Centre for Archaeological Fieldwork

Geophysical Survey Report No. 33

Magnetometry survey, Tullaghoge Car Park, Co. Tyrone

License No. AE/14/225

Dr Siobhán McDermott

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Summary of results

An evaluation resolution (1m x 0.125m) magnetic gradiometery survey was carried out over a total of 1.2 ha to the west of Tullaghoge Fort (TYR 038:016). In general the magnetic survey data was quite noisy returning a notable amount of high magnetic spotting and dipolar readings. These are mainly due to magnetic contamination and geological factors.

There was limited evidence of anomalies with archaeological potential.

Site Specific Information

Site Name: Tullaghoge Fort

Townland: Ballymully Glebe

SMR No: TYR 038:016

Grid Ref: H 82342 74177

County: Tyrone

Dates of Survey: 12th January – 15th January 2015

Surveyors Present: Siobhán McDermott, Grace MacAlister, Dermott Redmond, Stuart Alexander

Size of area surveyed: 1.2 Ha

Weather conditions: Changeable from wintry showers to cold, clear and frosty.

Solid Geology: Rockdale Limestone Formation – interbedded limestone & argillaceous rocks

Drift Geology: Diamicton Till

Current Land Use: Heritage landscape with low intensity grazing

Intended Land Use: Public car park & amenities

Survey methodology overview

Survey type
Magnetic gradiometery
Instrumentation:
Bartington Grad601-2 magnetic gradiometer
  Probe spacing:
  1m
  Grid size:
  30m x 30m
  Traverse interval:
  1m
  Sample Interval:
  0.125m
  Traverse Pattern:
  Zig-zag

Lecia TS06-plus total station
  Station setup:
  Tied into Irish National Grid using differential GPS
  Map Accuracy:
  Survey grade accuracy (<3cm)
  Georeferencing:
  The EDM data will be used to georeference the geophysical survey datasets exported from Geolplot v.3 into ArcMap 10.2.

Data processing:
The geophysical data was processed in Geoplot v. 3 software. The primary processes applied included Zero Mean Traverse to remove traverse stripping and Low Pass Filter to remove high frequency, small scale spatial detail. The data was interpolated to smooth its appearance and account for traverse to sample interval ratio differences.

Visualisations:
The datasets will be visualised in Geoplot v.3 using shade, trace, dot density and relief plots. The raster datasets were imported into ArcMap 10.2. The resulting rasters were analysed in relation to the historical Ordnance Survey map series, available orthorectified aerial photographs and the previous seasons of electrical resistance surveys.

Digital archive:
The geophysical datasets were collected, processed and archived in accordance with Archaeological Data Services best practice.[1]

[1] Schmidt, A. & E. Ernenwein, 2011, Guide to good practice: Geophysical data in Archaeology [Online] http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc

