ARCHAEOLOGICAL PROJECT SERVICES

GEOPHYSICAL SURVEY: LAND OFF LITTLEWORTH DROVE DEEPING ST NICHOLAS LINCOLNSHIRE (LDDN25)



Prepared for
STUDIO 11 ARCHITECTURE
by
Archaeological Project Services

Planning Application: H03-0048-25
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Document Control

Project Name	**Littleworth Drove, Deeping St Nicholas**
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Reviser(s)	**Paul Cope-Faulkner**
Date of Last Revision	**1/12/2025**
Version	**1.0**

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Site name	**Littleworth Drove, Deeping St Nicholas - Geophysical Survey Report**
National Grid Reference	**TF 2180 1657**
OASIS Record No.	**archaeol1-538875**

Statement of professional competence:
Jonathon Smith has a BA (Hons) in archaeology, an MA in prehistory and is an affiliate member of the Chartered institute for Archaeologists (ACIfA). He began working as a junior geophysicist for APS in 2011 and became responsible for the team in 2016.

Jonathon surveyed and analysed sites for Historic England's Lincolnshire Long Barrows Project, which has been published in *Houses of the Dead?* edited by Barclay, Field and Leary.

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1. SUMMARY

A detailed magnetic gradiometer survey was undertaken for Studio 11 Architecture in connection with a proposed residential development on land north of Littleworth Road, Deeping St Nicholas, Lincolnshire. The survey area totalled c. 1.6ha.

The site in an area rich in iron Age and Roman remains, particularly settlements which include salterns on the edge of fenland.

The survey revealed a complex network of sinuous former marshland channels. An area with more regular features was tentatively identified, which might be a series of enclosures. Nearby, although outside the development area, a strongly magnetic feature was identified, which ming indicate the presence of a saltern.

2. INTRODUCTION

2.1 Definition of an Evaluation

An archaeological evaluation is defined as *'a programme of non-intrusive and/or intrusive fieldwork which seeks to determine the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts. It may form a single or final phase of work within a defined area or site on land, in an inter-tidal zone or under water'* (CIfA 2023).

2.2 Project Background

Archaeological Project Services (APS) was commissioned by Studio 11 Architecture to undertake a detailed magnetometer survey totalling some 1.5ha on land to the north of Littleworth Drove, Deeping St Nicholas, Lincolnshire. This was in advance of a proposed residential development. The work was undertaken in accordance with a written scheme of investigation prepared by APS and approved by the Archaeological Advisor to South Holland District Council. The survey was carried out on 17th November 2025.

2.3 Topography and Geology

The Site is a field north of the junction of Littleworth Drove and Campains Lane, at National Grid Reference TF 2180 1657 (Fig 1). The Site is level at c.2m OD, sitting in the wide low-lying plain of former fenland. Elevation data indicates the site lay east of a majour roddon (a silted-up streams which stands higher than the surrounding landscape), with a small roddon visible on the Site itself (Plate 1). Roddons often offered higher, dry places to build settlements at certain points in history, whereas the land between was often seasonally submerged.

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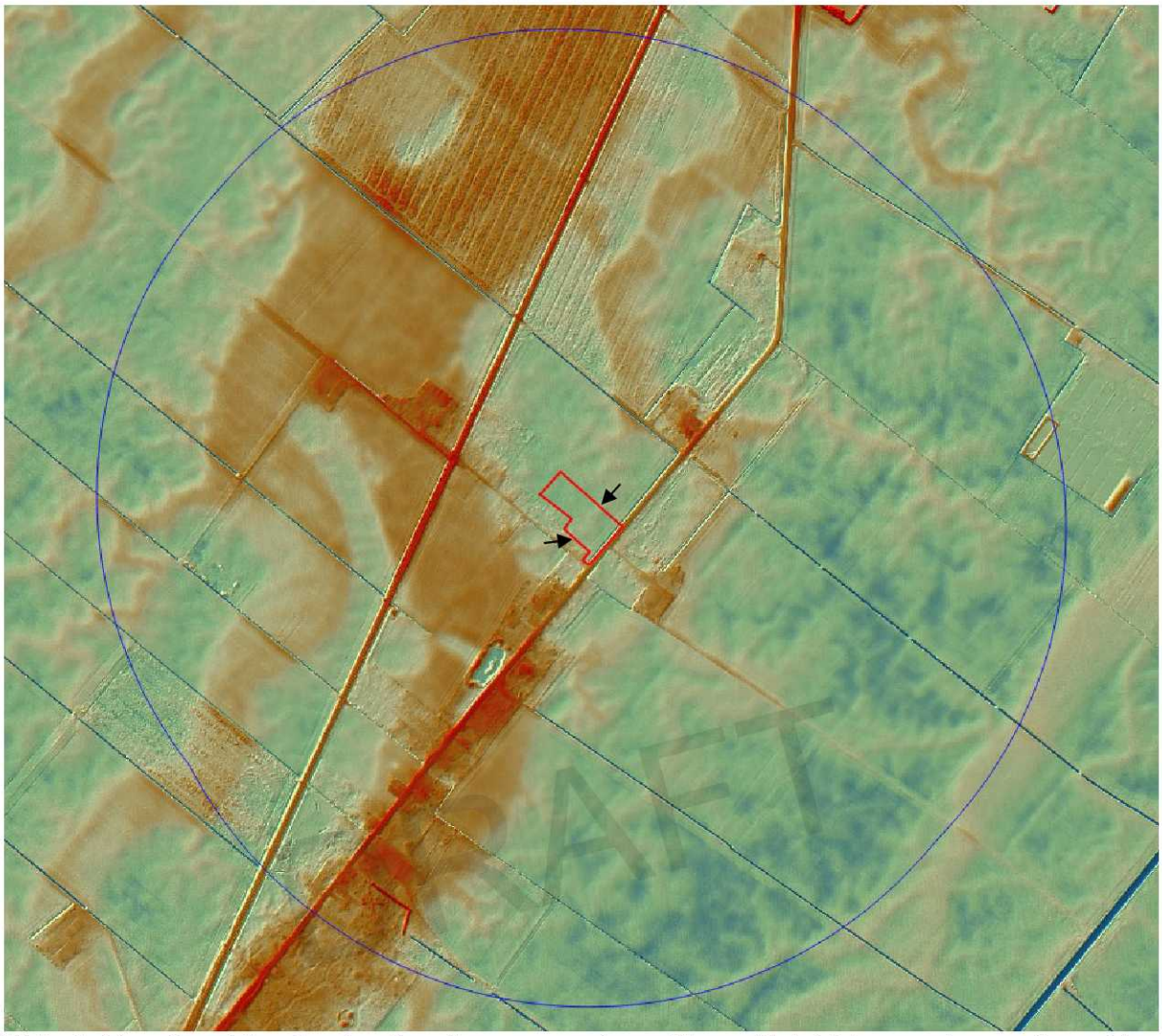


