
GEOPHYSICAL SURVEY ON SKOMER ISLAND, PEMBROKESHIRE

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Image: Toby Driver

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1 INTRODUCTION

This document reports on geophysical surveys undertaken on Skomer Island, Pembrokeshire, during 2-5 April 2012. The fieldwork formed part of a larger programme of research, as outlined in an earlier project proposal (Barker and Driver 2011). The focus for the research is the relict prehistoric agricultural and settlement remains on the island, which are among the best preserved anywhere in the British Isles. The analysis of new remote sensing data and fieldwork in 2011 has revealed new information about the island's settlements, field systems and ritual monuments, which demonstrates a much deeper chronology than has previously been considered. The field investigations in 2012 continued the landscape survey programme and assessed the potential of geophysical techniques – the latter forming the subject of this report.

1.1 Location, land use and access

Skomer Island lies off the south western coast of Pembrokeshire. It is separated from the mainland at Wooltack Point by the treacherous tidal race of Jack Sound, and the intervening Midland Isle. While its closest eastern point, The Neck, lies just over a kilometre from the mainland, western Skomer is over 4 kilometres distant. The main island measures nearly 2 kilometres north–south, and 2.3 kilometres east–west, the Neck extending east for a further 0.9 kilometres.

Skomer is owned by the Countryside Council for Wales and managed by the Wildlife Trust of South and West Wales as a National Nature Reserve, with large parts of it a Scheduled Ancient Monument and the sea a Marine Nature Reserve. The ground is heavily burrowed, in places continuously, and these burrows (a proportion of which originated or continue as rabbit warrens) are a seasonal home to Manx Shearwaters and Puffins. This 'perforated' ground surface is extremely delicate and therefore all excursions off the main footpaths are only permitted with special authorisation from the warden whilst taking care to avoid collapsing burrows.

1.2 Geology and topography

The island is formed on volcanic rocks, among them basalt, rhyolite and dolerite which are thought to be of Silurian age (John 2009, 28). These geological formation processes are evident in a variety of prominent outcrops which break the horizon in the northern island, and form several east–west ribs in the mid and south of the island, lending the valleys in between an 'insular' character. Many outcrops are loose and shattered, often with large blocks resting at odd angles or propped on smaller slabs. The bedrock is overlain in large areas by glaciofluvial deposits and a small depth of peat is recorded within the valleys. Much of the island is relatively level country, whilst the topography attains 79m OD in the centre. The island is watered by several active springs, has two streams, North Stream and South Stream, and a handful of ponds.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

2.1 Historical summary

Skomer is one of various points along the western seaboard of Wales where

relatively complete examples of later prehistoric or Romano-British settlements and field systems are preserved. The island has close affinities with other island landscapes, including Ramsey, some 14 kilometres to the north (James and James 1994), and Skokholm, Skomer's nearest island neighbour 4 kilometres to the south. Although Skokholm has long been the 'poor cousin', in archaeological terms, of the western Pembrokeshire islands, apparently preserving little visible evidence for field systems or hut settlements, new aerial photography by the Royal Commission in 2011, together with evidence from the recently-acquired LiDAR survey (see below, 2.3), shows denuded prehistoric field systems in the south-west of the island as well as several undated earthworks in the centre and north-east (Davis forthcoming a). Information from Deanna Groom at the Royal Commission also suggests the location of a 'lost' island known as the Reef, in between Skomer and Skokholm, which may well have been exposed as dry land in the Mesolithic period, only to be lost to rising sea levels by the Neolithic. Sub-angular enclosures with radiating walls and a possible stone-built roundhouse are known from Grassholm Island which lies 11 kilometres west of Skomer, while hand-made pottery of Iron Age type was collected here before 1951 (Driver 2007, 87; Davis forthcoming b). Further afield, the newly scheduled Cardigan Island has a series of enclosures, building platforms and ponds (Bewers 1994), for which a precise chronology is still awaited.

It is only in recent generations that these islands have been seen as remote places, predominantly sanctuaries for wildlife. Prior to this they were merely extensions of the mainland, offering prime agricultural land, in which their apparent remoteness posed few problems and was in many ways a benefit. Throughout the medieval period and later, revenue from Skomer came from its coneys, with the rabbit catch averaging two to three thousand per season (Grimes 1950, 3). It also offered prime grazing land for sheep, cattle and horses. Arable farming came to an end on the island in the 1950s, when the last farmer, Reuben Codd, moved back to the mainland. Rising costs and the impact of increased industrialisation—getting a tractor across to Skomer was no mean undertaking—combined with a series of bad harvests forced an end to island farming (Howells 1961).

2.2 Previous archaeological research

One of the earliest references to the archaeology of Skomer was made by Edward Laws in his *History of Little England Beyond Wales*, where he claimed that the island contained more ancient enclosures and cairns than he knew of anywhere else in Pembrokeshire (Laws 1888, 15). This evidence was not, however, replicated on the early editions of the Ordnance Survey nor in the 1896–1907 Pembrokeshire Archaeological Survey undertaken by Laws and Dr Henry Owen. This survey did, however, make the first note of an excavation carried out by Mr Drane of Cardiff, who encountered calcined clay flooring while digging in some of the hut foundations (National Library of Wales, Oversize Atlas 319). Whilst the observations made by Laws were noted by the Royal Commission in the Pembrokeshire Inventory (RCAHMW 1925, no. 287), bad weather prevented a field visit and thus nothing more was added. A further 25 years passed until an article by Professor W.F. Grimes (1950), published in *Archaeologia Cambrensis*, finally revealed to a wider audience the archaeological wealth of Skomer.

Grimes's pioneering work involved the first detailed field survey and study of the island. He produced an archaeological map, based on a transcription from a set of Ordnance Survey aerial photographs, checked and augmented by detailed survey on the ground. Modestly, he noted 'it is not an accurate survey, but presents nevertheless a true picture of the character of the remains upon which an accurate survey may be used' (Grimes 1950, 1). It is Grimes we have to thank for drawing

together some of the less well documented evidence from the island, particularly relating to its medieval history (1950, 2–5). He also revealed a second excavation on the island by Mr Neale at two sites (huts 13 and 19), where he reported so few finds were made no further excavation was pursued (*ibid.* 2).

Thirty years later John Evans (1986; 1990) complemented and built upon this earlier work by recording in detail small enclosures and habitation sites. Evans's survey was undertaken at two spatial scales: one for huts and pounds (mapped at 1:100 by ground survey), and one for settlement complexes as a whole, transcribed from vertical and oblique aerial photographs by Terry James, then of the Dyfed Archaeological Trust.

A popular guidebook on the archaeology was published by Evans in 1986, with an academic article containing a high quality map of the surviving archaeological remains together with the detailed plans and description of many of the individual buildings published in 1990. It is worth noting that the published record contained only a proportion of the actual surveys completed during the fieldwork on Skomer. This is reflected in the rich and varied contents of Evans's Skomer archive held in the National Monuments Record of Wales, which includes original permatrace plans, colour slides, photographs, notebooks and interim reports, as well as unpublished building elevations of the limekiln and farm buildings. The main conclusion reached by John Evans, and the foundation for most modern interpretations thereafter, is that Skomer represents a brief event in Pembrokeshire's prehistory. He stated (1990, 255) that 'the occupation was short. There is little complexity in the field systems. . . . It is likely that the entire occupation took place over a few generations, perhaps a period of no more than a century'. It is this thesis that our study has taken as a starting point.

2.3 Summary of recent investigations

Evans's explanation of events on Skomer has lasted the test of time. However, a fresh perspective came with an archaeological flight to take aerial photographs of the island undertaken on the 4 March 2008 in excellent conditions of lighting and vegetation. A check between the new photographs and the published plans revealed discrepancies with the mapped detail. Field shapes were generalised, altered, wrongly depicted or had details 'smoothed out'. In places the excellent conditions in which the new photos had been taken picked out extremely denuded lynchets and boundaries showing clear phasing among overlapping field systems. Of the aerial photographs published in Evans's original article (1990, pls 17–22), neither the winter oblique photographs by Terry James nor the vertical aerial photographs by Cambridge University allow for a very clear view to be gained of the complex field systems; both sources have problems of lighting, clarity and surface vegetation.

