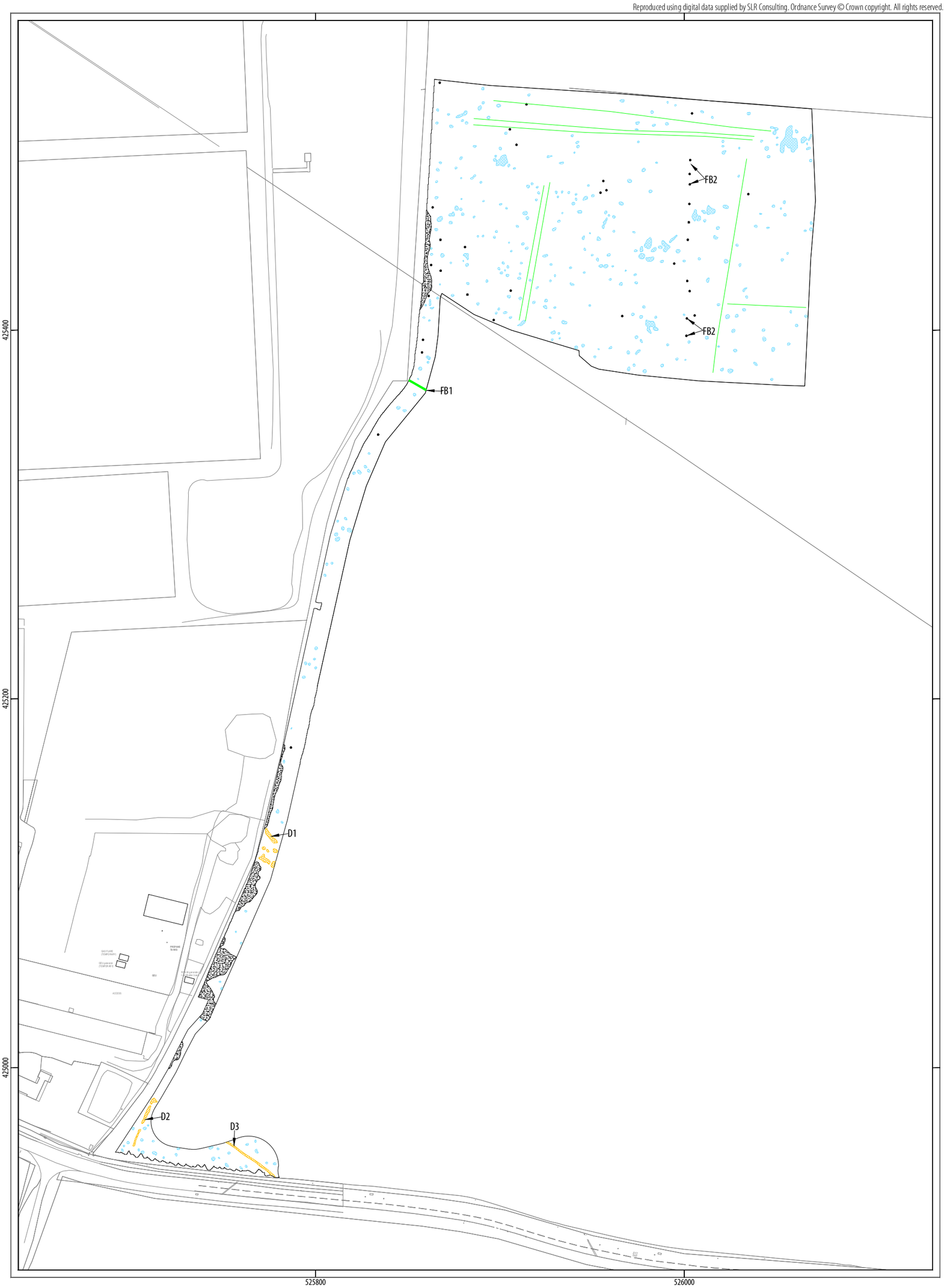
ILLUS 5 XY trace plot of minimally processed magnetometer data



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?

ABBREVIATIONS

D ditch

FB former field boundary

N

0 50m

scale 1:2,000 @ A3

PROJECT SKEY/01
Land east of Keyingham
Saltaugh
East Yorkshire

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ILLUS 6 Interpretation of magnetometer data

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

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 haematite. 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 so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue 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. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

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 (sometimes only visible on an XY trace plot) 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.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data 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 coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary. In addition, the raw data will be deposited with the Archaeology Data Service (ADS) in accordance with Devon County Council's Specification for Geophysical Survey.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-291105

PROJECT DETAILS	
Project name	Land East of Keyingham, East Yorkshire
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 3.7 hectare site on land east of Keyingham, East Yorkshire, to inform planning proposals for a proposed agricultural anaerobic digestion facility. The survey has successfully evaluated the site and identified three possible ditches along the proposed access corridor in the south-west of the site. Due to the narrow survey width along the access corridor no clear pattern is discernible in the magnetic dataset and the anomalies may be modern or agricultural in origin. However, they are interpreted as potentially archaeological due to their proximity to prehistoric and/or Roman cropmarks which are recorded on the Humber Historic Environment Record (HER). No other anomalies of likely archaeological potential have been identified across the site and therefore, on the basis of the geophysical survey, the archaeological potential of the site is assessed as low and locally moderate around the three ditches, broadly corroborating the conclusions of an earlier heritage assessment.
Project dates	Start: 18-07-2017 End: 18-07-2017
Previous/future work	No / Not known
Any associated project reference codes	SKEY-01 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Farm infrastructure (e.g. barns, grain stores, equipment stores, etc.)
Development type	Anareobic digestion
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology	CHALK (INCLUDING RED CHALK)
Drift geology (other)	Devensian Till
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	EAST RIDING OF YORKSHIRE EAST RIDING OF YORKSHIRE OTTRINGHAM Land East of Keyingham
Study area	3.7 Hectares
Site coordinates	TA 2593 2551 53.710555833973 -0.0917776666671 53 42 38 N 000 05 30 W Point
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	SLR Consulting Ltd
Project design originator	Headland Archaeology
Project director/manager	Harrison, S

Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No
PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Land East if Keyingham, East Yorkshire; Geophysical Survey
Author(s)/Editor(s)	Harrison, D.
Date	2017
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