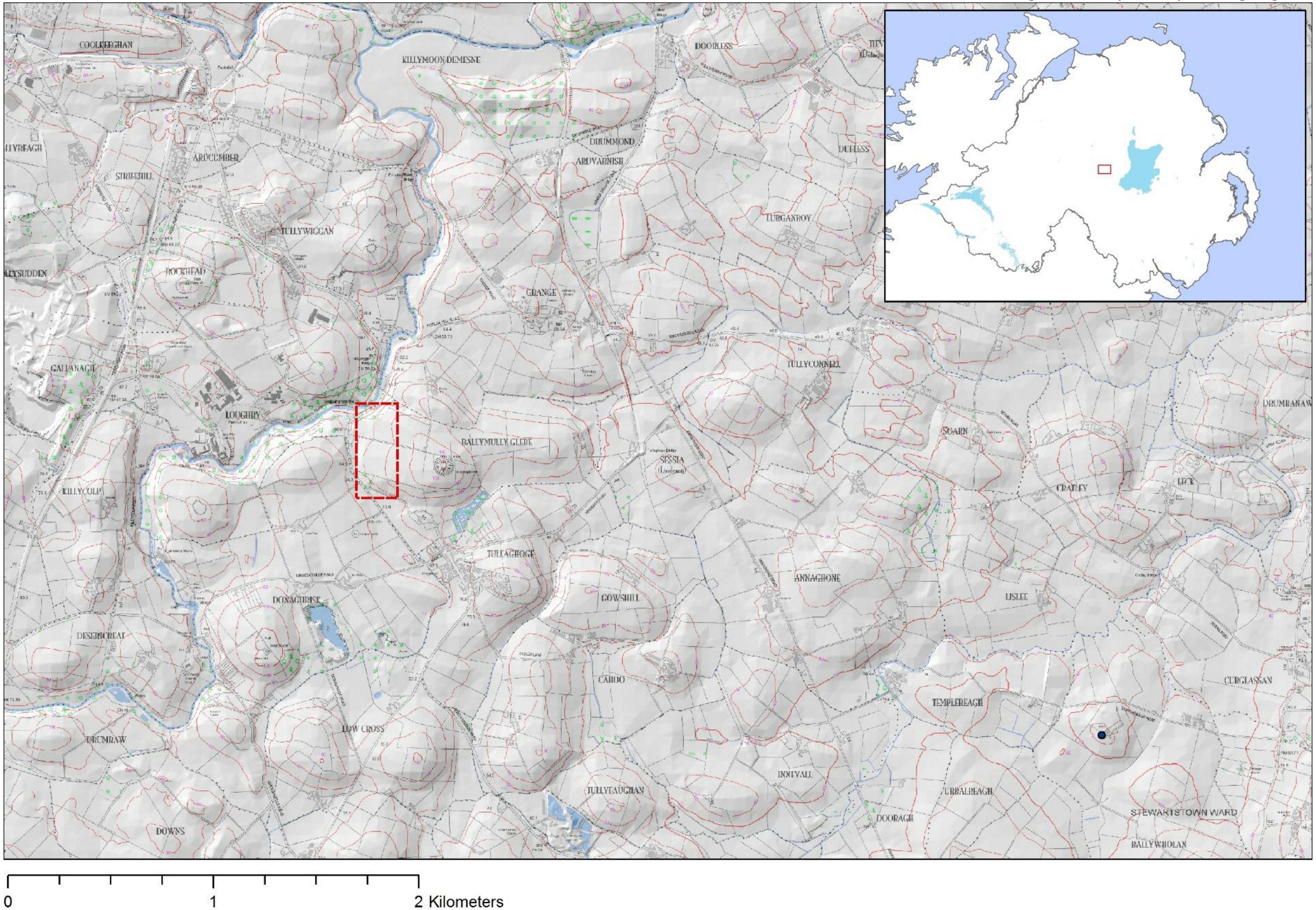

Figure 1
Location and landscape setting of the geophysical survey grid marked in red (OSNI 10km vector data layered over 5km DEM Hillshade)

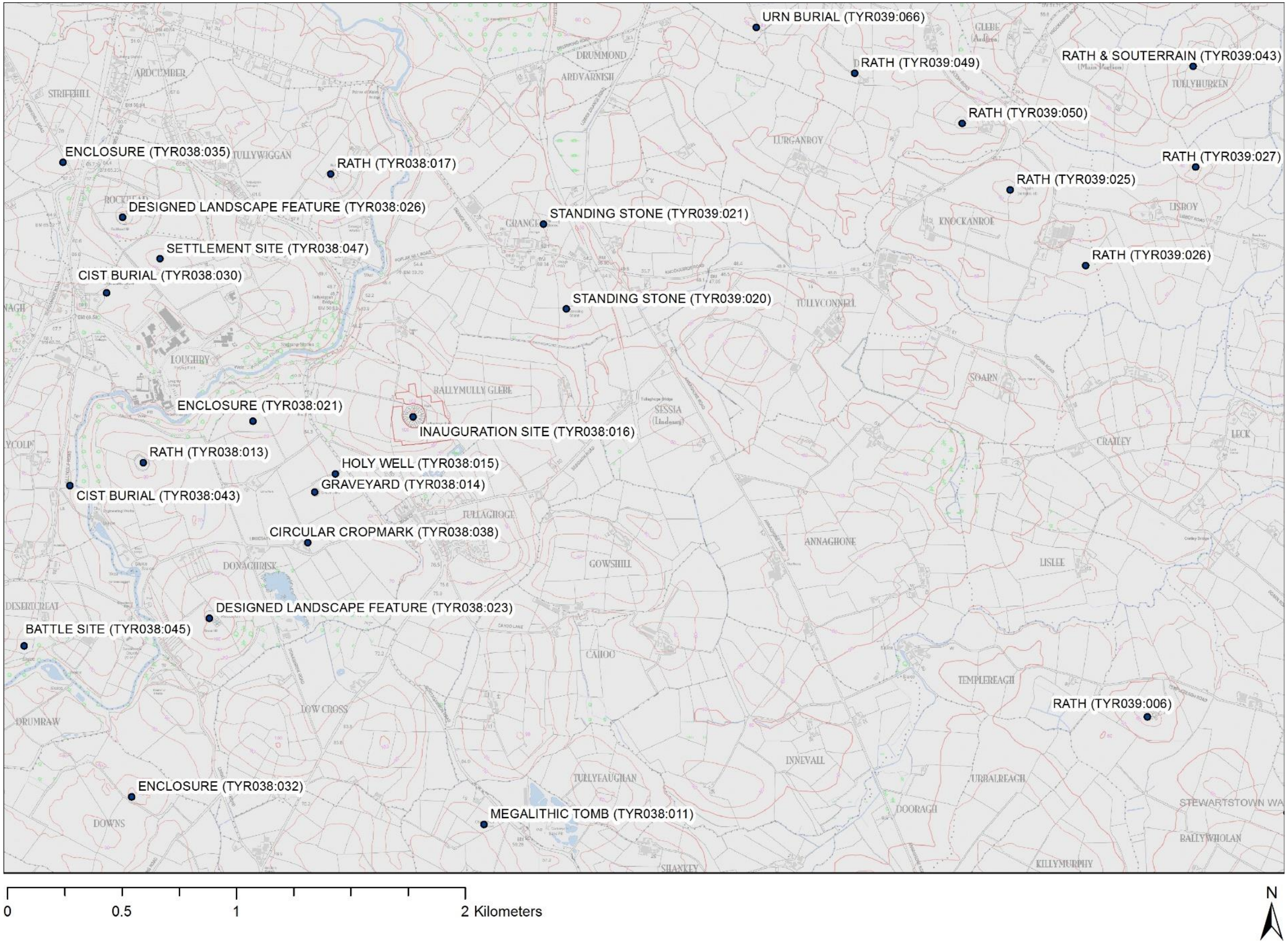

Figure 2 Wider recorded archaeological landscape setting. Geophysical survey area in red with Key NISMR locations noted.