A further breakthrough and a key to future investigative work was the opportunity to commission a new LiDAR survey of the island. A 0.5m resolution LiDAR survey of Skomer and Skokholm was commissioned, including the mainland between Wooltack Point and Gateholm Island. The survey, undertaken by the Geomatics Group of the Environment Agency, captured the island at just the right time. Following one of the hardest winters in recent history, during which there had been snowfall on the island, the vegetation was flattened to its lowest levels in many years. The new LiDAR data provided the basis for compiling a new detailed map of the island.

Guided by the results of the new oblique aerial photography, and before the LiDAR data was available, an initial short season of ground survey was undertaken in April 2011. This led to a number of new discoveries, potentially indicating initial construction of megalithic monuments in the Neolithic and Early Bronze Age, the

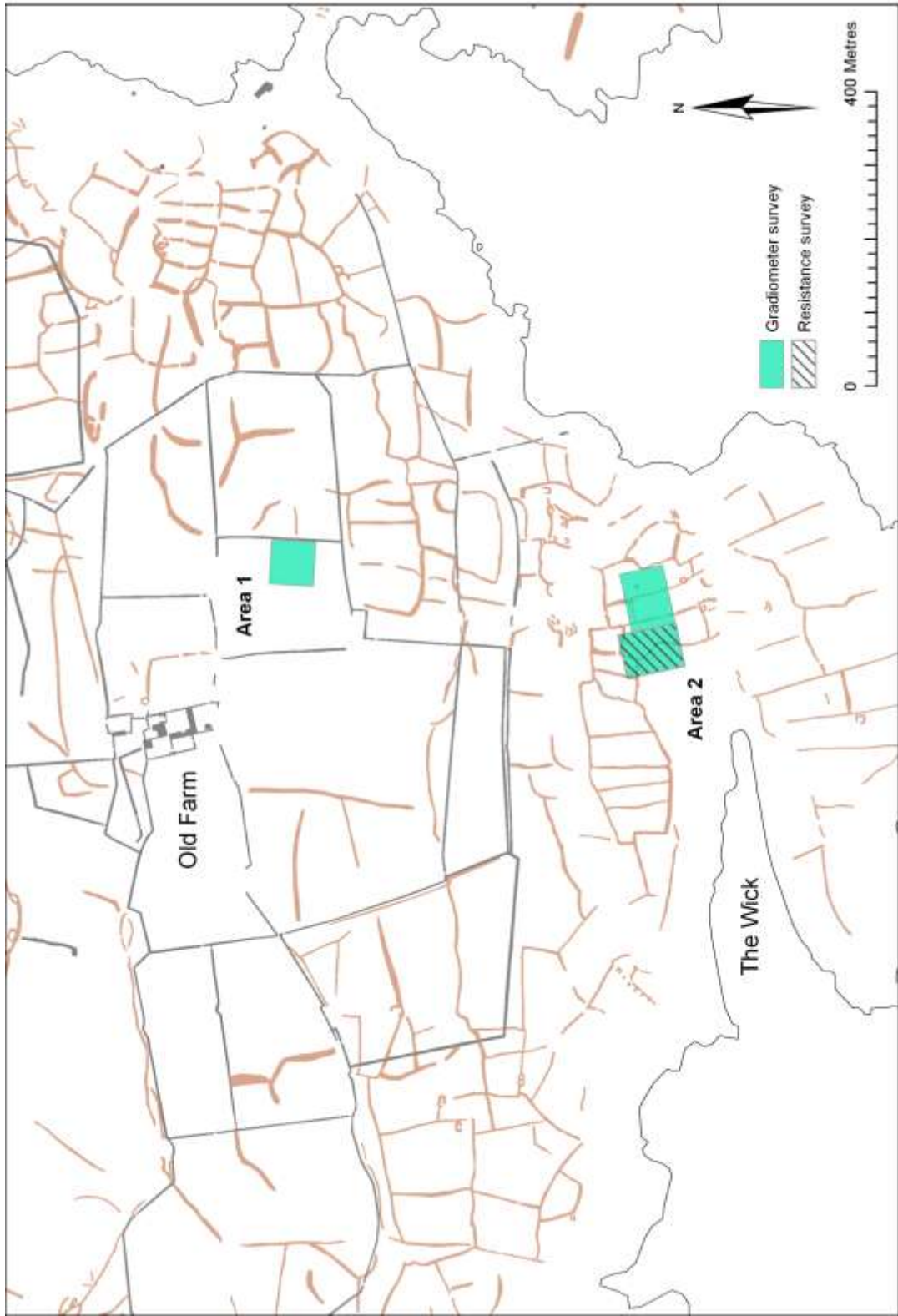


Figure 1 - Location map showing the locations of the survey areas overlain on the modern and ancient field banks mapped from the Lidar data by the RCAHMW.

establishment of coaxial fields and associated settlements in the south of the island, possibly in the later Bronze Age, followed by comprehensive settlement of the entire island, which might have taken place in the Iron Age and Romano-British periods. The dramatic 'Easter Island' scenario offered by Evans (1990, 255) in which the island's inhabitants ran out of wood and peat for fuel and building within a century and had to abandon the island, now seems too simplistic, and it may be more appropriate to envisage a succession of phases of expansion, contraction and abandonment.

3 PROJECT AIMS AND OBJECTIVES

3.1 Overall aims

The project will develop the research potential of the considerable amount of new data relating to the Skomer's landscape history. While the remote-sensing data and non-invasive field survey can take our understanding of the island's archaeology so far, it is the establishment of a chronology for the settlement on the island and an understanding of the paleoenvironment which are desperately needed to significantly advance the research. Although management recommendations are not intended to form a part of this research programme, data produced during the project will pave the way for new management recommendations to be made in due course.

The overall project has four aims:

1. Develop a new landscape history of Skomer that takes account of the complex and multi-layered character of the field archaeology.
2. Establish absolute chronological markers for key phases in the development of Skomer's landscape.
3. Reconstruct the environmental history of the island and assess the changing impact of human occupation.
4. Support the organisations responsible for Skomer in applying the research outcomes of the project to the conservation management of the island's historic and natural environment.

3.2 Objectives for 2012 geophysical survey

The aim of the geophysical survey in 2012 was to evaluate the potential of geophysical survey techniques on Skomer. There were two objectives:

1. Evaluate the preservation of sub-surface archaeological features within areas cleared and improved in the eighteenth and nineteenth centuries.
2. Evaluate the preservation of sub-surface archaeological features within areas of prehistoric relict field systems and settlements.

4 METHODOLOGY

4.1 Dates and conditions of fieldwork

The fieldwork was undertaken during 2-5 April 2012. The weather was generally dry, except for 4 April, when rain and high winds made fieldwork impractical. The soil remained damp throughout the fieldwork. The ground across most of the island is riddled with animal burrows, many of which are close to the surface and collapse

