The Roundel Geophysical Survey

Data Report

November 2012

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Summary

A geophysical survey was conducted between September 21st and 24th 2012 across the agricultural fields surrounding the Roundel. The survey was undertaken by members of the Strathearn Environs and Royal Forteviot (SERF) project, University of Glasgow. The results of this survey confirmed the presence of ditches initially identified through aerial photography. At least five, perhaps six, ditches were recorded to the NW of the Roundel. Towards the SE the line of these ditches became less clear. The geophysical data suggest the three innermost ditches are different in character to the outer ones. Other features detected in the field related to the underlying geology and a well noted on the OS 1st edition map of 1866.

Introduction

A geophysical survey was carried out on the Roundel (NO 1147 2010; NMRS NO12SW 189), between September 21st and 24th 2012 as part of the SERF programme.

Aims

The aim of the geophysical survey was to use geophysical techniques:

- to detect and characterise the archaeological features identified as cropmarks on aerial photographs;
- to identify and characterise any previously unknown archaeological features.

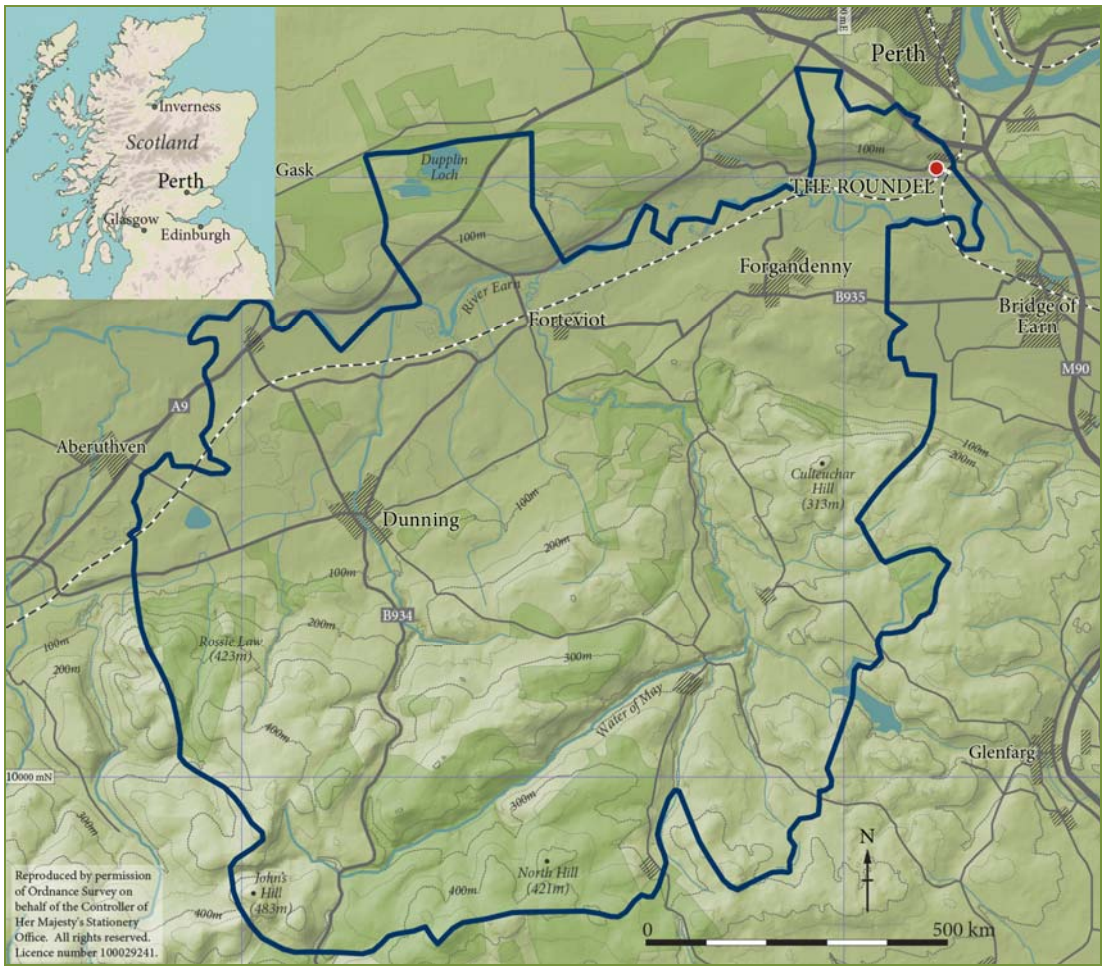

Figure 1: Location map of the Roundel (red) SW of Perth, in the NE corner of the SERF study area (dark blue)

Archaeological Description & Background

Situated on the SE flank of Hilton Hill, the Roundel is a small knoll with steep slopes on the SE, S and W sides and a more gentle approach on the N and NE sides. At present a modern bungalow sits on the summit of this knoll surrounded by fenced woodland. Early maps were examined in order to identify any previous constructions associated with the Roundel. James Stobie's map, dating from the end of the 18th century, depicts a large house at Hilltown with three outbuildings to its W (*see Figure 2*) (Stobie 1783). Although the map is not accurate enough to locate these buildings with any confidence, it is suggested that the large building is the site of the current Hilton house and that the three smaller buildings may have stood in the current field surrounding the Roundel or under the current electricity sub-station. In 1866 the Ordnance Survey map shows the Roundel was a wooded area named *Fir Knowe* with a solid boundary on the N and NE sides (*see Figure 3*). The only other feature in the surrounding field is a well located to the NE of the wood at the edge of and area depicted with sparsely set trees. It was sometime the 1950s the current house with an accompanying garden and track was constructed and renamed the Roundel.