Figure 3 Location of earlier seasons of electrical resistance geophysical surveys.

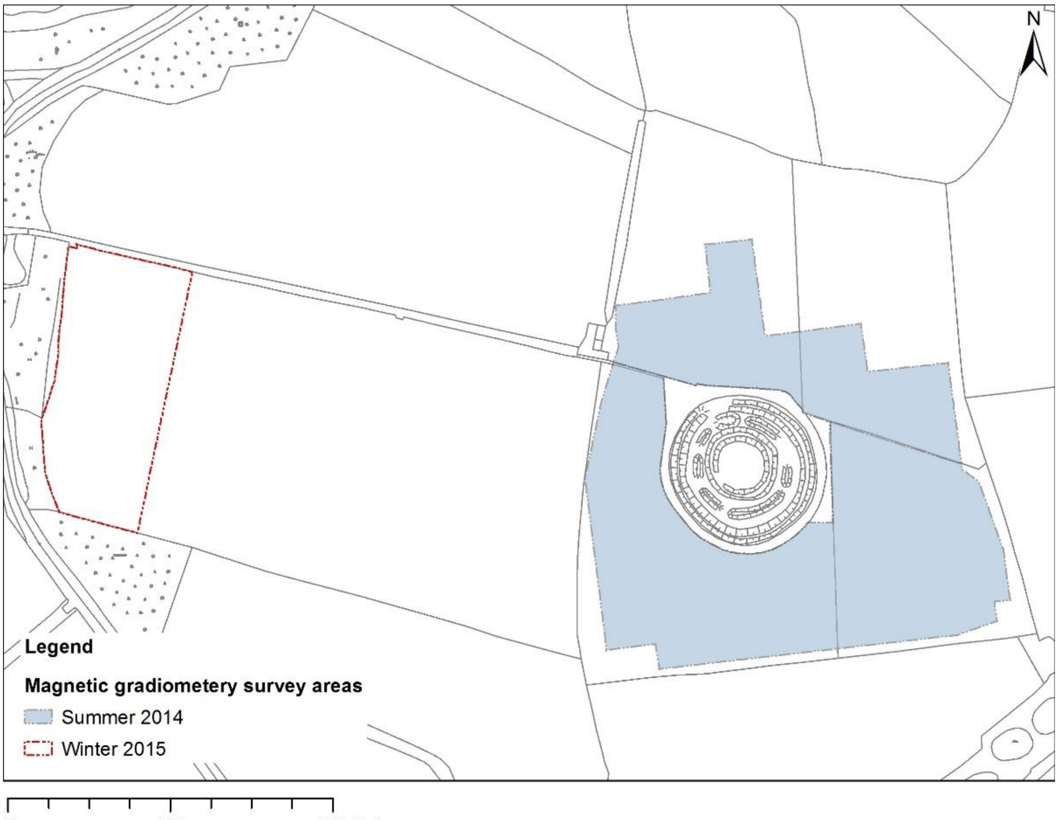

Figure 4 Extent of 2014 magnetometry survey and current survey.

Introduction

The survey area is located *c.* 550m north-north-west of Tullaghoge village mid-way between the towns of Cookstown and Stewartstown, Co. Tyrone. An area of 1.2 ha was surveyed *c.*300m west of Tullaghogue Fort (TYR038:016) to the centre of Ballymully Glebe townland, Desertcreat Civil Parish. The landscape is dominated by low-lying drumlins which stretch from the richer soils of the Lough Neagh basin westwards towards the water-logged Sperrin uplands and southwards into counties Armagh and Monaghan. At only *c.* 95m OD the drumlin affords an excellent aspect over the surrounding countryside. Standing on the drumlins eastern slopes you can look north towards Magherfelt and the pass through which the A29 travels to link Moneymore with Desertmarin. Turning clockwise onto the shores of Lough Neagh in the west, southwards onto north Armagh and finally south to Dungannon. The drumlin height obscures views from the eastern slopes onto Cookstown in the north-north-west and the Sperrin uplands to the west.

In general the magnetic survey data was quite busy returning a notable amount of high magnetic spotting and dipolar readings similar to the type of responses recorded in the immediate vicinity of the fort (McDermott 2014). The geology of the area probably accounts for a sizable proportion of these signals. In general magnetometer surveys respond well over limestone geology although the carboniferous limestone that dominates Ireland has a lower magnetic contrast then other limestone geologies (Bonsall *et al.* 2014, 7). It is more likely that the drumlin geomorphology and superficial till geology has the greater influence on the magnetometry data. The soil pedon is dominated by a boulder clay & gravel B-horizon which generally produces a poor response (David *et al.* 2008, 15, Sloan 2014a, 2014b).

