

A47 Wansford to Sutton Dualling

Scheme Number: TR010039

6.3 Environmental Statement Appendices Appendix 6.5 – Geophysical survey of the scheduled monument

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

July 2021



Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A47 Wansford to Sutton Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT APPENDICES Appendix 6.5 - Geophysical survey of the scheduled monument

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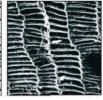














LAND ADJACENT TO THE A47, WANSFORD, PETERBOROUGH

GEOPHYSICAL SURVEY

commissioned by AMEY on behalf of Highways England

July 2017





LAND ADJACENT TO THE A47, WANSFORD, **PETERBOROUGH**

GEOPHYSICAL SURVEY

commissioned by AMEY on behalf of Highways England

July 2017

HA JOB NO. WSRS/01 NGR TL 0870 9978 PARISH Wansford

LOCAL AUTHORITY City of Peterborough

OASIS REF. headland5-290290

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a Scheduled Monument (List Entry 1006796), 5 hectares in size, to help guide route proposals in advance of the dualling and rerouting of the A47 between Wansford and Sutton. The monument comprises a series of cropmarks of likely Bronze Age origin. The survey has confirmed, enhanced and accurately mapped the cropmarks, identifying seven ring-ditches, probable barrows of varying size. Numerous discrete anomalies have been identified within the interior of the ring-ditches perhaps locating pits, cremations and/or inhumations. Parts of at least two interlinking ditchedenclosures have been identified in the north of the scheduled area containing numerous discrete anomalies which may be due to settlement activity. Thermoremnant anomalies east of the enclosures may indicate burning or industrial activity.

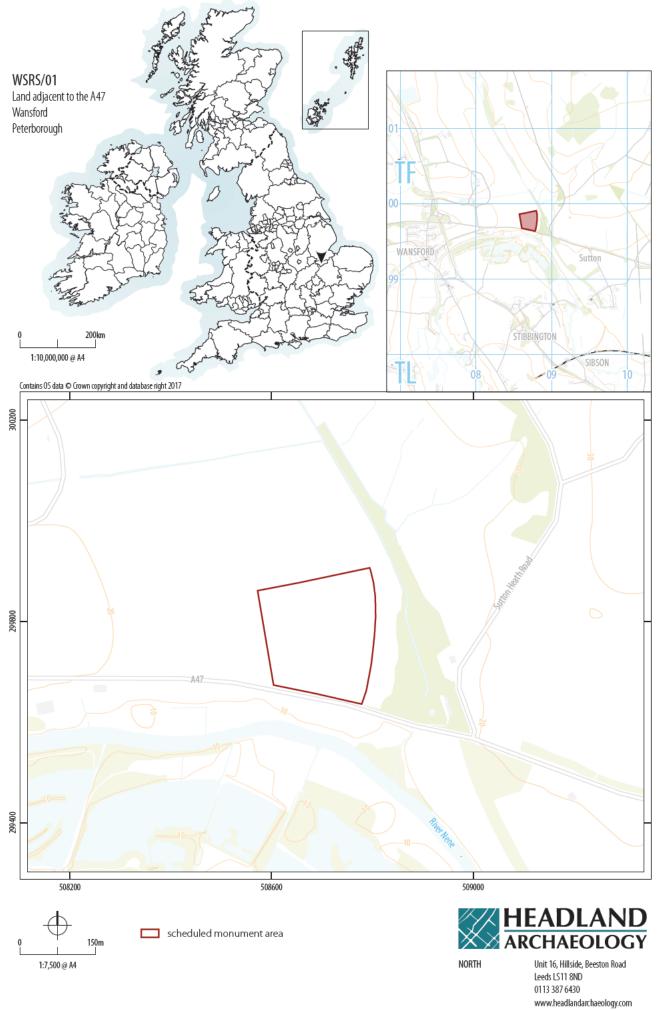
Broad and amorphous high magnitude anomalies along the southern and southwestern limits of the scheduled area locate backfilled quarry pits. It is interesting to note that the quarrying anomalies avoid a clear double ring-ditch in the south of the scheduled area and another ring-ditch in the west. This may suggest that the barrows were extant at the time of the extraction.