Plate 1. Elevation data, showing the site near a major roddon, with faint traces of a smaller roddon across the Site itself. The smaller roddon is indicated with black arrows. Blue is low (1m OD) and red is high (3.5m OD)

Local soils are of the Downholland 1 Association, typically clayey humic alluvial gley soils (Hodge et al. 1984, 166). These soils are formed on a superficial deposits of clay and silt Tidal Flat Deposits, which in turn sits on a bedrock of Oxford Clay Formation mudstone (BGS 2025).

2.4 Archaeological Setting

Excavations in the vicinity of the site have revealed Iron Age and Roman settlement on the large roddon to the southwest, west and north of the site. This includes an Iron Age saltern 300m southwest.

Deeping St. Nicholas is a relatively new village and probably came about as a result of post-medieval drainage of the fens. A church was built here in 1846 and it became a parish in 1856 (Wheeler 1896, 331). Prior to this, the area was part of the Deepings, fenland which was used from medieval times as seasonal pasture.

Historical maps and lidar data do not suggest any features on the site.

3. GEOPHYSICAL SURVEY

3.1 Methods

A magnetic gradiometry survey was carried out with a Bartington Grad 601-2 fluxgate magnetometer. The site was divided into 40m^2 grids using a survey grade GPS and each grid was walked systematically in a zigzag pattern, taking readings every 0.25m in traverses 1m apart.

The layout of the survey area is shown in Figure 2. At the time of the survey the field was freshly drilled and was ideal for surveying.

The survey was undertaken in accordance with EAC (2016) and CIfA (2014) guidelines and codes of conduct. A detailed methodology can be found in Appendix 1.

3.2 Results

The presentation of the data for the site comprises a greyscale print-out of the raw data (Fig. 3 and the processed data (Fig. 4). Magnetic anomalies have been identified and plotted on to an interpretative drawing (Fig. 5). In the following text, the numbers in brackets refer to annotations on Figure 5.

Positive linear anomalies
Irregular positive linear anomalies are so pervasive in the survey data, that no attempt has been made to transcribe them all. These are typical of marshland environments and represent many small streams.

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One strong and straight positive linear anomaly matches the location of a ditch predating the 1763 map (1).

A small number of straighter linear anomalies have been highlighted, which, together, have the appearance of a potential field system (2). This is a very tentative observation as the linear anomalies are otherwise not of a distinctive character and areas of seemingly regular disturbance might be expected in otherwise irregular data.

Areas of positive disturbance
Three areas of roughly rectangular positive readings have been highlighted (3-5). Each measure between 4.5-7m long by 2-3m wide, with a strength of anomaly between 3nT to 8nT. These are slightly more regular and magnetically stronger than surrounding anomalies, and in the case of (4) and (5), isolated from the surrounding linear disturbances. Tentatively, this might suggest a human origin, such a pond or pool. However, these anomalies are only just outside the typical background readings, which contains many irregular grains of positive readings.

Areas of bipolar disturbance
An area of bipolar disturbance (6) sits just outside the edge of the site. This has a positive core measuring 3m by 2m and measuring over 100nT. This is surrounded by very strong negative readings of -100nT, measuring 6m by 3.3m and weaker negative readings are still visible over a radius of 9m. There are no objects on the surface of the field which might account for this anomaly. Such strong and broad readings might be expected from a large metallic object or an area of intense burning, such as a saltern. A trace plot of the grid is presented below for detailed analysis (Plate 2). There are no internal features visible in the anomaly.