The data also displayed evidence for magnetic contamination. This occurred near lengths of the wire boundary fencing. Dipolar readings are also noted in the vicinity of fence posts from which the wire had been removed to facilitate this survey. The disturbances were confined to isolated dipolar responses. Even allowing for dipolar responses associated with this magnetic contamination there were still a large number of higher magnetic anomalies. Display of the data as dot density plots did not identify any patterns which may indicate human-made structures such as possible pit alignments. The 2014 gradiometery survey of the area immediately surrounding the fort (McDermott 2014) demonstrated its effectiveness allaying earlier concerns about the application of this survey method at this location (Trick 2006, 4). Further, the additional dataset supplemented that captured during the electrical resistance surveys (Trick 2006, McHugh 2008 & 2013) and aided their interpretation.

The landscape use is predominately agricultural and mainly pastoral. With evidence of significant changes since it was first recorded by the First Edition Ordnance survey, *c.* 1832 – 34 (Figure 9). Landholdings have been amalgamated, earlier field boundaries and settlements removed or eroded, trackways and entrances widened to allow access for heavier farm machinery and increase productivity. This is not a recent development with agricultural improvement occurring in the area for at least the last 230 years (McDermott 2013, 4). The detrimental effects of this activity in relation to topographically extant archaeology, as evident in the Tullaghoge LiDAR survey, has been discussed by McDermott (2013). Settlement patterns are typical of Irish rural dispersed settlement with the accompanying web of narrow roads.

The survey was to the west of the fort in an area which is ear-marked for development of public access amenities. Access to Tullaghoge Fort is provided by a concrete path which links it with a small car park. The car park is situated on a dangerous bend. The area surveyed during this current study is to the south of the concrete path over the river from the current car park and an area of mature trees. It slopes dramatically from the east to the west. The land is currently farmed for pasture but is likely to be developed to provide safe car parking facilities.

Historical context and previous archaeological enquiries

(See McDermott 2013 & 2014)

Tullaghoge Fort and its environs were the focus of a sustained programme of electrical resistance geophysical survey (Trick 2006, McHugh 2008 & 2013). The areas surveyed totalled *c.* 16.5 Ha. The large field to the south-west of the fort was surveyed as far as its westerly bounding fence. This was the wire fence removed to facilitate the present survey. This left the strip of land which is the focus of this investigation unexplored. In between December 2013 and February 2014 a series of trenches were excavated over this area to assess the presence and survival of archaeological remains prior to the development of public amenities (Sloan 2014a). Fifteen trenches (1m x 2m) were hand excavated and another seven (1.5m x 12 – 14m) were mechanically unearthed. The hand excavated trenches revealed little of archaeological significance in this area. A heavily eroded cereal drying kiln was unearthed during the machine excavation of one trench (Trench 32). This feature was fully excavated by hand. Environmental samples recovered during this process dated the kiln to the 7^{th} century AD (Sloan 2014a, 2). The current programme of geophysical survey was commissioned by the NIEA to identify magnetic anomalies with archaeological potential which may be targeted for excavation prior to the development of the site.

Discussion

The data returned a notable level of magnetic spotting and dipolar readings. The busy magnetic readings are primarily a consequence of a clay rich till which tends to return poorer results for magnetometry survey. A number of dipolar returns are probably associated with magnetic contamination which can mask archaeological anomalies.

It was not possible to identify any features that indicate a high level of archaeological potential. None of the dipolar anomalies display any diagnostic characteristics which facilitated the identification of the cereal drying kiln excavated during the summer of 2014 (McDermott 2014, Sloan 2014b). One strong dipolar response (Figure 8) may be of interest. The anomaly falls outside the area currently under development and it not relevant to this current study. It would be better understood in relation to a wider magnetometry survey o the result of which should be integrated into a GIS along with the early electrical resistance data. The success of such an approach has been demonstrated in the immediate vicinity of the fort (McDermott 2014).

Recommendations

Although no targets for excavation could be identified it is advised that top soil stripping of the area is archaeologically monitored.

Bibliography

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Appendix one: Georeferenced geophysical survey grid