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LAND ADJACENT TO THE A47, WANSFORD, PETERBOROUGH

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by AMEY (The Client), on behalf of Highways England, to undertake a geophysical (magnetometer) survey of a Scheduled Monument adjacent to the A47 at Wansford, Peterborough. The survey was carried out to help guide route proposals in advance of the dualling and rerouting of the A47 between Wansford and Sutton.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2017), with a Section 42 licence issued by Historic England (SL00159177; Appendix 6), 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 May 24th 2017 in order to provide additional information on the Scheduled Monument and enable an assessment to be made of the impact of any proposed development on the monument.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The Scheduled Monument comprises a trapezoidal-shaped block of land, centred at TL 0870 9978, 1km east of the village of Wansford, Peterborough (see Illus 1). It is bound to the south by the current A47, and to the west by a mature hedgerow. The eastern and northern monument extents are unbound and open onto a larger grass field (see Illus 2).

The site is located on a slight east-facing slope at between 16m and 18m above Ordnance Datum (AOD).

1.2 GFOLOGY AND SOILS

The underlying bedrock geology mainly comprises of Whitby Mudstone Formation with Grantham Formation (sandstone, siltstone and mudstone) recorded in the west. This is overlain throughout by River Terrace Deposits of sand and gravel (NERC 2017).

The soils are characterised as freely draining loams being classified in the Soilscape 7 association (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

The Scheduled Monument is detailed within the Cultural Heritage chapter of an Environmental Assessement Report (AMEY 2016) as Bronze Age cropmarks of high archaeological value. The City of Peterborough Historic Environment Record (HER) records two find spots of Roman coins and artefacts within the scheduled area (01989/00190).

A Technical Note (AMEY 2017) records the Scheduled Monument (NHLE 1006796) as containing at least seven ring-ditches up to 35m in dimeter, at least one of which is bivallate – comprising two largely concentric circular ditches.

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 scheduled area. 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 east

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 V3.0.31.4 (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 1:7,500. Illus 2 is a site condition photograph. Illus 3 is a 1:3,000 scale survey location plan showing the GPS swath data.

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 1:1,000 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 with the Section 42 licence shown in Appendix 6.

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

The survey has detected a variable magnetic background across the PDA with numerous discrete areas of magnetic enhancement across the magnetic dataset. This is thought to be due to localised variations in the composition of the soils and underlying River Terrace deposits. The ground conditions across the survey area were good and the overall quality of the data collected was good throughout.

Against this background numerous anomalies have been identified. Those anomalies with modern, agricultural or geological origins are discussed first followed by those anomalies with a possible or probable archaeological cause. All are cross-referenced to specific anomalies on the interpretative drawings, 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 edges is due to ferrous material within or close to the adjacent field boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

A series of faint parallel linear trends can be seen on a north-east to south-west orientation across the north of the scheduled area. The anomalies are parallel with the historic pattern of land division and are due to cultivation. Faint linear trends which are oblique to the field boundaries are likely to be due to field drains.

4.3 GEOLOGICAL ANOMALIES

Numerous low magnitude discrete anomalies and faint curvilinear trends are identified across the PDA. These are due to minor variations in the composition of the soils and the superficial deposits- sand and gravel. Broad bands of magnetic enhancement are identified along the southern field boundary, parallel with the River Nene which passes on the other side of the A47. The anomalies are thought to locate bands of alluvium deposited by the river during episodes of flooding.

4.4 OUARRYING ANOMALIES

Two broad amorphous areas of magnetic enhancement (Illus 6; Q1 and Q2) have been identified in the south and south-west of the site. These are characteristic of former quarry pits with the anomalies being due to the magnetic contrast between the material used to infill the quarries and the surrounding soils.

4.5 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

Against the prevailing variable magnetic background it is difficult to confidently discriminate between discrete anomalies which may be due to archaeological features, such as pits, and those that are probably due to localised geological variation. For this reason most of the discrete anomalies within enclosures and ring-ditches have been ascribed a possible archaeological origin with those outside, except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.

Seven ring-ditches (RD1–RD7), probable barrows, have been identified across the scheduled area corresponding to known cropmarks. The anomalies are due to soil-filled ditches. The locations and dimensions of the ring-ditches are detailed in Table 1.