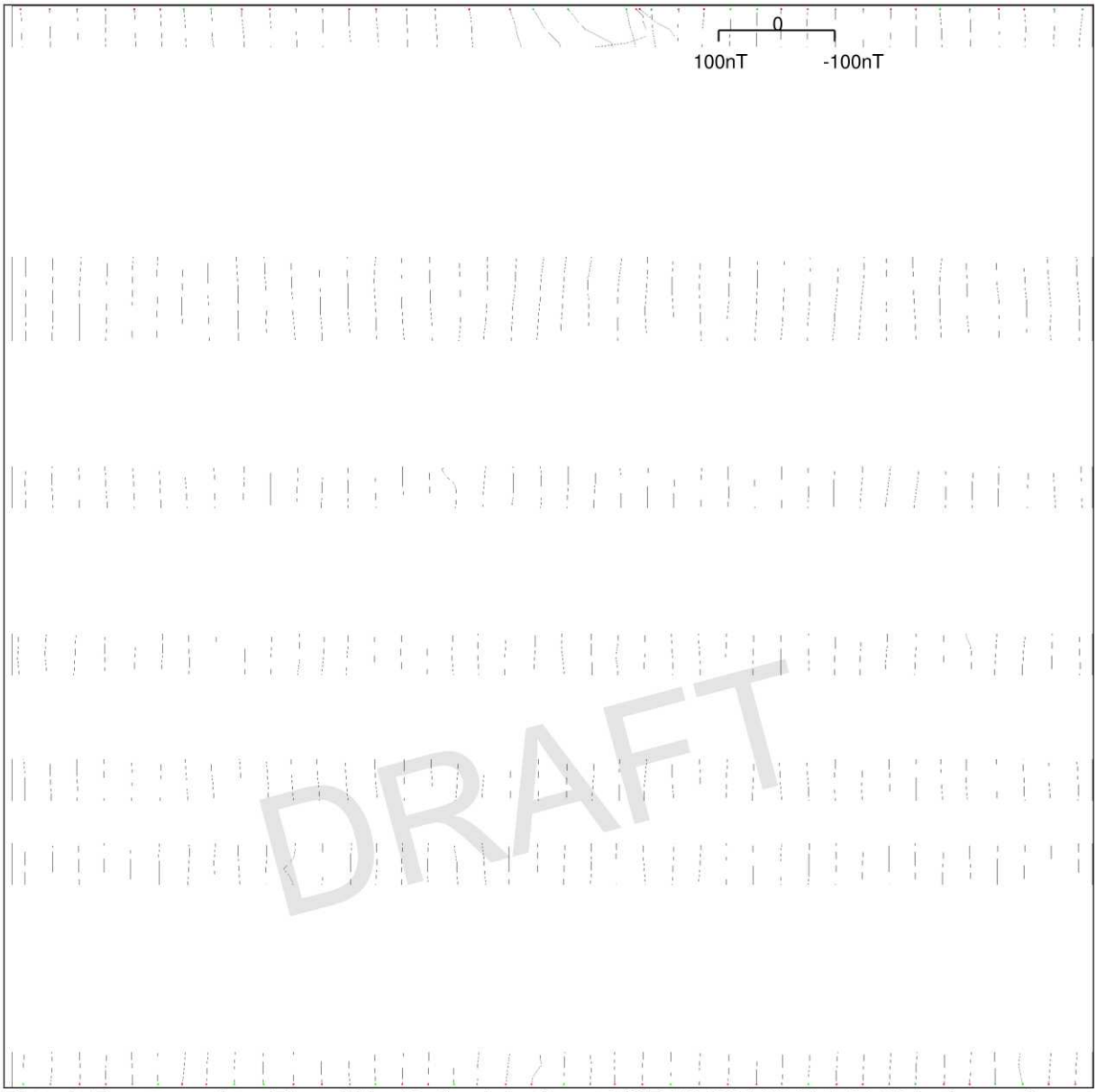


Plate 2. Raw trace data. The grid is 40m², originating at NGR 521824.22 316536.26 in the southwest corner.

Discrete dipolar response

Examples of magnetic dipoles have been highlighted with blue dots. These are typically caused by small metallic items in the topsoil, such as nails, which arrive by manuring practices and as fragments of agricultural machinery. As such, these are not typically given any archaeological significance. The dipoles concentrate at the field boundary, especially adjacent to nearby gardens, which is typical of waste accumulating at the field edges.

Negative anomaly

A negative anomaly is present at the edge of the survey. This was noted being due to a steel barrel placed at the edge of the field (Hayes and Lane 1992).

Agricultural features

Four northeast-southwest orientated linear anomalies are visible at the northwest corner of the survey, on the edge of the site. These have been highlighted with green lines. The strength, clarity, regularity and consistent spacing (7m) of these linear anomalies suggests an agricultural function. They most likely represent 19th century or modern drains.

4. DISCUSSION

The survey has shown that the site was formerly marshland, punctuated by many irregular, sinuous streams and small pools. This is consistent with what is known about the history of the site. Very tentatively, some features with greater regularity have been highlighted (1-4) which might have a human origin. However, it is thought most likely that these are also natural features, with the seeming regularity an expression of the random characteristics inherent in the streams and pools.