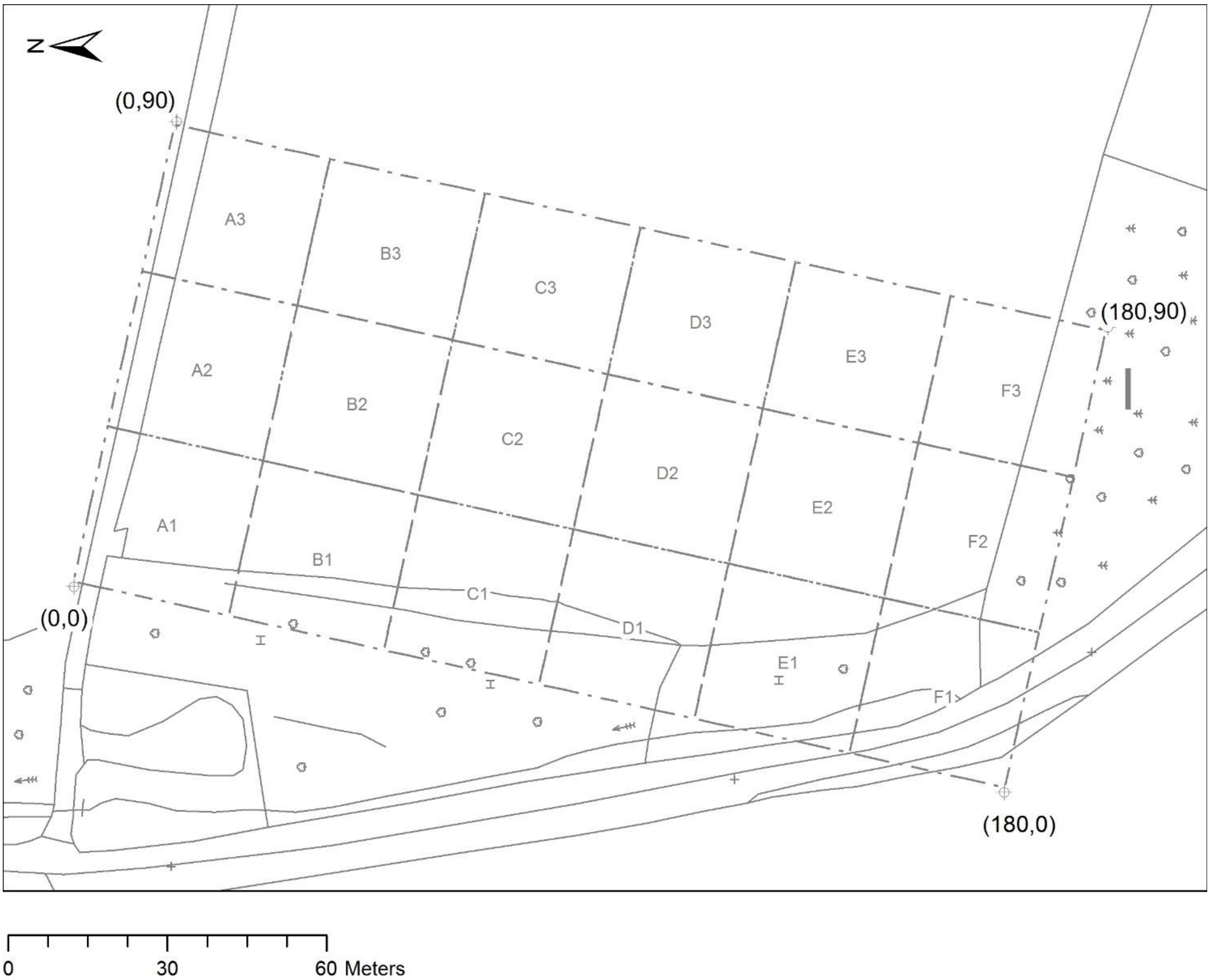

Figure 5 Geophysical survey grid with local coordinate system.

Table 1 ING coordinates for local grid points

Local grid coordiante	ING coordiantes
0, 0	E 282081.58, N 374448.89
0, 90	E 282169.40, N 374429.47
180,0	E 282042.71 N 374273.28
180,90	E 282130.59 N 374253.73