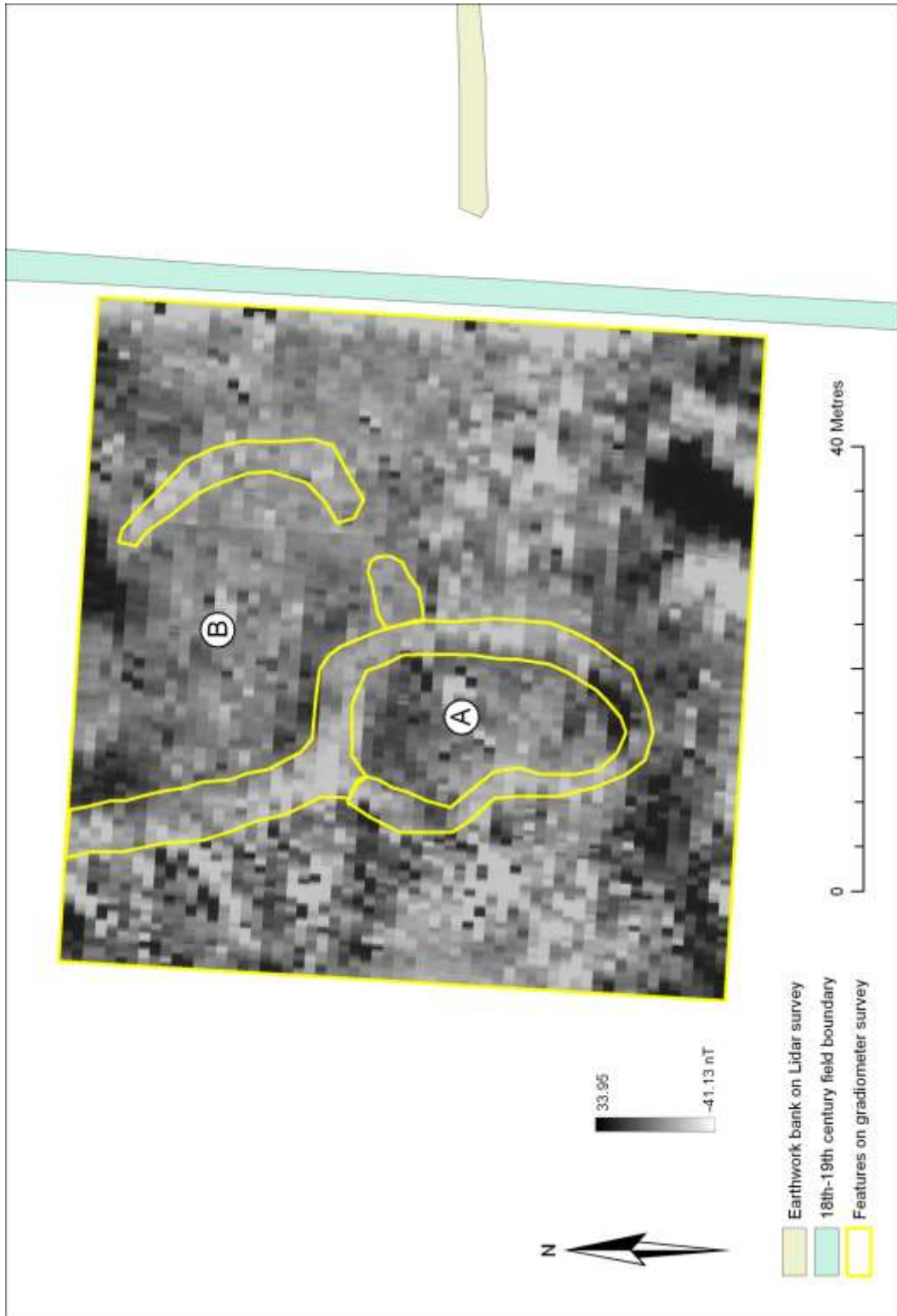


Figure 2 - Plot showing the results and interpretation of the processed gradiometer survey east of the Old Farm (Area 1). The raw and processed survey plots are presented without annotation in the appendix.

under a person's weight (section 1.1, above). Heavily burrowed ground was avoided; however, the mild contortions that were occasionally required to avoid the burrows when walking with the gradiometer did affect the quality of the data. The survey was undertaken by staff from the RCAHMMW and the University of Sheffield: Louise Barker, Oliver Davis, Toby Driver and Bob Johnston.

4.2 Grid locations

The surveys took place in two locations (Fig 1): (1) 0.36 hectares within the post-medieval field system 200 metres southeast of the Old Farm (NGR SM728093); (2) 0.96 hectares amongst the ancient fields in the southeast of the island (NGR SM727088).

Area 1 was selected to evaluate the preservation of sub-surface archaeological features within areas cleared and improved in the eighteenth and nineteenth centuries. Area 2 was chosen because aerial mapping and ground survey had identified a relatively large circular 'platform' that was provisionally interpreted as a possible stance for a timber structure or structures. The survey area was extended eastwards to include a low earthen mound, which may be a prehistoric funerary barrow.

4.3 Survey methods

The geophysical surveys were completed using a Geoscan RM15 resistance meter and a Geoscan FM256 fluxgate gradiometer. The resistance survey was undertaken at a resolution of 1x1m within 20m grid squares. The gradiometer survey was undertaken with a 1m traverse and 4 samples per metre within 20m grid squares. Grids were laid out by hand, their corners marked with bamboo canes and 300mm plastic pegs. Their locations were recorded using Leica Viva survey grade GNSS. The geophysical survey data was downloaded and processed using Geoplot 3.0 for Windows. The final presentation of the results was completed using ArcGIS 10 and Adobe Illustrator. Methods and standards of fieldwork and analysis followed established professional guidelines (English Heritage 1995; Gaffney et al. 2002).

5 RESULTS

5.1 Area 1: Old Farm

Nine 20x20m grid squares were surveyed using the fluxgate gradiometer within one of the improved fields lying southeast of the Old Farm (Figure 1). The location was chosen because a putative linear earthwork, aligned east-west, was identified in the adjoining field using the Lidar data. The earthwork continued up to the modern boundary but it did not continue beyond into the surveyed field.

The results of the survey did not show the continuation of the earthwork boundary. However, there are reasonably well-defined curving linear features produced by a negative magnetic response of c.-15-20nT (Figure 2). These formed an oval enclosure (A, Figure 2), 30x19m externally and 24x13m, internally, with a larger but incomplete enclosure to the north (B, Figure 2). The western limit of the enclosures is defined by a zone of magnetic variability (probably caused by local variation in the geology) that may mask other features and create or exaggerate the edge to the probable archaeological features. A large positive magnetic anomaly (up to 100nT) 'flanked' by negative responses in the southeast corner of the survey area may be either a large ferrous object or geological. It is unlikely to be archaeologically significant.

The curving, irregular form of the possible archaeological features is similar to some of the enclosures and associated field plots identified elsewhere on the island through aerial mapping. For example, the oval enclosure located on the north side of an outcrop at SM 7176 0957 – it measures 27x19m externally, and is also aligned north-south (Figure 3).

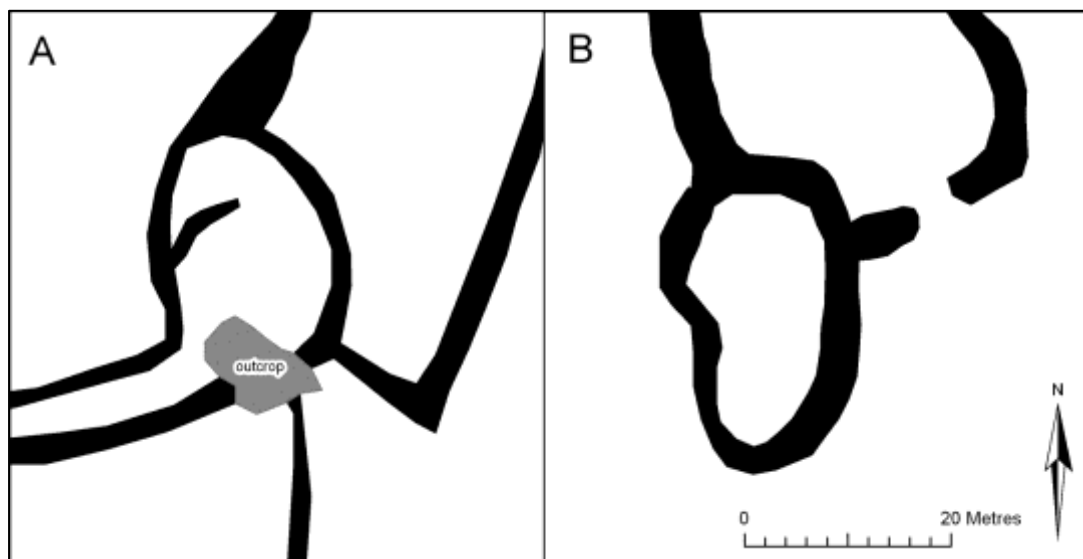


Figure 3 – a comparison of the enclosure mapped from the Lidar data at SM 7176 0957 (A) with the possible enclosure mapped from the gradiometer survey in area 1 (B). The enclosures are drawn at the same scale and orientation.

5.2 Area 2: The Wick

5.2.1 Gradiometer survey

Twenty four 20x20m grid squares (0.96 hectares) were surveyed using the fluxgate gradiometer within the relict field systems to the northeast of The Wick (Figure 1). The location was chosen in order to evaluate a possible circular platform, which is defined on its eastern side by an eccentric curve in one of the relict boundaries. The survey area was extended eastwards to include a low earthen mound, which may be a Bronze Age barrow.

The survey is dominated by a zone of highly variable readings on the southern edge of the plot. This is bisected by a band of positive readings, aligned roughly east-west. This feature does not correspond with the surveyed field boundaries, and given the association with the variable readings and the alignment (which matches the alignment of bedrock geology), it is probably geological.