Of note, the potential small roddon suggested by the contour data for the site is not visible in the magnetic data.

A bipolar anomaly is present just outside of the site boundary (about 0.6m from the redline boundary). This has the potential to be a saltern. It sits at about 1m OD, significantly lower than the Saltern discovered on the roddon to the southwest, which was discovered on land at about 2.5m OD. Alternatively, the bipolar anomaly could be due to a large piece of modern metallic contamination.

There is no obvious way the features revealed could contribute to the regional research framework (Knight *et al*, 2012).

The magnetic strength of the data obtained is relatively high, with may areas in excess of +/- 5nT. This may mask more subtle features. The data quality on the northern part of the survey is good, but sub-par on the southern third, where frequent misalignments in the anomalies are evident. This drop in quality may be due to the irregular grid shapes which require more complex procedures to accommodate, or operator fatigue leading to an increased error rate. The grids remain largely readable, although there is potential that a very small or weak anomalies might be concealed is increased.

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5. ACKNOWLEDGEMENTS

Archaeological Project Services wish to acknowledge Kris Baxter of Studio 11 Architecture for commissioning this project. Paul Cope-Faulkner edited this report.

6. PERSONNEL

Project coordinator: Paul Cope-Faulkner
Geophysical Survey: Jonathon Smith
Survey processing and reporting: Jonathon Smith
Archiving: Denise Buckley

7. BIBLIOGRAPHY

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Margary, ID, 1973 *Roman Roads in Britain* (3rd edition)

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8. ABBREVIATIONS

AOD Above Ordnance Datum

APS Archaeological Project Services

BGS British Geological Survey

CIfA Chartered Institute for Archaeologists

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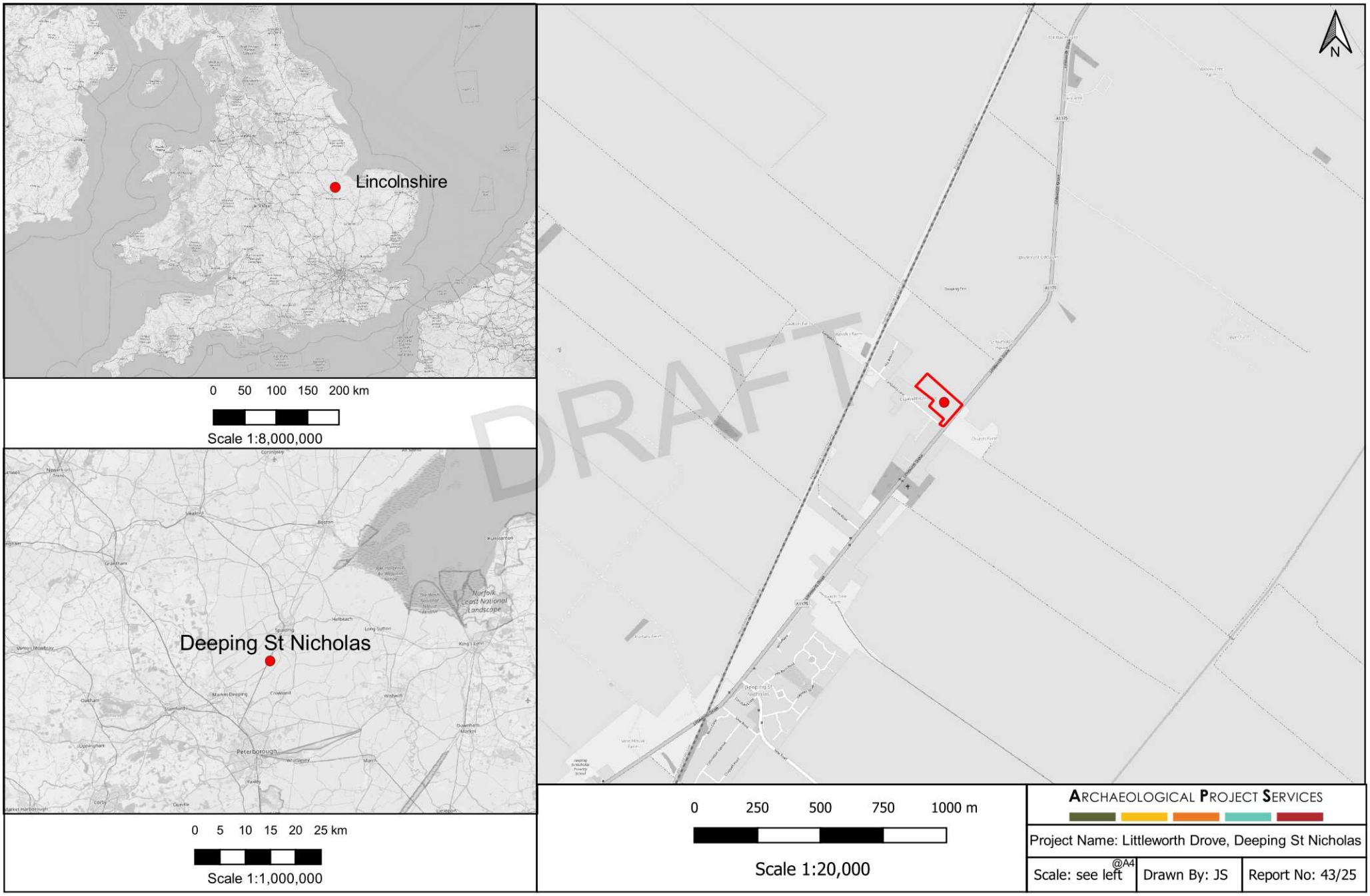