Appendix two: Data plots

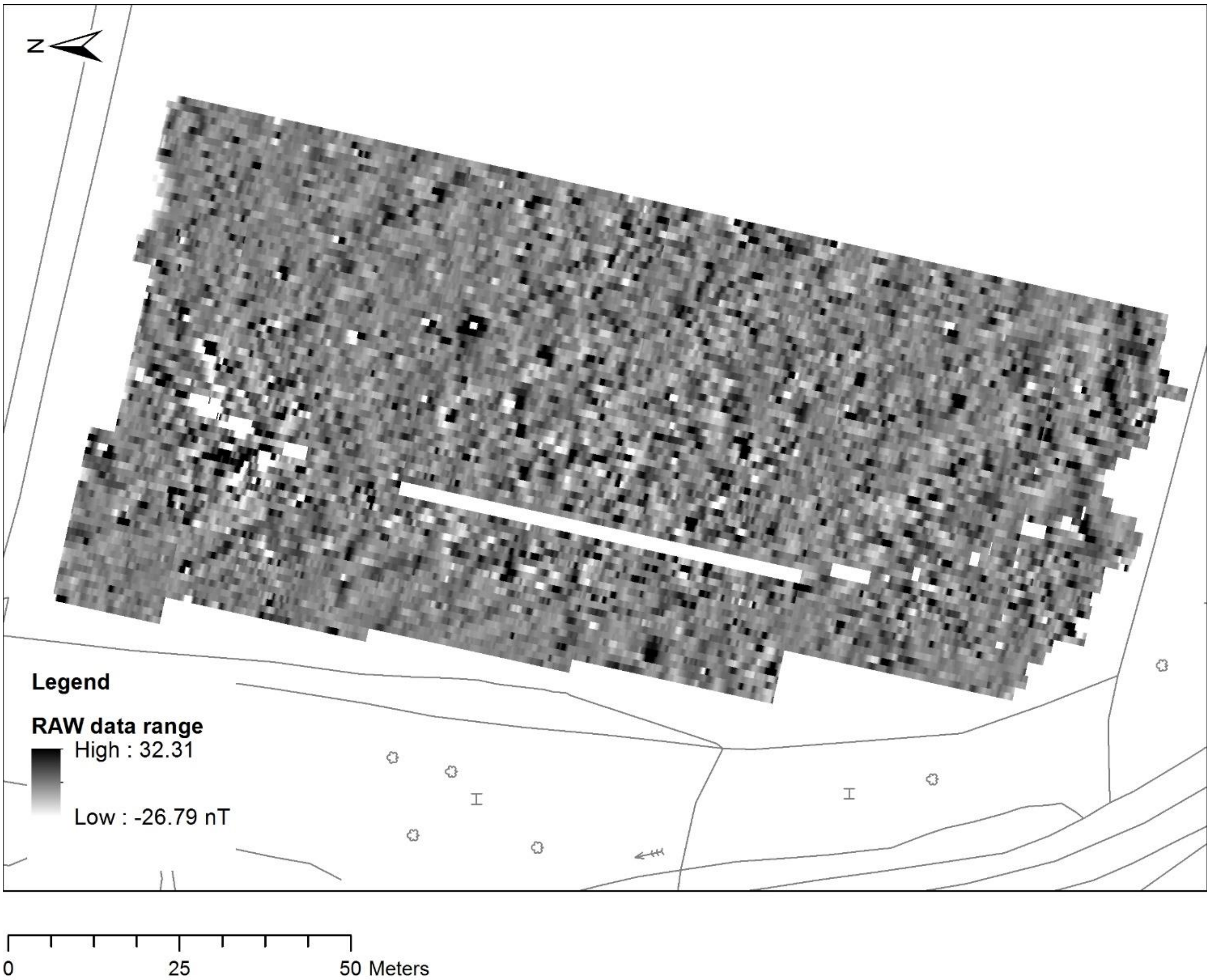

Figure 6 Greyscale plot of raw data. Clipped +/-24 nT and Zero Mean Travers applied with no thresholds.
Statistics:
Mean: 0.40
Std Dev.: 4.46

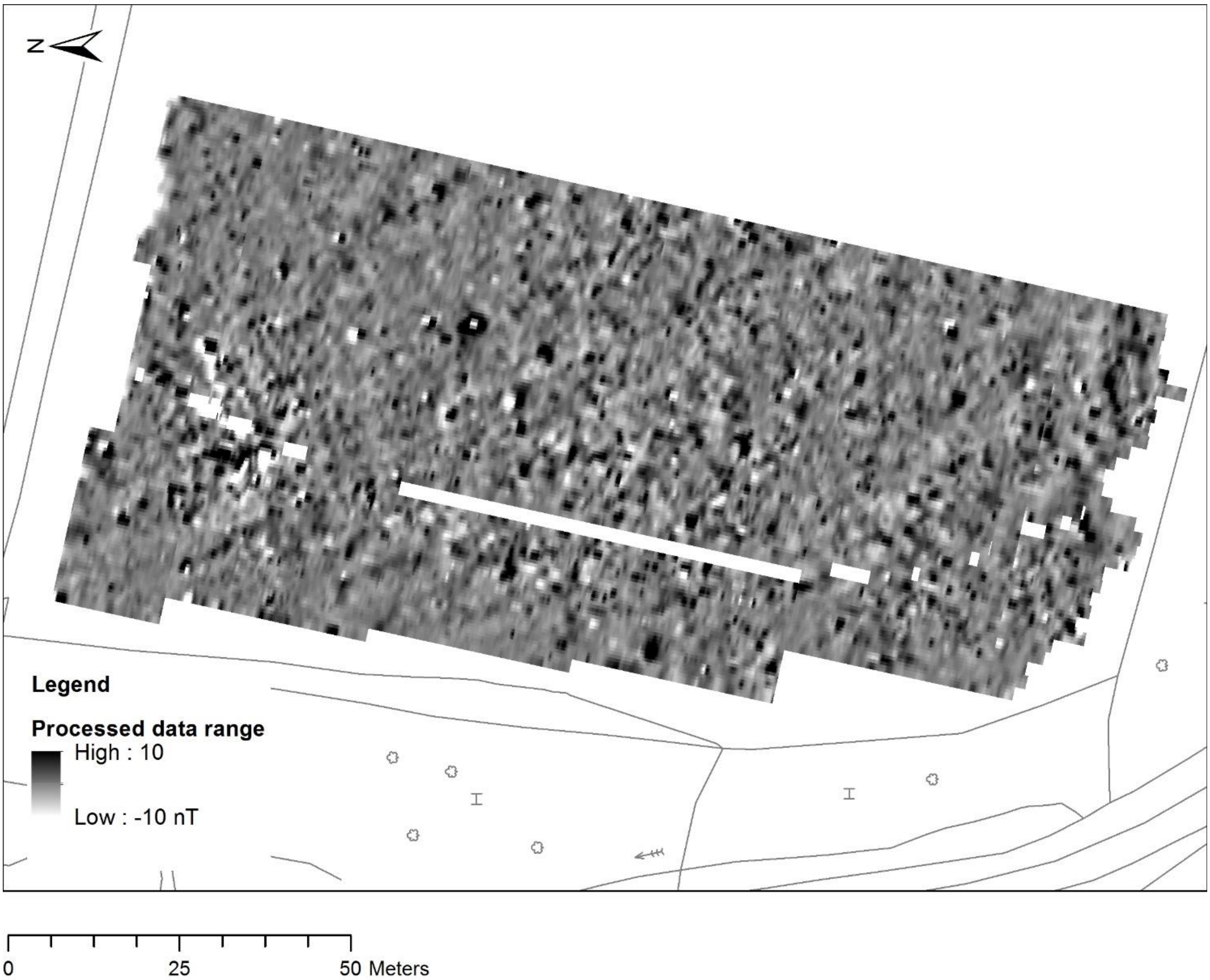

Figure 7 Greyscale plot clipped +/- 24nT, ZMT, LPF Gaussian weighting applied on the y-axis, and sin(x)/x interpolation along the y-axis.
Statistics:
Mean: -0.33
Std Dev.: 3.28

