LAND AT CREASE DROVE, CROWLAND, LINCOLNSHIRE

GEOPHYSICAL SURVEY (CRCD16)

Work undertaken for
N. Woodroffe & Sons C/O
Robert Doughty Consultancy

October 2016

Report produced by
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ARCHAEOLOGICAL PROJECT SERVICES

Quality Control

Crease Drove,
Crowland,
Lincolnshire

CRCD16

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1. SUMMARY

A detailed magnetic gradiometer survey was undertaken for N. Woodroffe & Sons C/O Robert Doughty Consultancy in connection with proposed development on land at Crease Drove, Crowland, Lincolnshire. The survey area totalled c. 3.3ha.

The only feature that is thought to be of possible archaeological origin is a small positive anomaly that forms a flattened oval crescent in the northwest corner of the site. Given the proximity to known Bronze Age artefacts and remains it is possible it may be related to the nearby barrows.

All other anomalies identified are thought to relate to modern, agricultural or geological features and anomalies likely to be natural accumulations of enhanced magnetic material. However, due to the proximity to archaeological features in the vicinity an archaeological origin cannot be discounted.

2. INTRODUCTION

2.1 Definition of an Evaluation

Geophysical survey is a non-intrusive method of archaeological evaluation. Evaluation is defined as *'a limited programme of non-intrusive and/or intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site. If such archaeological remains are present Field Evaluation defines their character and extent, quality and preservation, and it enables an assessment of their worth in a local, regional, national or international context as appropriate'* (CIfA 2014a).

2.2 Project Background

Archaeological Project Services (APS) was commissioned by Robert Doughty Consultancy on behalf of N. Woodroffe & Sons to undertake a detailed magnetometer survey totalling some 3.3ha on land at Crease Drove, Crowland, Lincolnshire. This was in advance of proposed development of the area. The work was undertaken in accordance with a specification prepared by APS and approved by the Planning Archaeologist, South Holland District Council. The survey was carried out on the 26th October 2016.

2.3 Topography and Geology

Crowland is situated 12.5km south of Spalding, 12.6km north of Peterborough in the administrative district of South Holland, Lincolnshire (Fig 1). The proposed development site is located to the southwest edge of Crowland at National Grid Reference TF 2356 0967 (Fig 2).

The site is on low-lying flat land at 3m OD in the valley of the River Witham which lies to the west. Local soils are of the Downholland 1 Association, typically humose clayey soils (Hodge *et al*. 1984, 166). These soils overlie deposits of Nordelph Peat formed approximately 2500 years ago that cover an estuarine or marine sand and gravel, known as the Abbey Gravels (Horton 1989, 27). Former courses of the Welland have been identified close by (Hayes and Lane 1992, 195). Below the drift deposits is a solid geology of Jurassic Oxford Clay (BGS 2016).

2.4 Archaeological Setting

The area of investigation lies along the gravel peninsula which was the focus for a Bronze Age barrow cemetery. Two of the recorded barrows, located a little north and northwest of the site, were destroyed principally through gravel quarrying during the 19th century (Hayes and Lane 1992, 197). Aerial photographs indicate that the barrow cemetery extended further to the southwest. Finds recorded from these barrows indicate that cremation was the common funerary practice and flint and bronze tools accompanied the burials. A bronze dagger fragment found at the northwestern corner of the site probably derives from such a barrow (Archaeological Project Services 2002).

3. GEOPHYSICAL SURVEY

3.1 Methods

A magnetic gradiometer survey was carried out with a Bartington Grad 601-2 fluxgate magnetometer. The field was divided into 40m grids 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 3. The site was relatively flat and had been recently harrowed and seeded following a potato crop harvest (Plate 1).

An area at the eastern edge of the site was not suitable for survey due to overgrowth and uneven ground. Additionally in this section there was a quantity of broken concrete and other building debris.