Figure 1 - Site Location

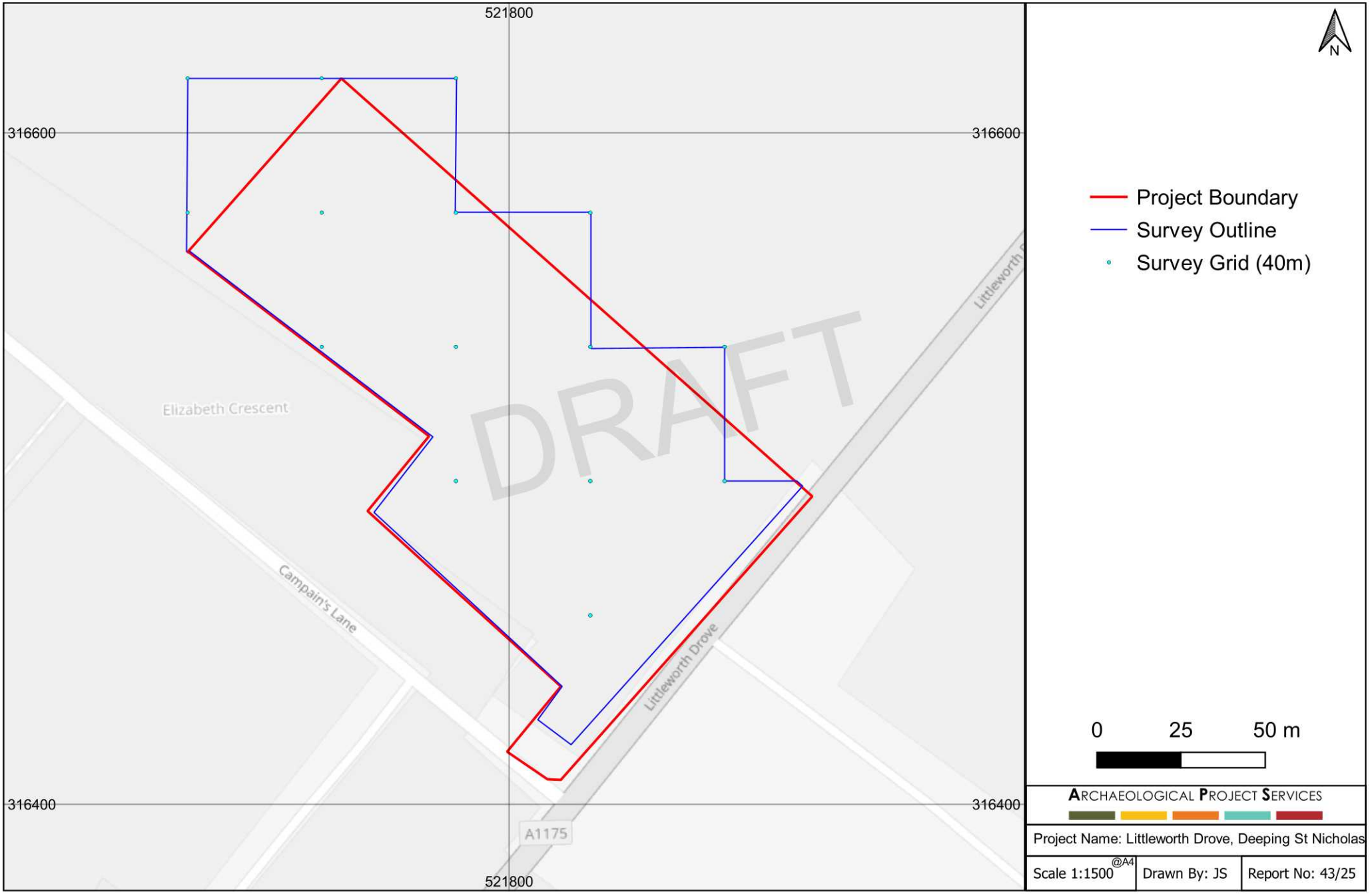


Figure 2 - Survey Layout



Figure 3 - Unprocessed greyscale data

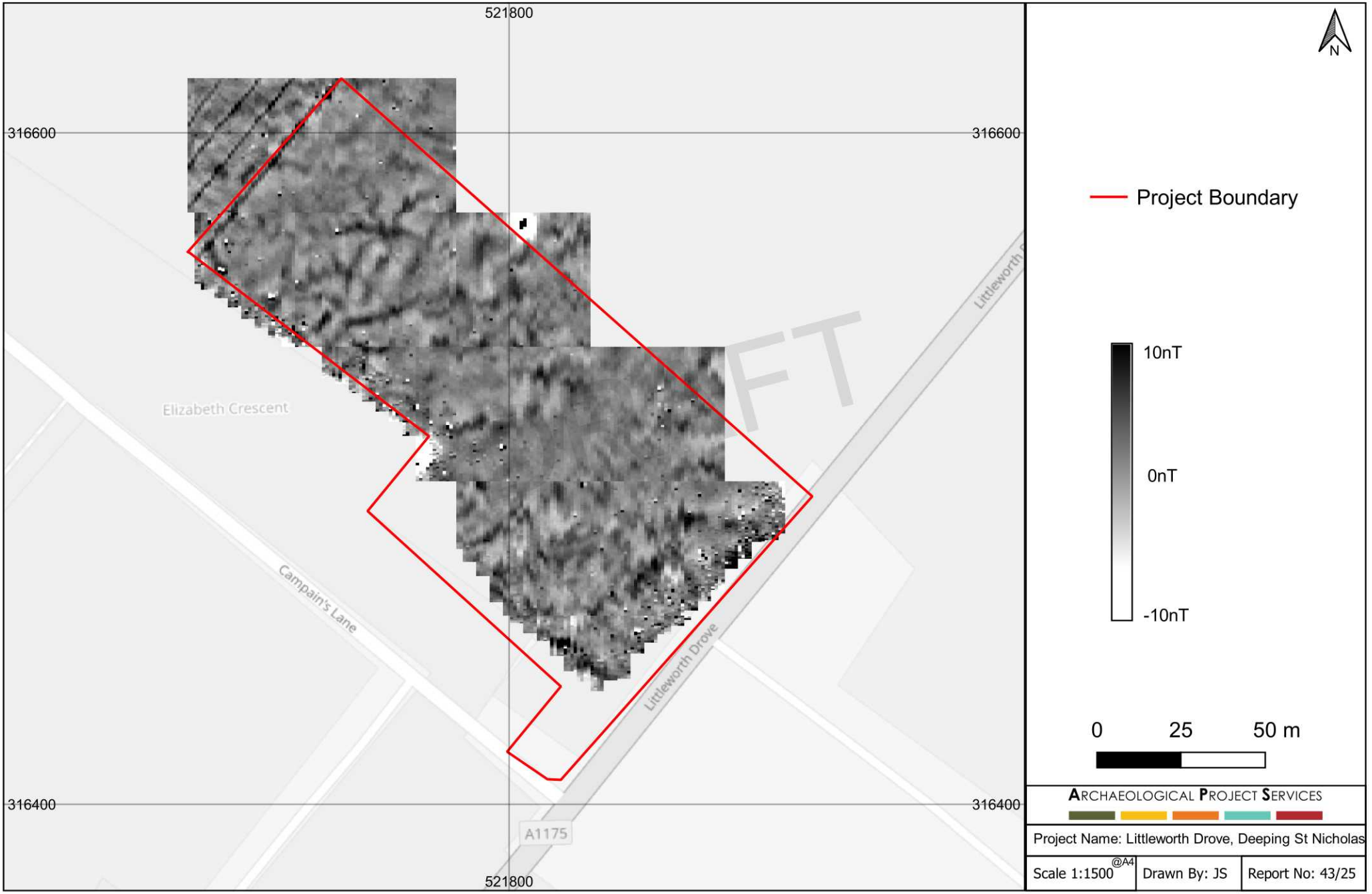


Figure 4 - Processed greyscale data

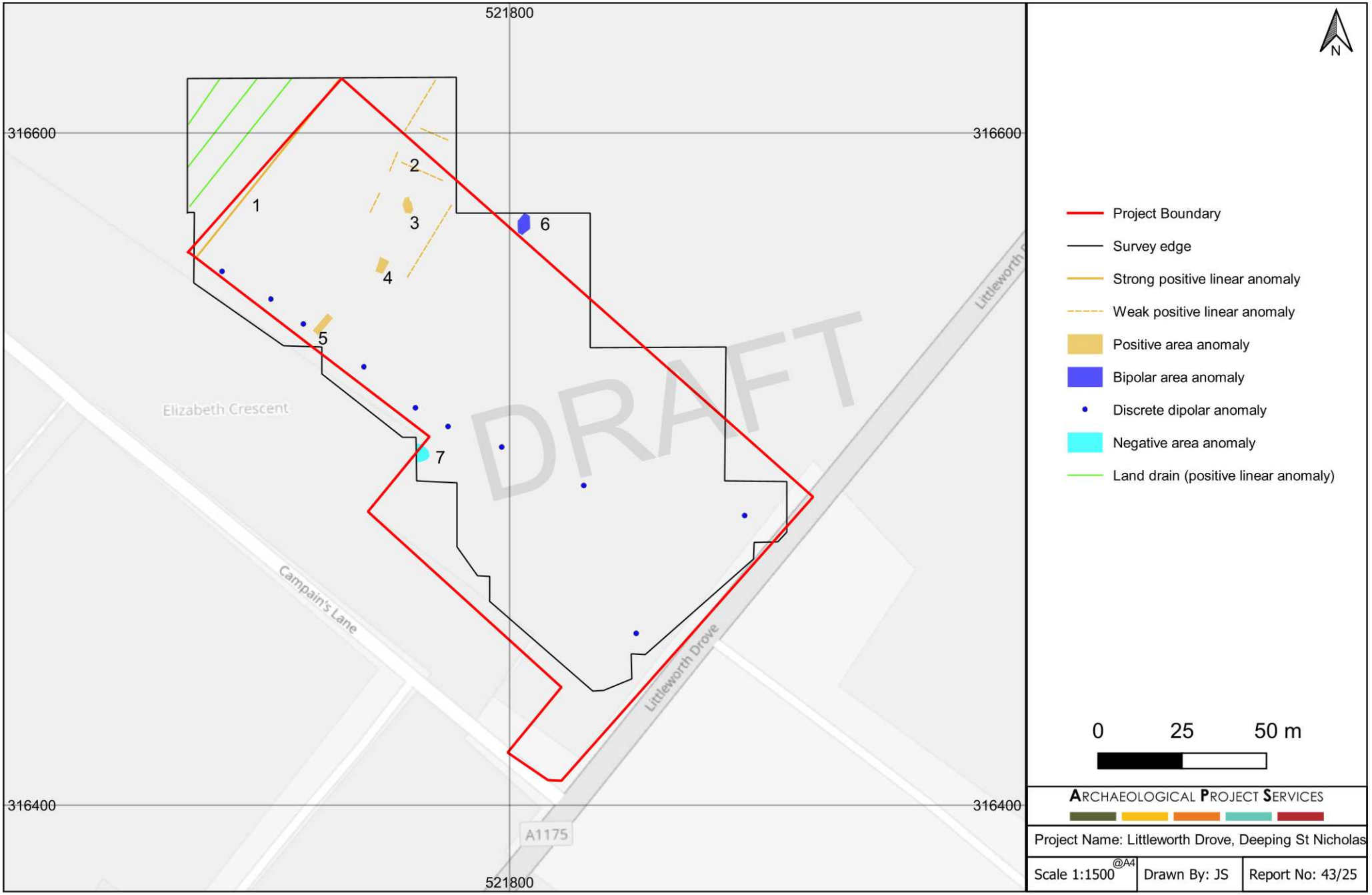


Figure 5 - Interpretation

Appendix 1

TECHNICAL INFORMATION

Principles of magnetometry
Magnetic prospecting is designed to identify concentrations of magnetised iron oxides in the soil. Iron oxides can exist in states of weak or a strong magnetisation (Gaffney and Gater 2003).

Human activities tend to enhance the magnetic properties of iron oxide particles. Where these particles accumulate, such as in cut features like ditches and pits, a weak positive magnetic anomaly is apparent. In cases where very strong heat has been applied, such as furnace and kiln bases, a bipolar magnetic anomaly will be apparent, with one area having a strong positive signature and one area having a strongly negative signature. Where banks have been built up from natural geological material which excludes magnetically enriched sediments, or walls have been made of stone, this may result in a negative anomaly. Modern metallic items and fired bricks cause sharp bipolar spikes. Modern services have a tendency to alternate between positive and negative readings along their length.