The obvious archaeological features on the survey are the relict field boundaries and the cultivation ridges (within the north-westernmost field) (Figure 4). The boundaries are narrow bands of high positive and negative readings, aligned roughly north-south and east-west. The linear features align closely with the banks mapped from the aerial survey (Figure 5). In the one instance where the geophysics and aerial mapping do not appear to be aligned – at the junction of the boundaries at the upper centre of the plot – the linear anomaly is a modern electricity cable laid next to the path (A, Figure 4). A large anomaly located towards the north-eastern edge of the survey area is probably caused by a ferrous object, and is unlikely to be archaeological significant (B, Figure 4). Two further anomalies on the survey may be of archaeological significance:

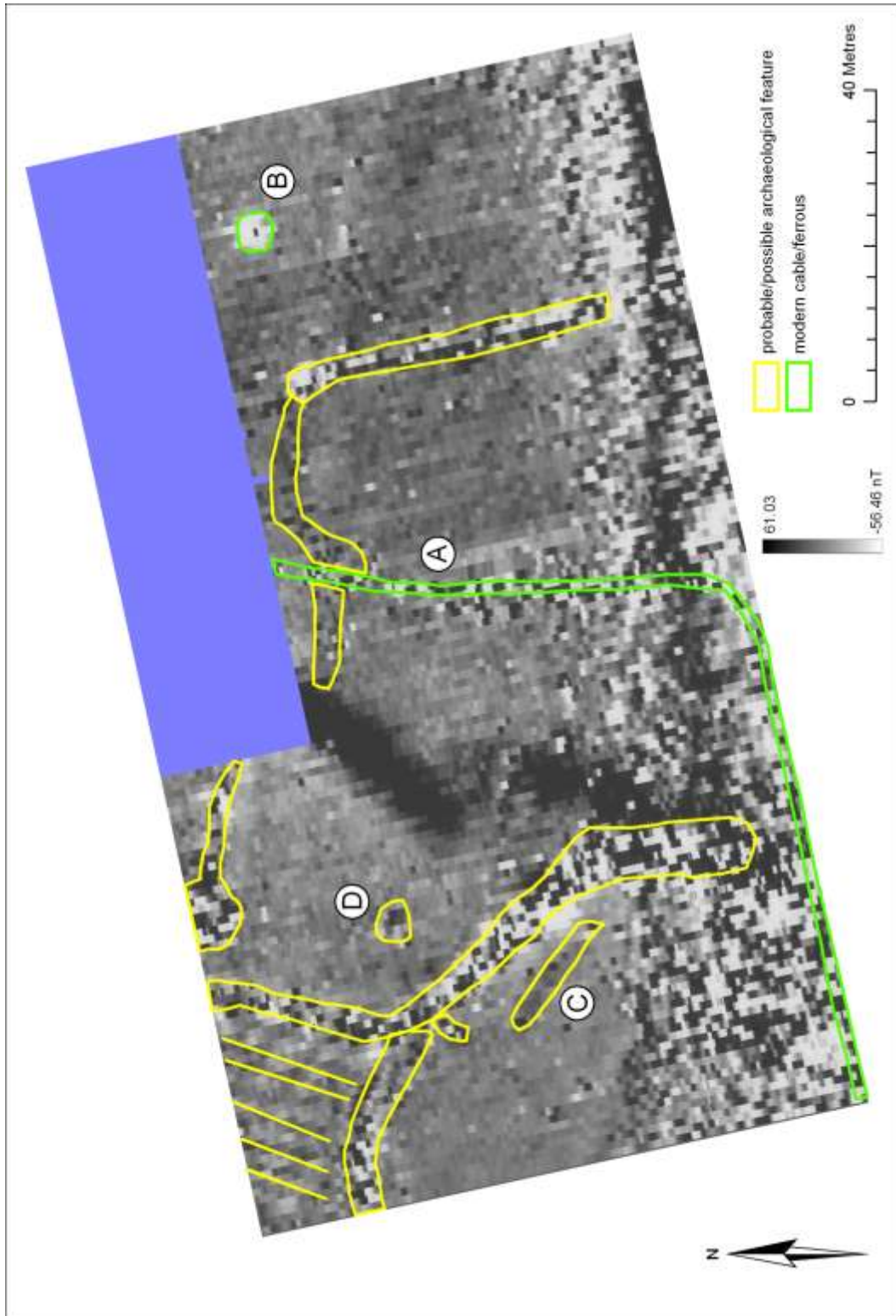


Figure 4 - Plot showing the results and interpretation of the processed gradiometer survey north of The Wick (Area 2). The raw and processed survey plots are presented without annotation in the appendix.

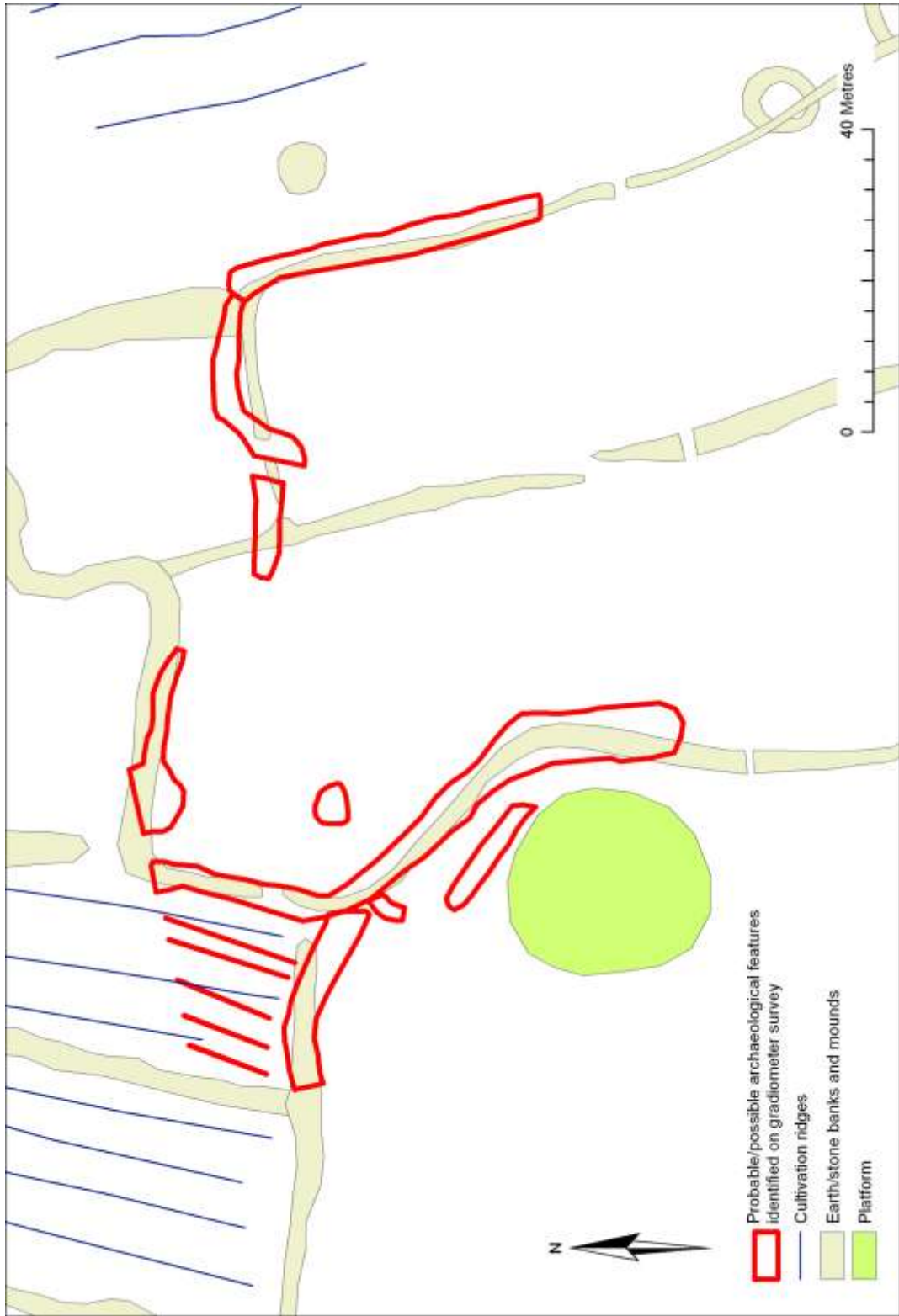


Figure 5 - A plot overlaying the interpretation of the gradiometer survey on the field banks, platform, and cultivation ridges mapped from the Lidar data.