Appendix three: Additional images

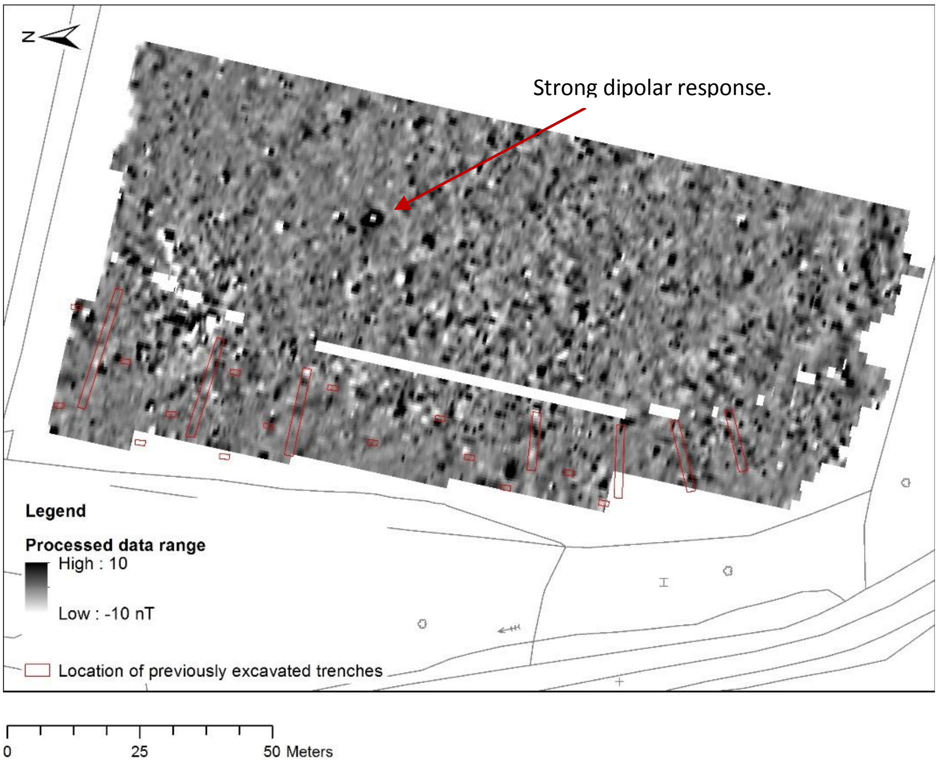

Figure 8 Location of trenches excavated by hand and machine prior to geophysical survey (Sloan 2014a).

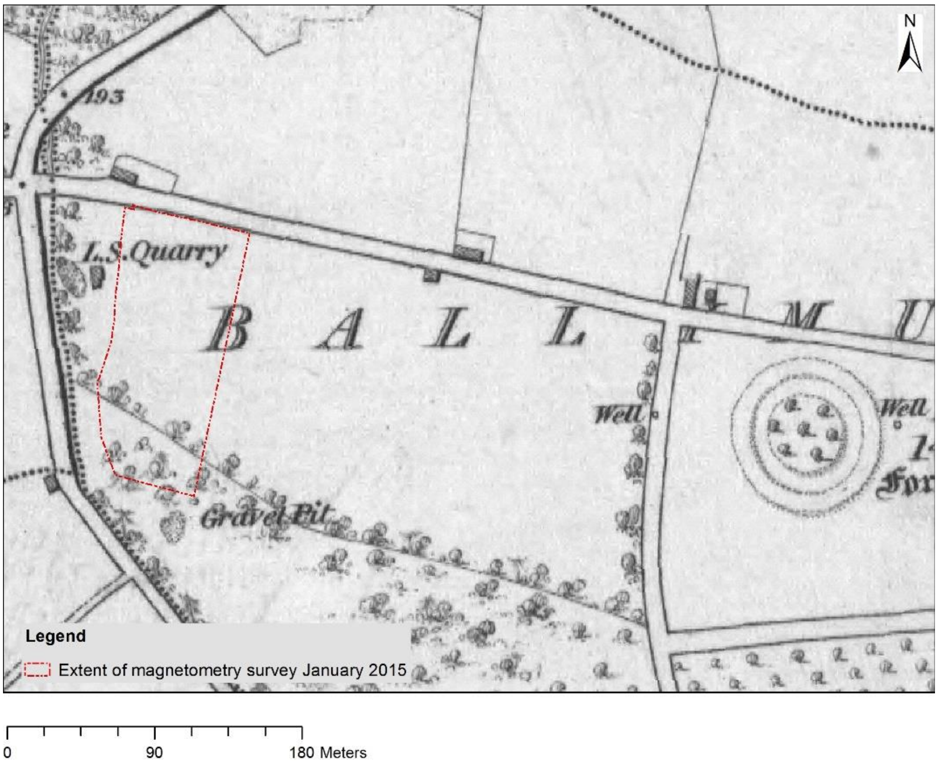

Figure 9 Area surveyed as depicted by the First Edition Ordnance Survey map series, *c.* 1832 – 4.