It should be noted that not all features will be detectable magnetically and an absence of anomalies does not necessarily indicate absence of archaeological features (Clark 1996).

Bartington Grad 601-2
A gradiometer uses two sensors separated by a fixed distance in order to measure the difference in strength between the earth's magnetic field and the soil. The Bartington Grad 601 uses two fluxgate sensors separated vertically by 1m to take these readings. This reduces natural variations associated with the Earth's magnetic field and deep geology. Changes as small as 0.2 nanoTesla (nT) in an overall field strength of c. 49,000nT can be accurately detected using this instrumentation, although in practice instrument interference and soil noise can limit sensitivity. The instrument has typical penetration of 0.5m-1m, although stronger anomalies can be detected at greater depths. The 601-2 model uses two sets of sensor pairs to take parallel readings 1m apart horizontally.

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Methodology
The survey area is divided into grid squares of 40x40m. The grids are set out using a survey grade GPS, accurate to 0.03m. The grids are systematically walked in a zigzag pattern with the gradiometer taking readings every 0.25m along a traverse, and each traverse being separated by 1m. This equates to 6400 sampling points in a full 40m x 40m grid. Readings are automatically recorded on a datalogger which is downloaded at the end of each day. The gradiometer is 'zeroed' at the start of each day and at intervals throughout to ensure consistent results are achieved throughout the survey.

Data Processing
The data is downloaded and processed using TerraSurveyor64 software (version 41.15.2). The raw data is then adjusted to emphasise possible features. At each stage the data is examined as a greyscale image and as a trace plot.

Raw data
The data is not clipped so that the highest/lowest readings are most visible. The range is constrained to -100nT to 100nT range.

Processed Data
The following processes are applied to produce the processed greyscale image:

- Destripe: Each traverse is flattened with regard to surrounding traverses by setting the median value of the traverse to 0nT. This produces cleaner images, but may cause bleeding where particularly strong signals are present at one end of a traverse.
- Data Clip: The data is clipped to provide the most suitable contrast for seeing archaeological features. This excludes readings outside of the -10nT to 10nT range.
- Grad shade: This is to remove pixelation and smooth anomalies in data for interpretation.

Data is exported as a PNG image and georeferenced for use in scale plans of the site. Anomalies are then checked against historical maps, and where available, lidar contour data.

References

Clark, A., 1996 *Seeing Beneath the Soil*, London, 2nd edn.