RING-DITCH	NGR (TL)	DIAMETER
RD1	0862 9985	15m
RD2	08619979	22m
RD3	0873 9983	23.5m
RD4	08719979	37m
RD5	0868 9976	25.5m
RD6	08719975	11m
RD7	0866 9968	27m

TABLE 1 Ring-ditch locations

The ring-ditches vary in size with RD7 particularly notable for its bivallate form. A fragmented curvilinear anomaly in the interior of RD4 may also be caused by a concentric ditch or a series of pits. Numerous high magnitude discrete anomalies have been identified within the ring-ditches which may locate pits, cremations and/or inhumations. High magnitude rectilinear anomalies within the north of the scheduled area appear to form parts of at least two interlinking enclosures (E1 and E2). Dense clusters of anomalies in the

ILLUS 3 Survey location showing GPS swaths (1:3,000)

4

interior of the enclosures may be caused by pits perhaps suggesting settlement activity. East of the enclosures broad amorphous high magnitude anomalies (BU) may locate areas of burning with linear anomalies (D1 and D2), probable ditches, extending beyond the survey limit to the north.

5 CONCLUSION

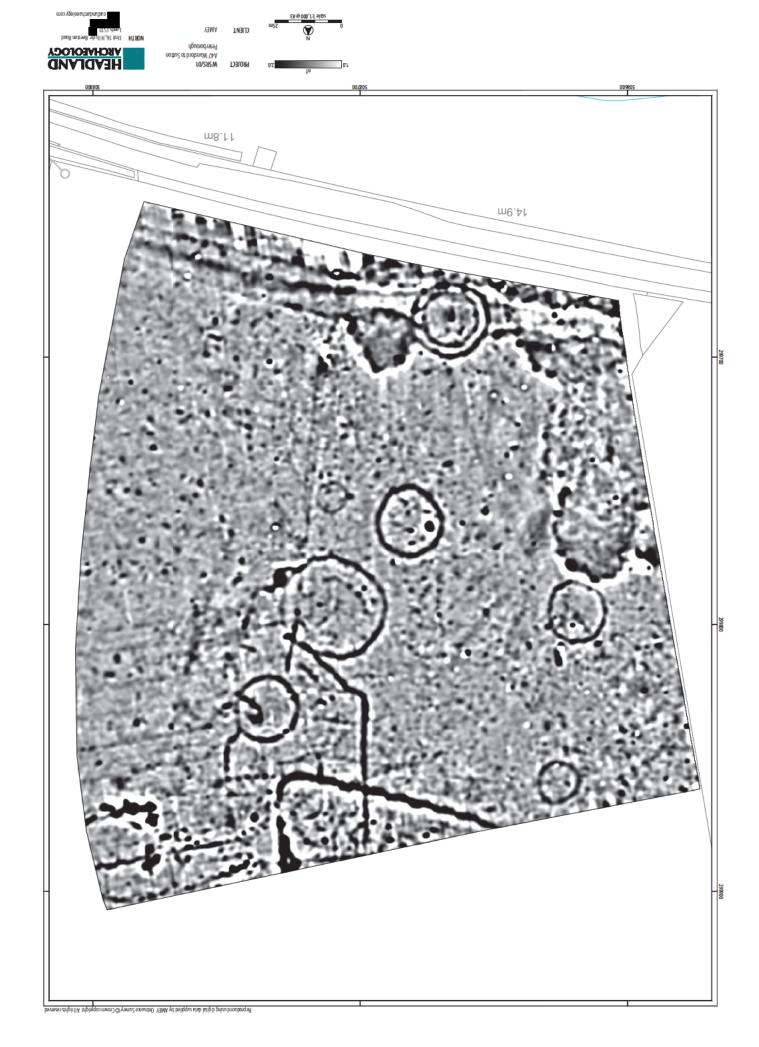
The geophysical survey has successfully evaluated and accurately mapped the Scheduled Monument, confirming and enhancing the archaeological record with the identification of seven probable barrows. Numerous discrete anomalies have been identified within the barrows which may locate pits, cremations and/or inhumations. In addition to funerary evidence, suggestions of settlement activity has been identified in the north of the site in the form of two probable ditched-enclosures containing numerous pit-type anomalies as well as high magnitude anomalies suggesting burning or industrial activity. Broad and amorphous high magnitude anomalies along the southern and southwestern limits of the scheduled area locate backfilled quarry pits. It is interesting to note that the quarrying appears to avoid a clear double ring-ditch in the south of the scheduled area and another ring-ditch in the west. This may suggest that the barrows were extant at the time of the extraction.