The survey was undertaken in accordance with English Heritage (2008) and CIfA (2014b) guidelines and codes of conduct. Detailed methodology can be found in Appendix 1.

3.2 Results

The presentation of the data for the site involves a greyscale print-out of the raw data (Fig 4; clipped for display but otherwise unprocessed) and the processed data (Fig 5). Magnetic anomalies have been identified and plotted on to an interpretative drawing (Fig 6). These interpretations have then been overlaid onto historic mapping (Fig 7). In the following text, the letters refer to annotations on Figures 5 and 6.

<u>Positive linear responses</u>
Within the data are a few positive linear responses (highlighted by red lines). Anomaly **A** in the northwestern corner of the site, is a small flattened oval crescent feature measuring approximately 9m by 7m, that may be of archaeological origin. The nature of this feature is unclear although due to the proximity to known archaeological remains an archaeological origin cannot be discounted.

Located towards the centre of the site, anomaly **B** is a small irregular response of uncertain origin. This may represent a natural accumulation of magnetic material though the proximity to known archaeological remains means that an archaeological origin cannot be completely ruled out.

A northwest-southeast positive linear anomaly (**C**), crosses the centre of the site. This response follows the line of a former field boundary shown on OS mapping from at least 1886 to 1952 (Fig 7).

Agricultural activity
The current agricultural regime can be seen clearly as closely spaced positive linear anomalies running northwest – southeast across the site. These have not been marked individually for clarity and, instead the general orientation has been highlighted (green arrows).

The linear features, anomalies **G** at the eastern edge of the site, are probably associated with the agricultural activity and may be a former headlands.

Isolated positive responses
Within the site there are four isolated positive responses (highlighted by red circles). These are uncertain in origin though could possibly be natural accumulations of magnetic material. However, the proximity to possible archaeological remains means that an archaeological origin cannot be completely ruled out.

Isolated dipolar responses
Several isolated dipolar responses (**F**) (highlighted by blue circles) appear to form a linear pattern on a northwest-southeast alignment in the southern half of the site. This line of anomalies is thought to relate to a former fence or temporary boundary running across the site.

Area of positive response
In the northeast and southwest parts of the site there are small areas of positive response (highlighted by blue cross hatch), these are probably accumulations of more magnetic material in the soil, although due to the proximity of possible archaeological remains an archaeological origin cannot be discounted.

Area of geological response
Anomaly (**E**) is clearly present through a large area of the site this is thought to be a geological feature as it is not a uniform pattern of disturbance.

Area of dipolar disturbance
Two areas of dipolar disturbance, anomalies **D** and **H** (highlighted by pink cross hatch) lie in the eastern part of the site. Anomaly **D** is thought to relate to the demolition of the former buildings shown on the OS 6 inch map of 1952 (Fig 7). Anomaly **H** lies in close proximity and may also be related to the former buildings however, the telegraph pole and transformer present in this location is more likely to be the cause of the anomaly in this instance.

4. DISCUSSION

The only clear anomaly that is of possible archaeological origin is located in the northwest corner of the site. This feature is small, approximately 7m x 9m and forms a flattened oval crescent. In form and size this is distinctly different to Bronze Age barrows known in the area, as these are fairly regular circles generally, 25-30m across (APS 2002). However, given the proximity to known Bronze Age artefacts and remains it is possible that anomaly **A** may be related to the nearby barrows.

All other anomalies identified within the survey are thought to be modern, agricultural and geological in origin. However due to the proximity to known archaeological remains an archaeological origin cannot be ruled out.

5. ACKNOWLEDGEMENTS

Archaeological Project Services wishes to acknowledge the Robert Doughty Consultancy who commissioned the project on behalf of N. Woodroffe & Sons. Gary Taylor and Denise Drury edited the report.

6. PERSONNEL

Project coordinator: Sean Parker
Geophysical Survey: Sean Parker and Jonathon Smith
Survey processing and reporting: Sean Parker and Jonathon Smith.