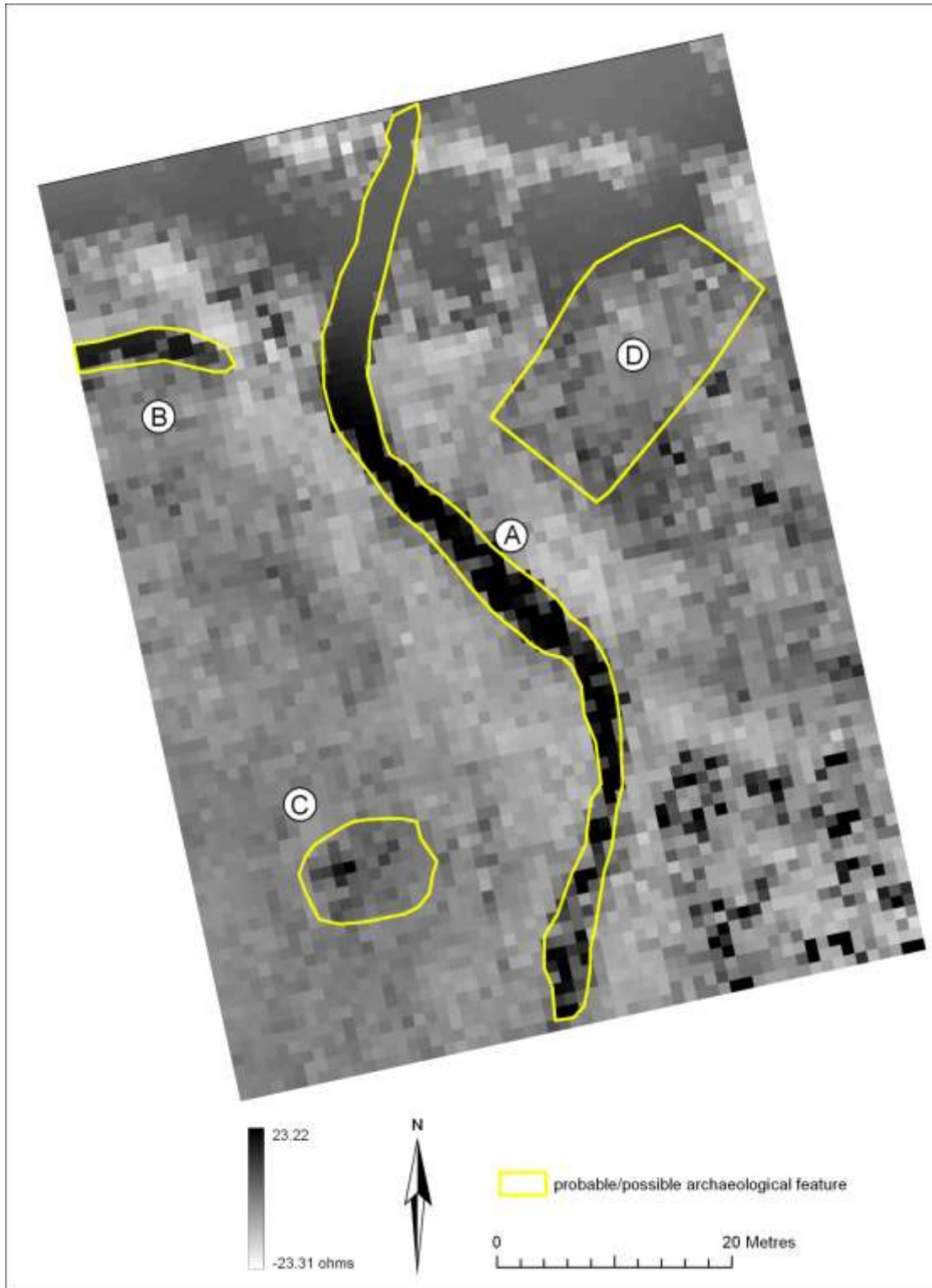


Figure 6 - Plot showing the results and interpretation of the processed resistance survey north of The Wick (Area 2). The raw and processed survey plots are presented without annotation in the appendix.

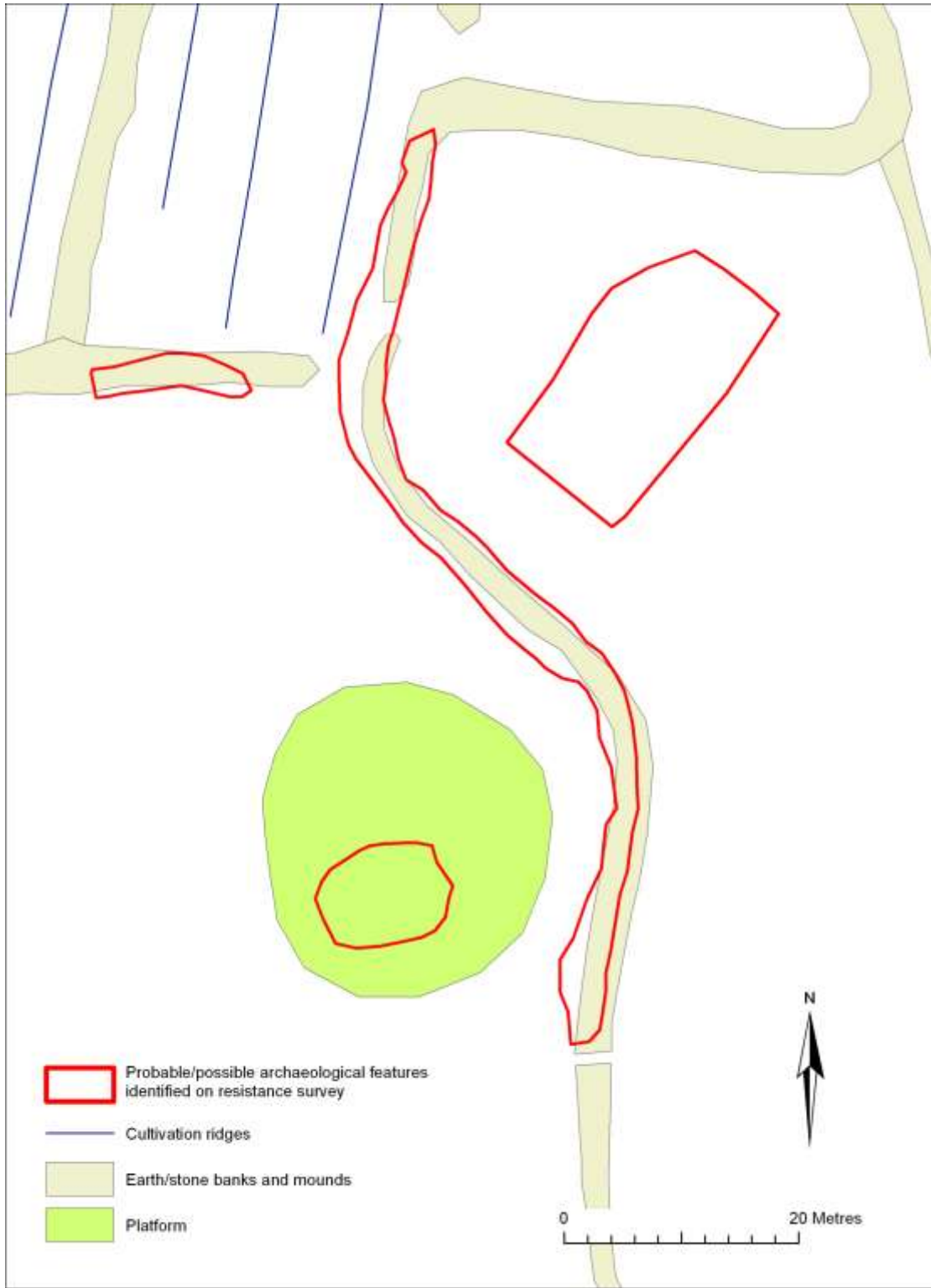


Figure 7 - A plot overlaying the interpretation of the resistance survey on the field banks, platform, and cultivation ridges mapped from the Lidar data.

C – a linear feature (length 17m, width 2m) that lies parallel with and adjacent to the western-most north-south boundary (B, Figure 4). The feature is defined by a band of marginally more positive readings, c.2–8nT, when compared with -3–1nT in the surrounding area.