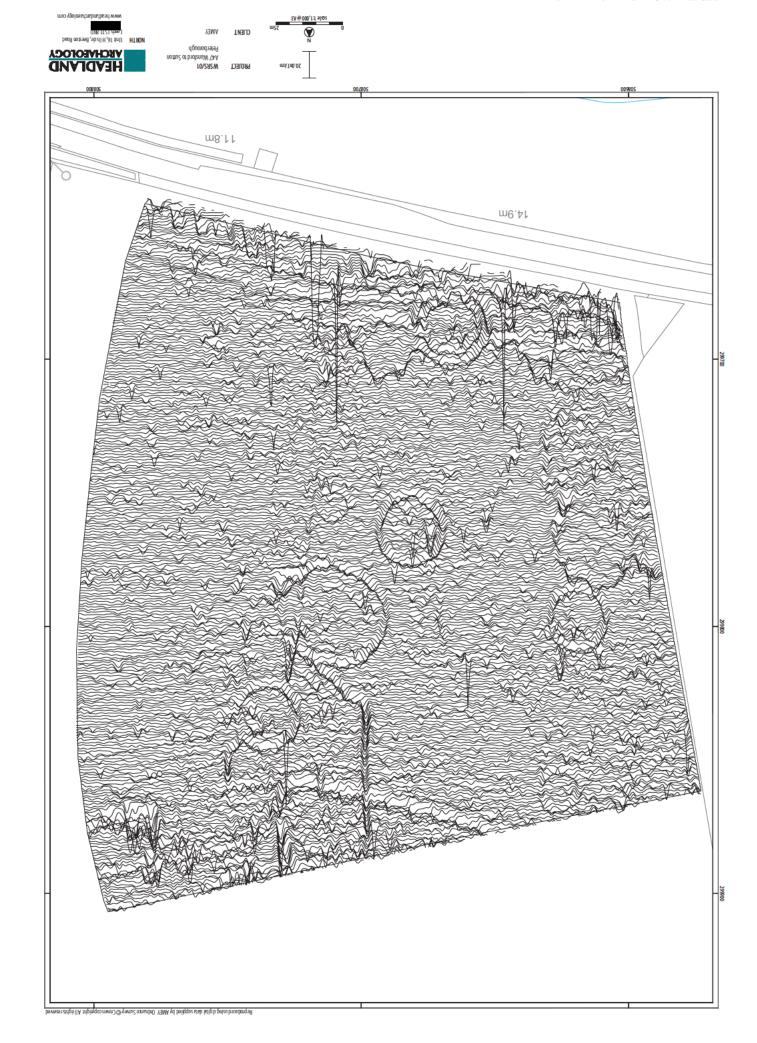
6 REFERENCES

AMEY 2016 Road Investment Strategy; East Area 6; Environmental Assessment Report A47 Wansford to Sutton [unpublished doc AMEY Doc No. A47IMPS1-AME-WS-ZZ-DO-J0024]

AMEY 2017 *A47 Wansford Archaeological Technical Note* [unpublished doc AMEY Doc No. A47IMPS2-AME-WS-ZZ-DO-J0055]

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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/Geophysics3). The data will be stored in an indexed archive and migrated to new formats when necessary.

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.

2017 by Headland Archaeology (UK) Ltd File Name: WSRS-01-Report-v2.pdf

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-290290

PROJECT DETAILS	
Project name	LAND ADJACENT TO THE A47, WANSFORD, PETERBOROUGH
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a Scheduled Monument (List Entry 1006796), 5 hectares in size, to help guide route proposals in advance of the dualling and rerouting of the A47 between Wansford and Sutton. The monument comprises a series of cropmarks of likely Bronze Age origin. The survey has confirmed, enhanced and accurately mapped the cropmarks, identifying seven ring-ditches, probable barrows of varying size. Numerous discrete anomalies have been identified within the interior of the ring-ditches perhaps locating pits, cremations and/or inhumations. Parts of at least two interlinking ditched-enclosures have been identified in the north of the scheduled area containing numerous discrete anomalies which may be due to settlement activity. Thermoremnant anomalies east of the enclosures may indicate burning or industrial activity. Broad and amorphous high magnitude anomalies along the southern and southwestern limits of the scheduled area locate backfilled quarry pits. It is interesting to note that the quarrying anomalies avoid a clear double ring-ditch in the south of the scheduled area and another ring-ditch in the west. This may suggest that the barrows were extant at the time of the extraction.
Project dates	Start: 24-05-2017 End: 24-05-2017
Previous/future work	Not known / Not known
Any associated project reference codes	WSRS17-01 - Sitecode
Any associated project reference codes	1006796 - SM No.
Type of project	Field evaluation
Site status	Scheduled Monument (SM)
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	RING-DITCH Bronze Age
Significant Finds	N/A 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)	Whitby Mudstone Formation and Grantham Formation
Drift geology	RIVERTERRACE DEPOSITS
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	CAMBRIDGESHIRE PETERBOROUGH WANSFORD Land Adjacent to the A47, Wansford, Peterborough
Study area	5 Hectares
Site coordinates	TL 0870 9978 52.584580881445 -0.395426746834 52 35 04 N 000 23 43 W Polygon
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	AMEY
Project design originator	Headland Archaeology
Project director/manager	Harrison, S
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer

LAND ADJACENT TO THE A47, WANSFORD, PETERBOROUGH WSRS/01

PROJECT ARCHIVES		
Physical Archive Exists?	No	
Digital Archive recipient	In house	
Digital Contents	"other"	
Digital Media available	"Geophysics"	
Paper Archive Exists?	No	
PROJECT BIBLIOGRAPHY 1		
Publication type	Grey literature (unpublished document/manuscript)	
Title	Land Adjacent to the A47, Wansford, Peterborough: Geophysical Survey	
Author(s)/Editor(s)	Harrison, D.	
Date	2017	
lssuer or publisher	Headland Archaeology	
Place of issue or publication	Edinburgh	
Description	A4 glue bound report	
Entered by	Sam Harrison @headlandarchaeology.com)	
Entered on	14 July 2017	

APPENDIX 6 SECTION 42 LICEN



EAST OF ENGLAND OFFICE

Mr Declan Hurl Amey Rushmere House 46 Cadogan House Belfast BT9 6HH Direct Dial:

Our ref: AA/43325/5

24 April 2017

Dear Mr Hurl

Ancient Monuments and Archaeological Areas Act 1979 (as amended) section 42 - licence to carry out a geophysical survey

SITE REVEALED BY AERIAL PHOTOGRAPHY W OF SUTTON HEATH, WANSFORD, PETERBOROUGH

Case No:SL00159177

Monument no: NHLE 1006796; PE201

I refer to your application dated 21 April 2017, to carry out a geophysical survey at the above site.

Historic England is empowered to grant licences for such activity and I can confirm that we are prepared to do so as set out below.

By virtue of powers contained in section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983) Historic England hereby grants permission for geophysical survey of SITE REVEALED BY AERIAL PHOTOGRAPHY W OF SUTTON HEATH, for the areas shown on the map that accompanied your application (copy attached). This permission is subject to the following conditions.

- The permission shall only be exercised by Declan Hurl and nominated representatives and by no other person. It is <u>not</u> transferable to another individual.
- 2. The permission shall commence on 24 April 2017 and shall cease to have effect on 31 July 2017.
- 3. A full report summarising the results of the geophysical survey and their interpretation shall be sent in hard copy to Andrew Northfield at the address below and electronic (pdf) format to poppy@HistoricEngland.org.uk, copied to @HistoricEngland.org.uk no later than 6 months after the completion of the survey.
- 4. The enclosed questionnaire shall be completed and appended to the survey



24 BROOKLANDS AVENUE, CAMBRIDGE, CB2 8BU







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report. For convenience an electronic version of this questionnaire can be downloaded from http://HistoricEngland.org.uk/advice/technical-advice/archaeological-science/geophysics.

- 5. A copy of the report shall also be sent (in their preferred format) to the local Historic Environment Record (HER). The local HER's contact details can be found at http://www.heritagegateway.org.uk/gateway/chr/default.aspx.
- 6. A record signposting your investigation shall be made with the Archaeology Data Service using their online OASIS Data Collection form no later than 6 months after completion of the survey. Please see http://oasis.ac.uk/ for details or contact oasis@HistoricEngland.org.uk for information and training.

This letter does not carry any consent or approval required under any enactment, byelaw, order or regulation other than section 42 of the 1979 Act (as amended).

You are advised that the person nominated under this licence to carry out the activity should keep a copy of this licence in their possession in case they should be challenged whilst on site.

uk









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