7. BIBLIOGRAPHY

Archaeological Project Services, 2002 *Desk-Based Assessment of the Archaeological Implications of Proposed Development on Land adjacent to Crease Drove, Crowland, Lincolnshire* (CHW02), APS report **88/02**

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Hayes. P.P, Lane T.W. 1992 *The Fenland Project Number 5: Lincolnshire Survey, The South-West Fens*

Hodge, C.A.H., Burton, R.G.O., Corbett, W.M., Evans, R. and Seale, R.S., 1984 *Soils and their use in Eastern England,* Soil Survey of England and Wales **13**

Horton, A., 1989, *Geology of the Peterborough district,* Memoirs of the British Geological Survey

OS 1886 *Lincolnshire sheet CLIII.NW 6 inch map*

OS 1952 *Lincolnshire sheet CLIII.NW 6 inch map*

8. ABBREVIATIONS

APS Archaeological Project Services

BGS British Geological Survey

CIfA Chartered Institute for Archaeologists
OS Ordinance Survey

Figure 1 - General location plan

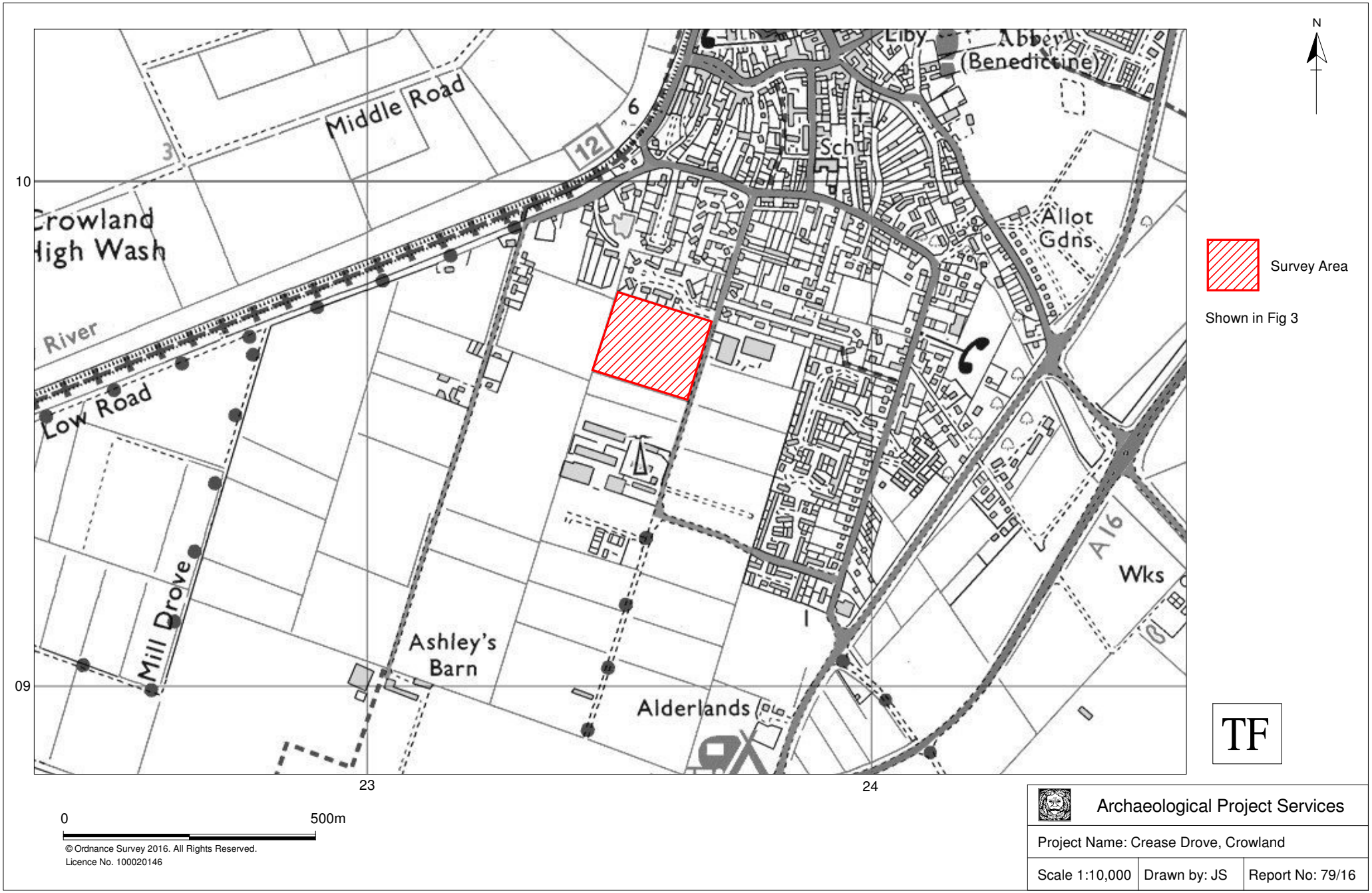

Figure 2 - Site Location

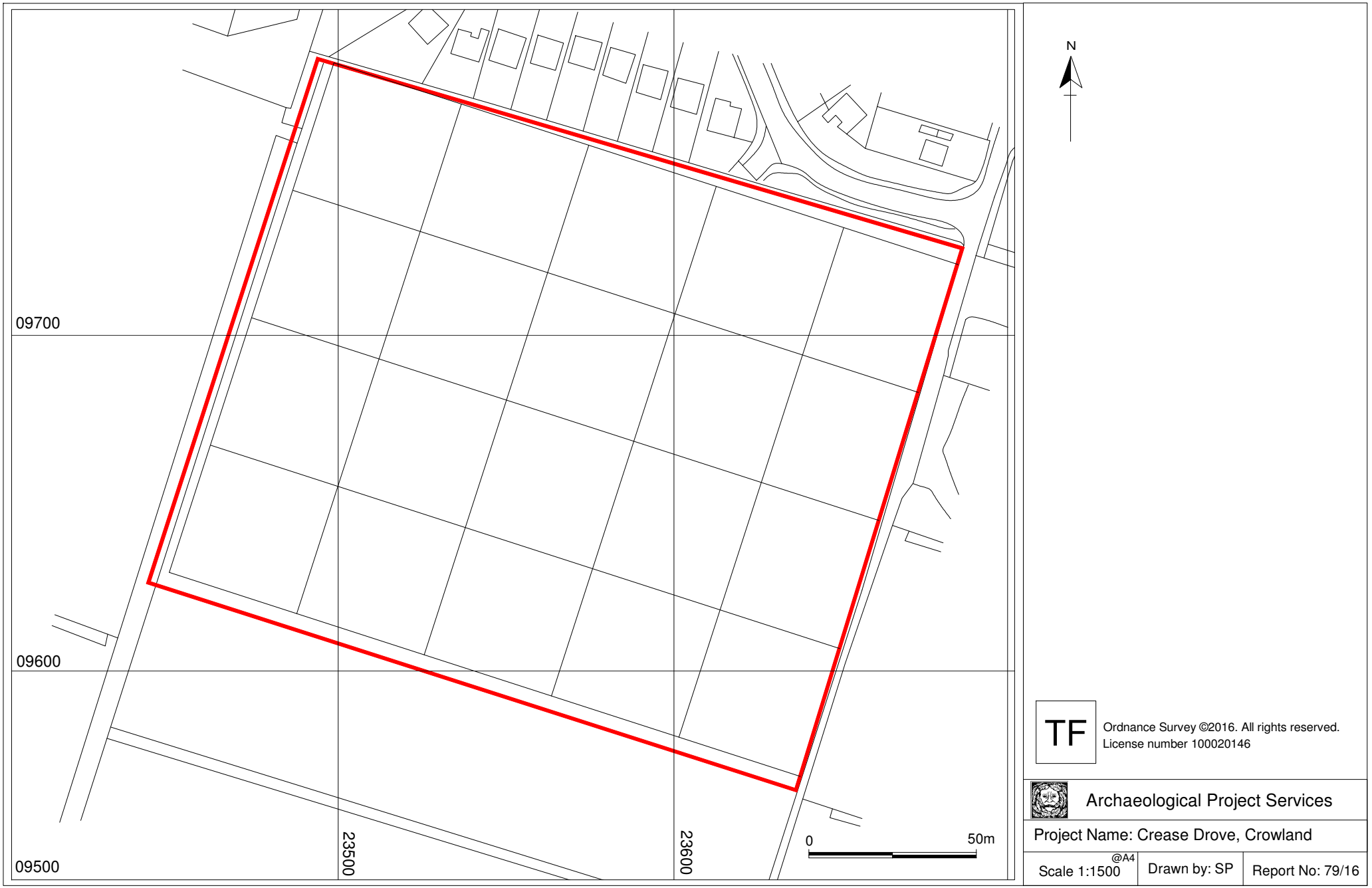

Figure 3 - Site Layout

Figure 4 - Raw Data

Figure 5 - Processed Data

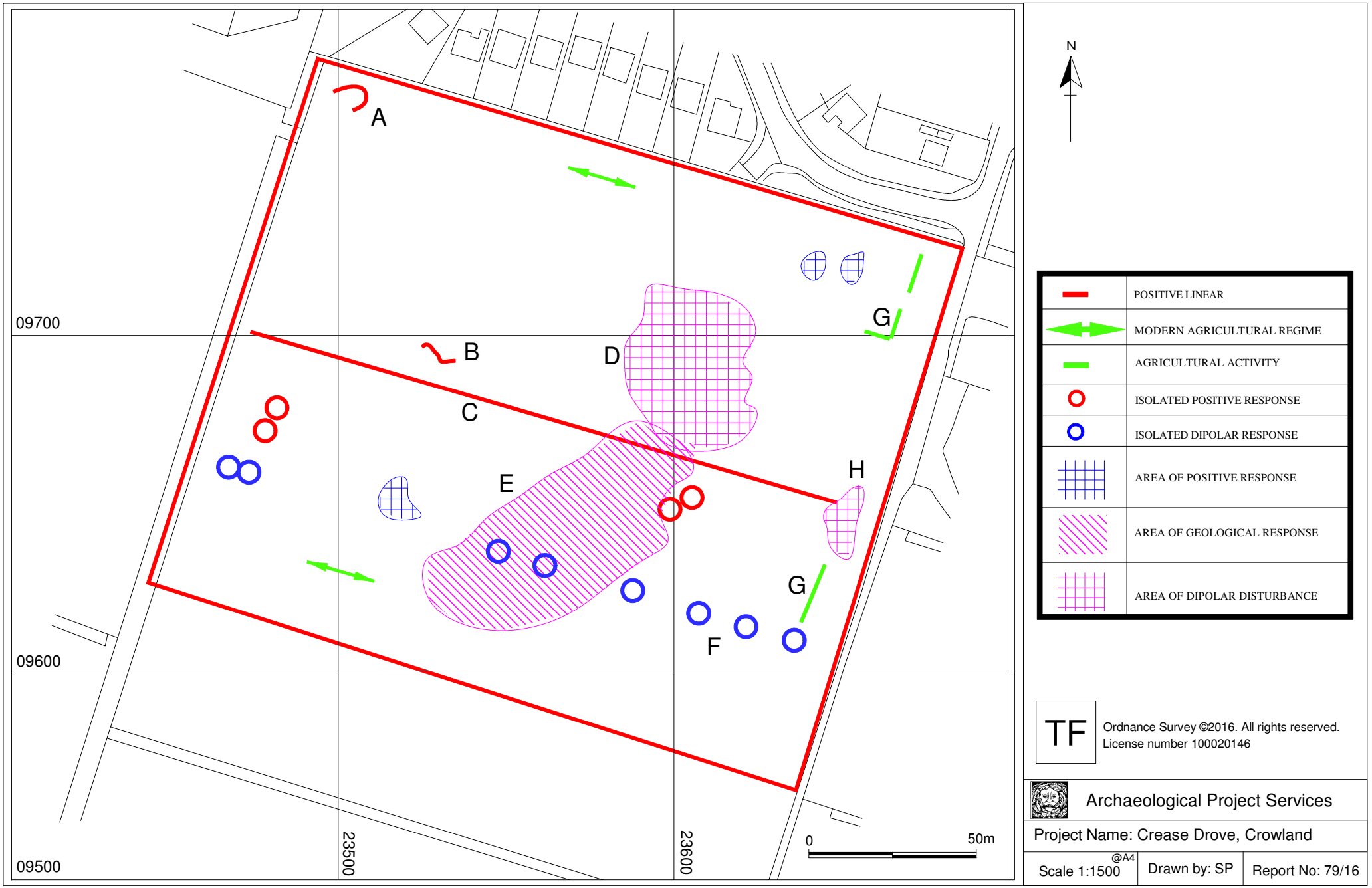

Figure 6 - Interpretation

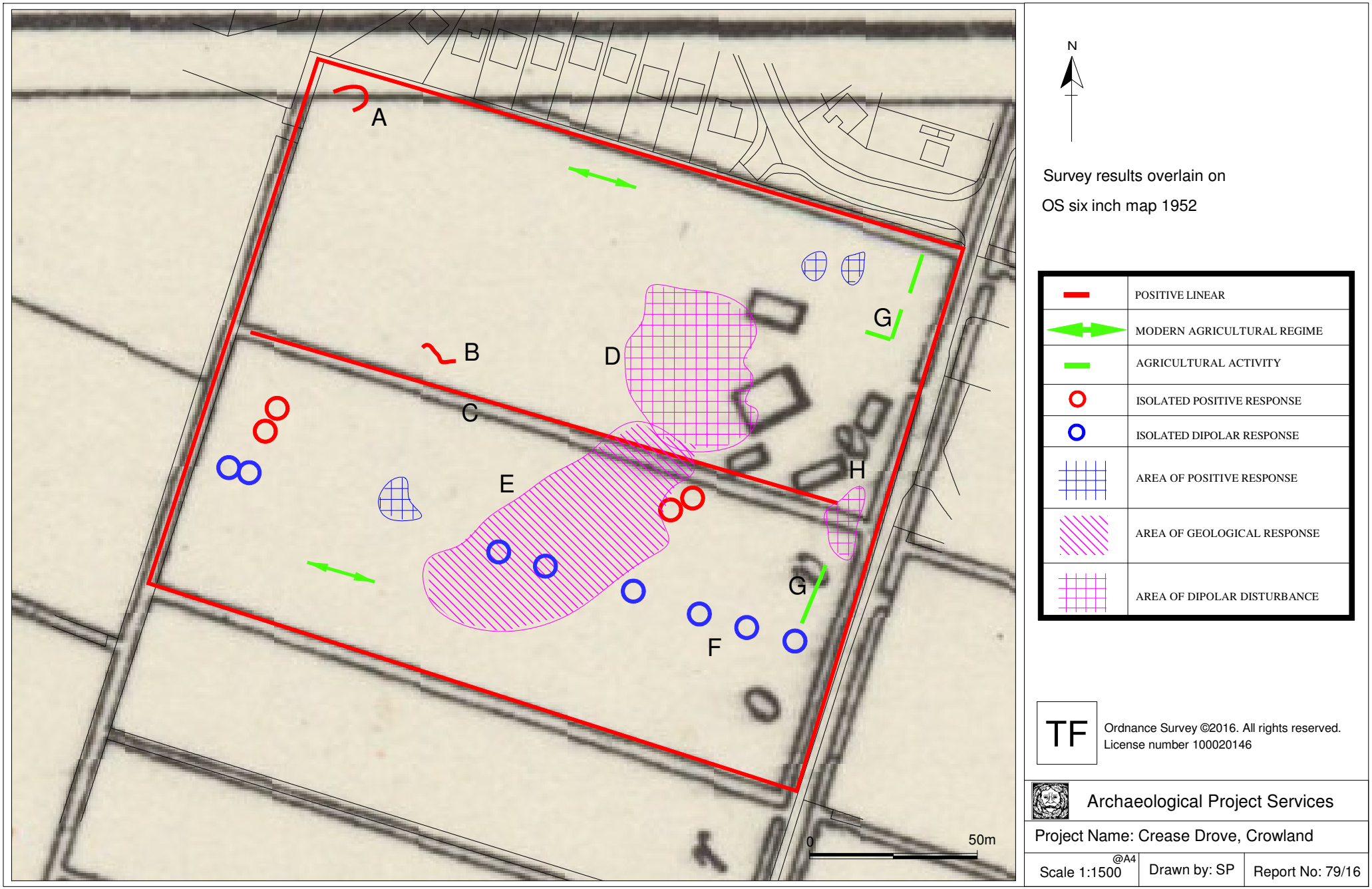

Figure 7 - Historic mapping

Plate 1
View of site, looking northwest

Appendix 1

TECHNICHAL INFORMATION

Principles of magnetometry
The basis for magnetic prospecting is the presence of weakly magnetised iron oxides in the soil. Depending on the state of iron oxides, the material will exhibit either a weak or a strong magnetisation (Gaffney and Gater 2003).

Human activities tend to enrich sediments with magnetic particles. Strong heat, such as that generated by fires, cause surrounding iron particles in the soil to become aligned with the earth's magnetic field and take on a magnetic charge. 