D – a positive magnetic anomaly (<9nT) surrounded by a 'halo' of negative readings (-5–0nT), c. 4.5–5m across, located 9m east of the same north-south boundary as feature B.

5.2.1 Resistance survey

Twelve 20x20m grid squares (0.48 hectares) were surveyed using the resistance meter within the relict field systems to the northeast of The Wick (Figure 1). As with the gradiometer survey, the location was chosen in order to evaluate a possible circular platform, which is defined on its eastern side by an eccentric curve in one of the relict boundaries.

Again, the obvious archaeological features on the survey are the relict field boundaries (A and B, Figure 6). These are narrow bands of high resistance readings, which align closely with the banks mapped from the aerial survey (Figure 7). Two further features are possibly of archaeological interest:

C – An oval area, 11x9m, of marginally higher resistance to the surroundings, with a smaller area of high resistance readings on the west side within the oval. In size and shape, this feature could be the remains of a small building. This interpretation, although speculative, is strengthened by the location of the feature within the circular platform (Figure 7).

D – A faintly defined rectangular area, 23x13m, on the northeast part of the survey. The edges of the 'feature' are extremely indistinct, although there is an area of slightly higher resistance readings compared with the values to the south. The northern side of the feature is defined by a zone of high resistance readings which are probably caused by the geology. A linear low resistance feature that bisects this zone of high resistance is probably also a product of the geology.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The aim of the survey was to evaluate the potential of geophysical survey techniques on Skomer. The survey focussed on two locations where there was potential for the discovery of sub-surface archaeological features: within the improved fields by the Old Farm, and amongst the relict field systems close to The Wick.

The gradiometer survey by the Old Farm identified a probable archaeological feature, which we have interpreted as a prehistoric enclosure similar to earthwork examples recorded elsewhere on the island. The resistance and gradiometer surveys by The Wick proved less conclusive. In addition to the earthwork boundaries and cultivation ridges that are prominent on the Lidar survey, there was one faintly defined oval feature on the resistance survey. This oval lies within a larger earthwork platform, and it may be archaeologically significant.

The geology dominated some areas of the plots, particularly the gradiometer survey.

The impact of the geology is variable, which corresponds with the complex surface geology and bedrock. The gradiometer and the resistance meter are more effective in areas of glaciofluvial sands and gravel, and the instruments are less effective where there is a lot of surface stone or the volcanic bedrock is close to the surface.

6.2 Recommendations for further work

The overall conclusion of the fieldwork is that geophysical survey techniques do have potential for identifying sub-surface archaeological features on Skomer Island. We recommend the following to build on these results:

1. Extend the geophysical survey area within the enclosed land around the Old Farm to trace the extent of the possible enclosures, and test the use of a resistance meter with the same area.
2. Identify and undertake geophysical survey within areas of the prehistoric field systems where the discovery of sub-surface features would enhance our understanding of the archaeological landscape.
3. Following recommendation 1, undertake evaluative excavation of the possible enclosure within the enclosed land by the Old Farm, and consider evaluating the oval feature identified during the resistance survey by The Wick.

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8 APPENDIX – RAW AND PROCESSED SURVEY PLOTS

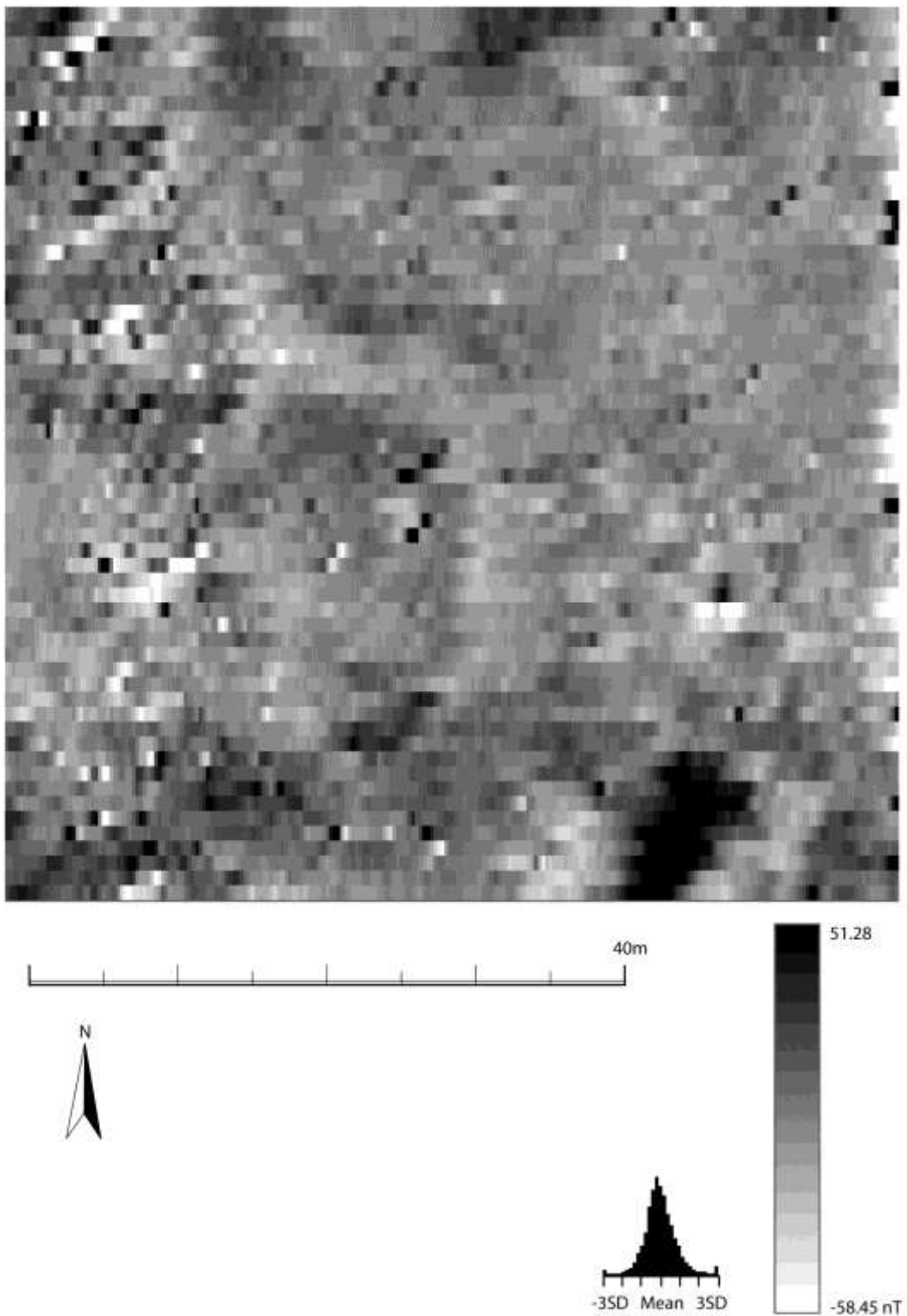


Figure 8 - Area 1 gradiometer survey: greyscale shade plot of the unprocessed data.