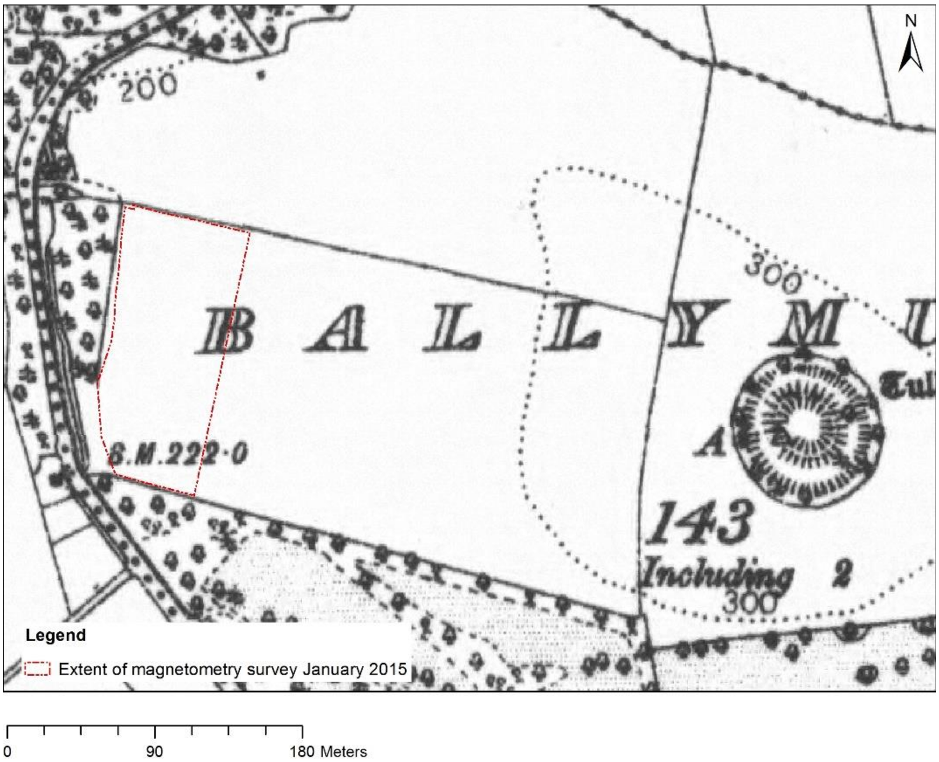

Figure 10 Area surveyed as depicted by the Third Edition Ordnance Survey map series, *c.* 1905-6.

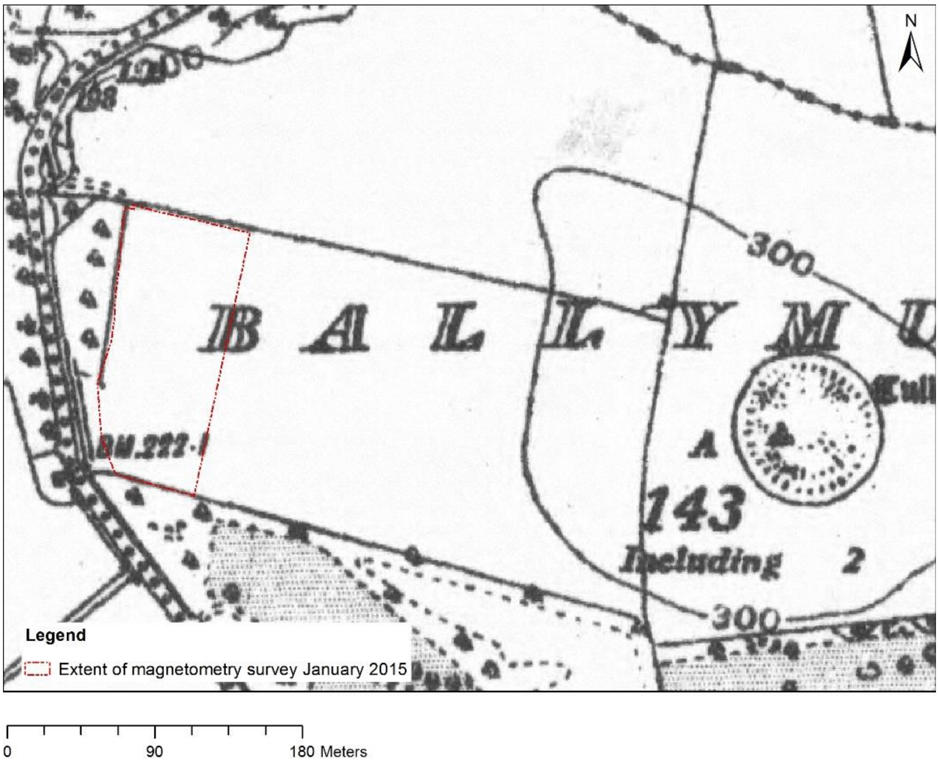

Figure 11 Area surveyed as depicted by the Fifth Edition Ordnance Survey map series, *c.* 1950 – 3.

Figure 12 Area surveyed as captured in orthorectified aerial photographs, 2006.

Figure 13 Area surveyed as captured by LiDAR survey. LiDAR data visualised using Principle Component Analysis of 16 hillshades at regularly varying azimuths and a fixed zenith, 11^{o}, 2nd band displayed.