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 area. 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 responsive and 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, which reduces 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 pairs of sensors to take parallel readings 1m apart.

Methodology
The survey area is divided into grid squares of $30m^2$ or $40m^2$, depending on the terrain. The grids are set out using a survey grade GPS, accurate to 0.03m. The grids are systematically walked in a zig-zag pattern with the gradiometer taking readings every 0.25m along a traverse, and each traverse being separated by 1m. This equates to 3600 sampling points in a full 30m x 30m grid or 6400 in a 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 TerraSurveyor software (version 3.0.25.1). 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.

Minimally Processed data
The data is clipped so that the mid-range of readings is most visible. This involves excluding all readings outside of the -20nT to 20nT 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 -5nT to 5nT range.

The following processes may also be applied to improve the clarity of the processed greyscale images:

- Despike: Isolated anomalous readings, such as those generated by tiny iron fragments, are removed from the data. This makes the images cleaner. The parameters used are: X radius = 2; Y radius = 2; Threshold = 3SD; Spike replacement = median.

- Destagger: Minor inconsistences in the way an operator walked grids can be corrected by shifting a traverse up to 0.5m to match edges with adjacent traverses.

Data is exported as a JPG 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

Appendix 2

THE ARCHIVE

The archive consists of:

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

File names	CRCD16.xyz
Explanation of codes used in file names	.xyz files allow whole composite to be generated and stored easily.
Description of file formats	All files are in xyz format where Z= nT reading
List of codes used in files	
Hardware, software and operating systems	TerraSurveyor 3.0.31.0 running under Windows 10
Date of last modification	27/10/16
Indications of known areas of weakness in data	
Survey Technique	Zigzag
Origin	Starts at 0
Grid size	40m x 40m
Interval	X=0.25, Y=1m
Dummy Value	32702
XYZ Separation	Comma

All primary records are currently kept at:

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 number: LCNCC:2016.163

OASIS code: archaeol1-266842

Site Code: CRCD16