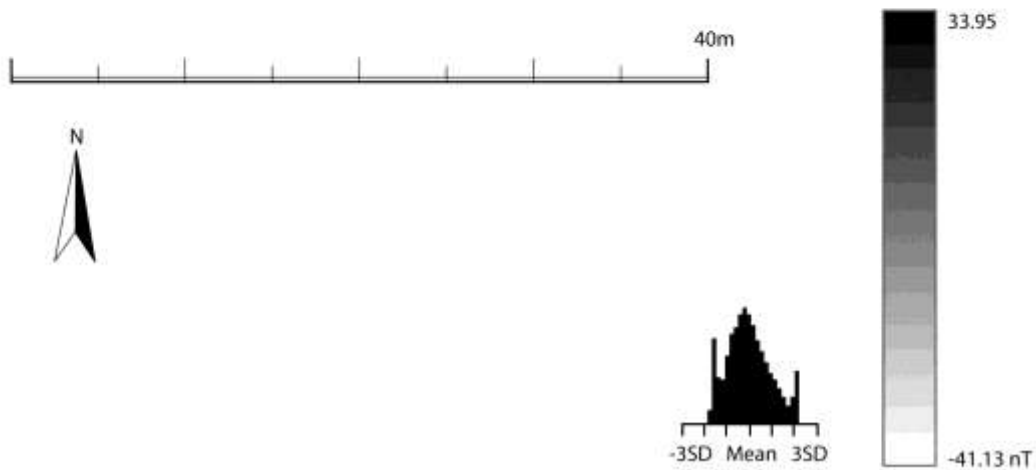
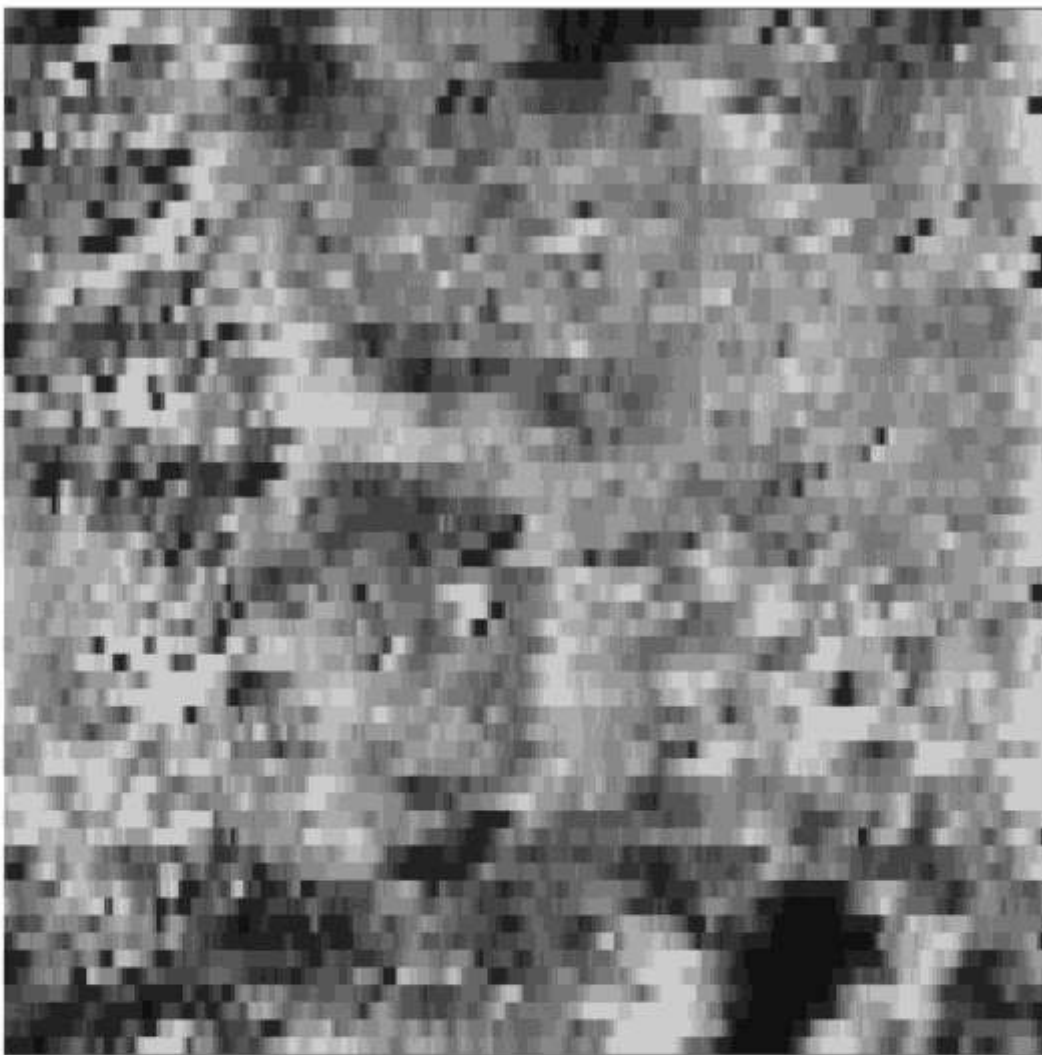


Figure 9 - Area 1 gradiometer survey: greyscale shade plot of the processed data.

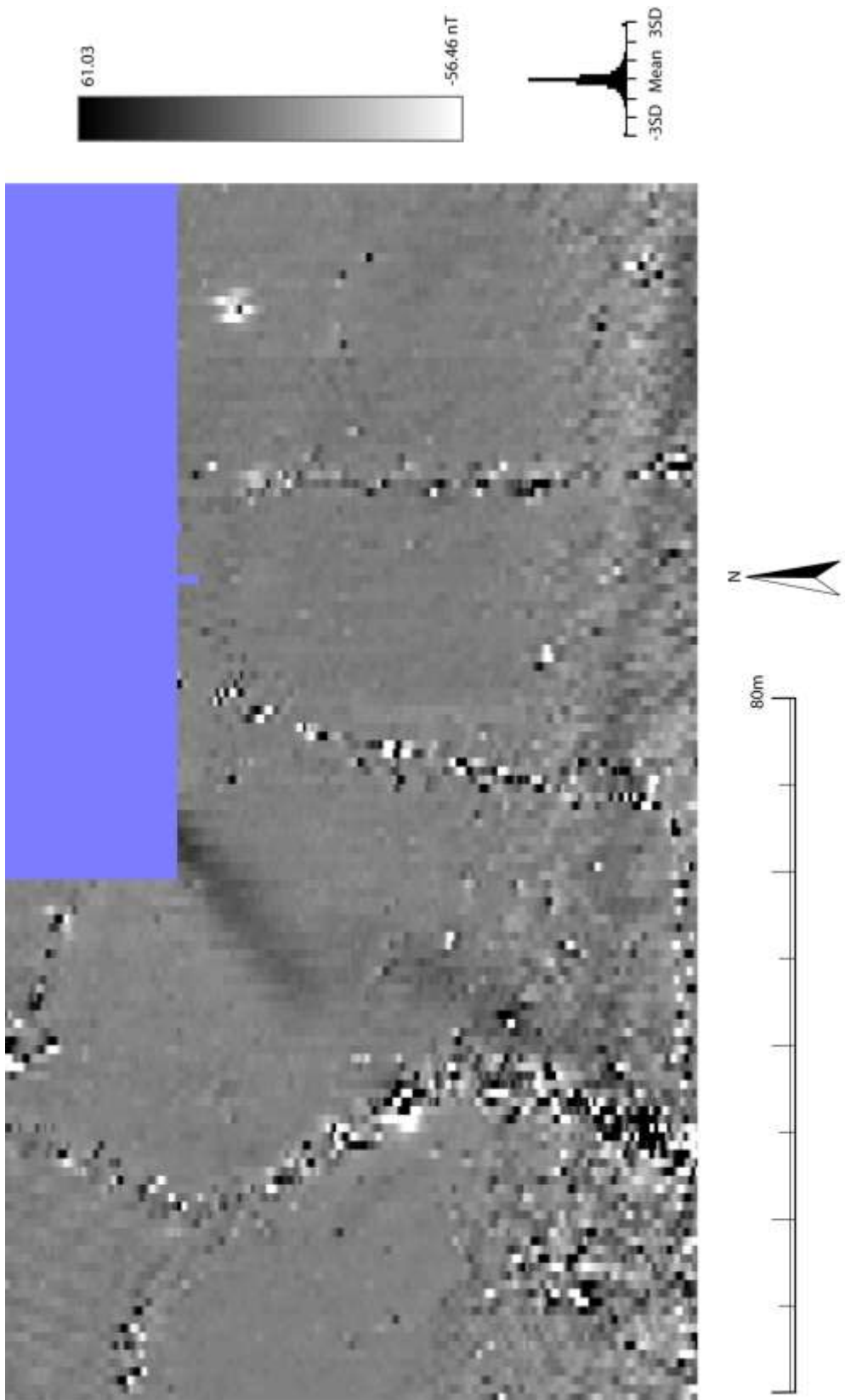


Figure 10 - Area 2 gradiometer survey: greyscale shade plot of the unprocessed data.