Gaffney C. and Gater, J., 2006 *Revealing the Buried Past: Geophysics for Archaeologists,* The History Press

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Appendix 2

GLOSSARY

Alluvium	Deposits laid down by water. Marine alluvium is deposited by the sea, and fresh water alluvium is laid down by rivers and in lakes.
Bronze Age	A period characterised by the introduction of bronze into the country for tools, between 2400 and 800 BC.
Cropmark	A mark that is produced by the effect of underlying archaeological or geological features influencing the growth of a particular crop.
Domesday Survey	A survey of property ownership in England compiled on the instruction of William I for taxation purposes in 1086 AD.
Drift	Material that has been eroded, transported or deposited by glaciers (or their melt water). The term 'drift' is commonly used to describe any deposits of Quaternary age.
Geophysical Survey	Essentially non-invasive methods of examining below the ground surface by measuring deviations in the physical properties and characteristics of the earth. Techniques include magnetometry and resistivity survey.
Iron Age	A period characterised by the introduction of Iron into the country for tools, between 800 BC and AD 50.
Lidar	An aircraft-based method of survey using analysis of pulses of laser light reflected from the surfaces of the ground and buildings. It is cable of identifying subtle differences in topography.
Medieval	The Middle Ages, dating from approximately AD 1066-1500.
Modern	The current period, dating from around AD 1900 to the present time.
Natural	Undisturbed deposit(s) of soil or rock which have accumulated without the influence of human activity
Neolithic	The 'New Stone Age' period, part of the prehistoric era, dating from approximately 4500 - 2250 BC.
Old English	The language used by the Saxon (*q.v.*) occupants of Britain.
Post-medieval	The period following the Middle Ages, dating from approximately AD 1500-1900.
Prehistoric	The period of human history prior to the introduction of writing. In Britain the prehistoric period lasts from the first evidence of human occupation about 500,000 BC, until the Roman invasion in the middle of the 1st century AD.
Ridge and Furrow	The remains of arable cultivation consisting of raised rounded strips separated by furrows. It is characteristic of open field agriculture.
Roman	Pertaining to the period dating from AD 43-410 when the Romans occupied Britain.
Saxon	Pertaining to the period dating from AD 410-1066 when England was largely settled by tribes from northern Germany, Denmark and adjacent areas.

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Appendix 3

THE ARCHIVE

The archive consists of:

1 Daily record sheets
1 Report text and illustrations
1 Digital data

File names	LDDN25.csv
Explanation of codes used in file names	.csv files allow whole composite to be generated and stored easily.
Description of file formats	All files are in csv format where Z= nT reading
List of codes used in files	
Hardware, software and operating systems	TerraSurveyor 64 41.15.2 running under Windows 11
Date of last modification	01/12/2025
Indications of known areas of weakness in data	
Survey Technique	Zigzag
Origin	Starts at 0-0. X axis progresses east. Y axis progresses south
Grid size	40mx40m
Interval	X=1, Y=0.25m
Dummy Value	No reading
XYZ Separation	Comma

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All primary records are currently kept at:

Heritage Lincolnshire/Archaeological Project Services
The Old School
Cameron Street
Heckington
Sleaford
Lincolnshire
NG34 9RW

Final destination of the archive is:

The Collection
Art and Archaeology in Lincolnshire
Danes Terrace
Lincoln
LN2 1LP

Accession No.: LCNCC:2025.203
OASIS code: archaeol1-538875

Appendix 4

OASIS SUMMARY

OASIS ID (UID)	archaeol1-538875
Project Name	Magnetometry Survey at Littleworth Drove
Sitename	Littleworth Drove
Sitecode	LDDN25
Project Identifier(s)	LDDN25
Activity type	Magnetometry Survey, MAGNETOMETRY SURVEY
Planning Id	H03-0048-25
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	Archaeological Project Services
Project Dates	26-Nov-2025 - 26-Nov-2025
Location	**Littleworth Drove** NGR: TF 21800 16570 LL: 52.73305851693592, -0.197597475121875 12 Fig: 521800,316570
Administrative Areas	Country: England County/Local Authority: Lincolnshire Local Authority District: South Holland Parish: Deeping St Nicholas
Project Methodology	A 1.5ha survey adjacent to a roddon. It revealed complex sinuous marshland streams and a large bipolar anomaly which might be a saltern or large metallic item
Project Results	The geophysical survey identified a complex series of sinuous marshland streams over the entirety of the site. One area contained slightly more regular features, but this is considered within the bounds of natural variation. A strong magnetic bipolar anomaly just outside the site boundary might be indicative of a saltern or a large metallic item
Keywords	Saltern - IRON AGE - FISH Thesaurus of Monument Types Saltern - MIDDLE IRON AGE - FISH Thesaurus of Monument Types Saltern - LATE IRON AGE - FISH Thesaurus of Monument Types Saltern - ROMAN - FISH Thesaurus of Monument Types
Funder	Private or public corporation Studio11 Architecture
HER	Lincolnshire HER - unRev - STANDARD
Person Responsible for work	Paul Cope-Faulkner
HER Identifiers	
Archives	Digital Archive - to be deposited with The Collection: Art and Archaeology in Lincolnshire;

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