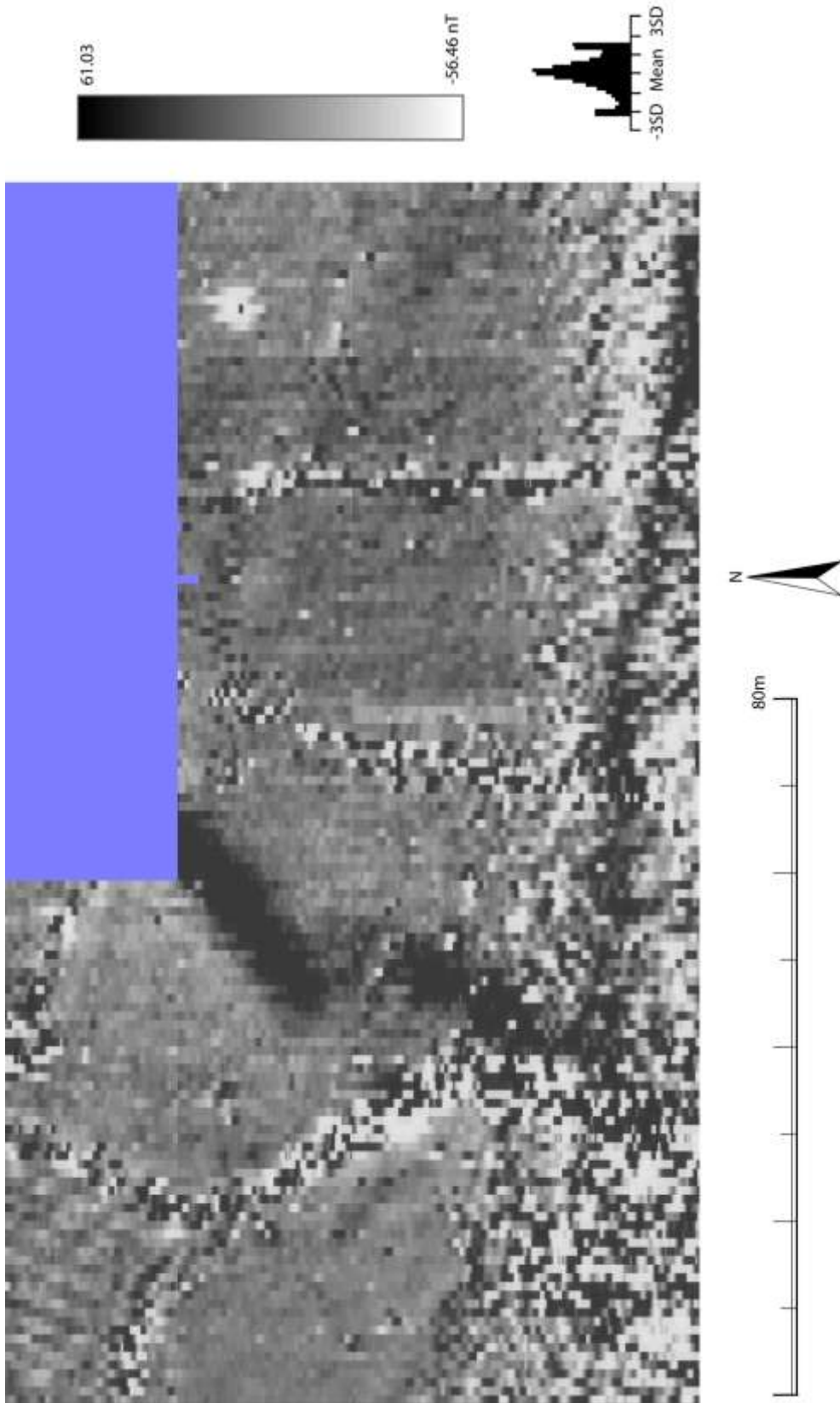


Figure 11 - Area 2 gradiometer survey: greyscale shade plot of the processed data.

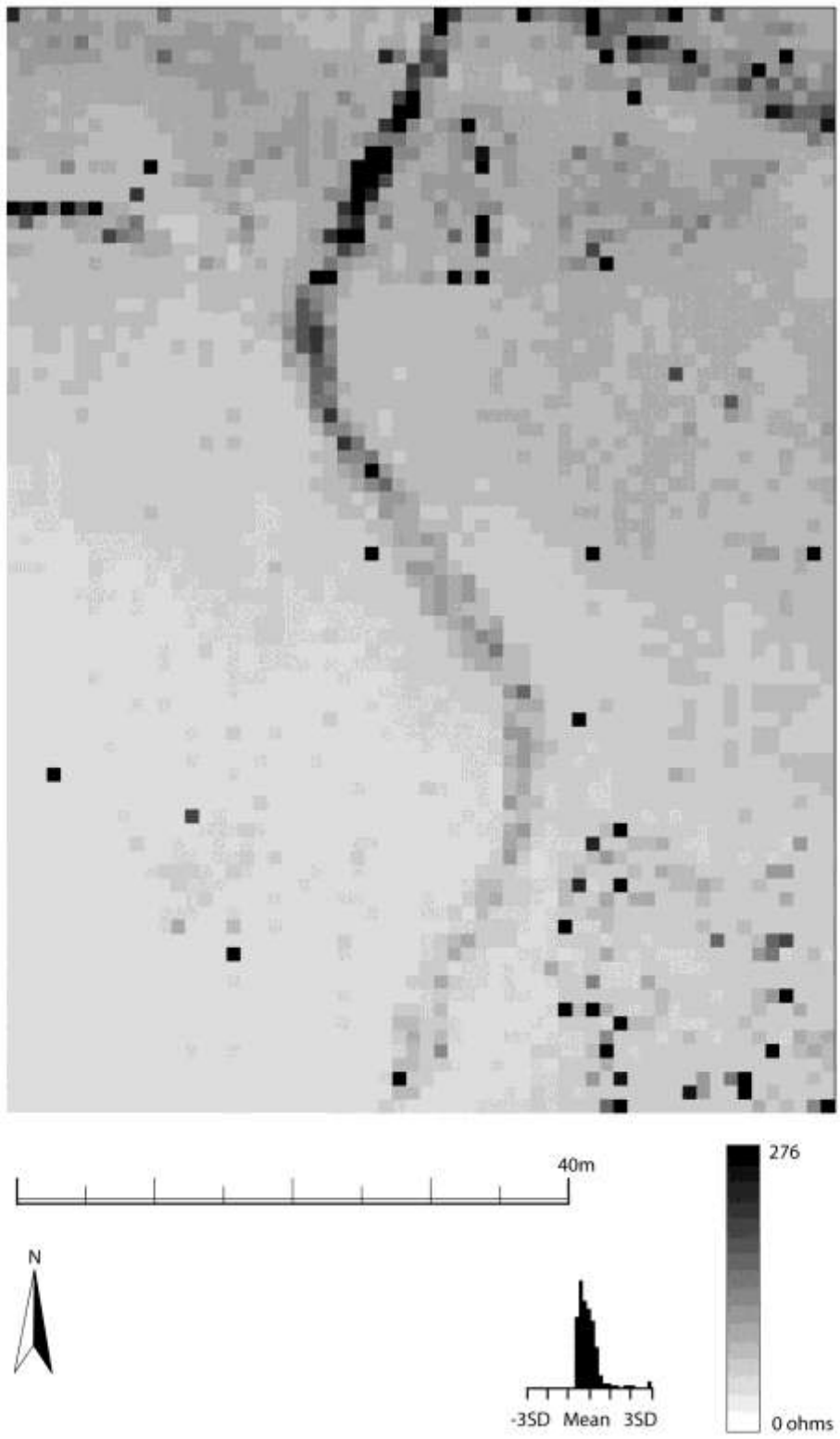


Figure 12 - Area 2 resistivity survey: greyscale shade plot of the unprocessed data.

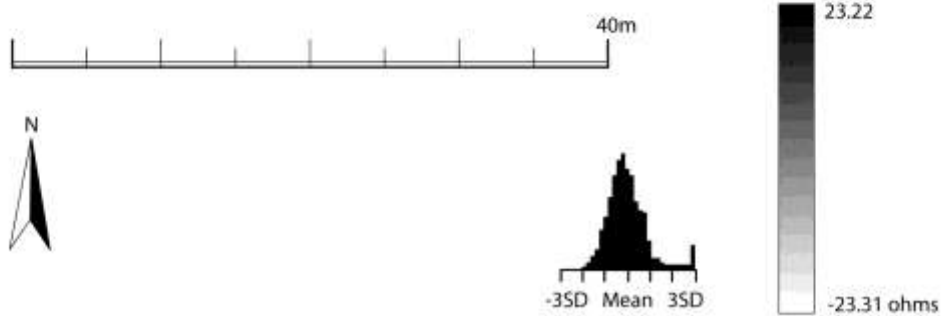


Figure 13 - Area 2 resistance survey: greyscale shade plot of the processed data.