Figure 2: Map of Hilltown (Stobie 1783)

Figure 3: Map showing Hilton House and Fir Knowe (OS 1866)

In 1975 cropmarks of a possible multi-ditched fort surrounding the Roundel was first detected on aerial photographs and since has been photographed several times over the years (*see Figures 4 & 5*). From the photographs at least five concentric ditches are clearly visible on the N side of the Roundel, which is the gentlest approach. The ditches measure up to 3m in width and there is a well-defined entrance, about 10m wide, on the NW side. The circuit of each of these ditches becomes less distinct towards the SE with the potential for several of these terminating on the E side of the slope. Here there may be a second entrance. There is no evidence of any ditches on the S and W sides on the knoll.

Figure 4: Aerial photo of The Roundel ©RCAHMS

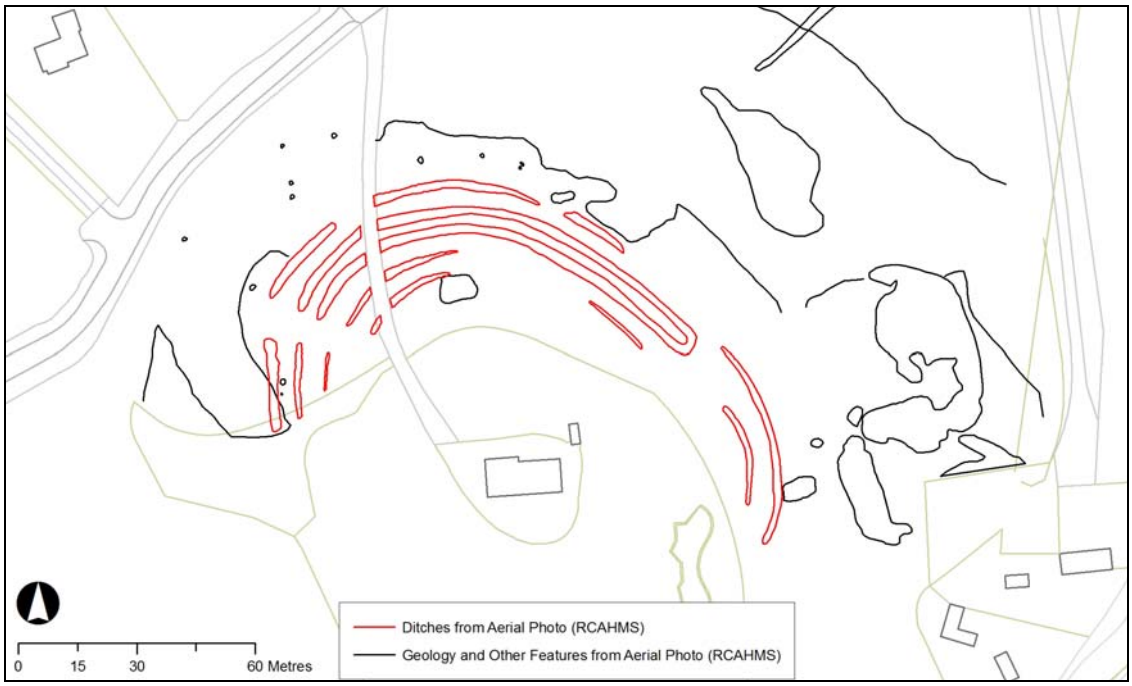

Figure 5: Transcription of archaeological features from the aerial photographs ©RCAHMS

In January and March 2009 and watching brief sponsored by Scottish and Southern Energy plc was undertaken by John Lewis of Scotia Archaeology (Lewis 2009). During this watching brief six narrow trenches were excavated for an underground electricity cable (see *Figure 5)*. The only potential archaeological remains were encountered in the long trench which ran along the N side of the base of the knoll. Within the narrow trench, which measuring about 0.4-0.45m wide and 1m deep, topsoil was generally only 0.2m in depth, sitting directly on bedrock. However, in three locations short lengths of deep deposits of grey-brown sandy loam and stones were encountered extending beyond the sides and the base of the trench. Two of these deposits likely relate to the ditches noted on aerial photos. The other deposit was recorded on the NW side opposite the entrance but does not relate to any previously known feature (Lewis 2009).

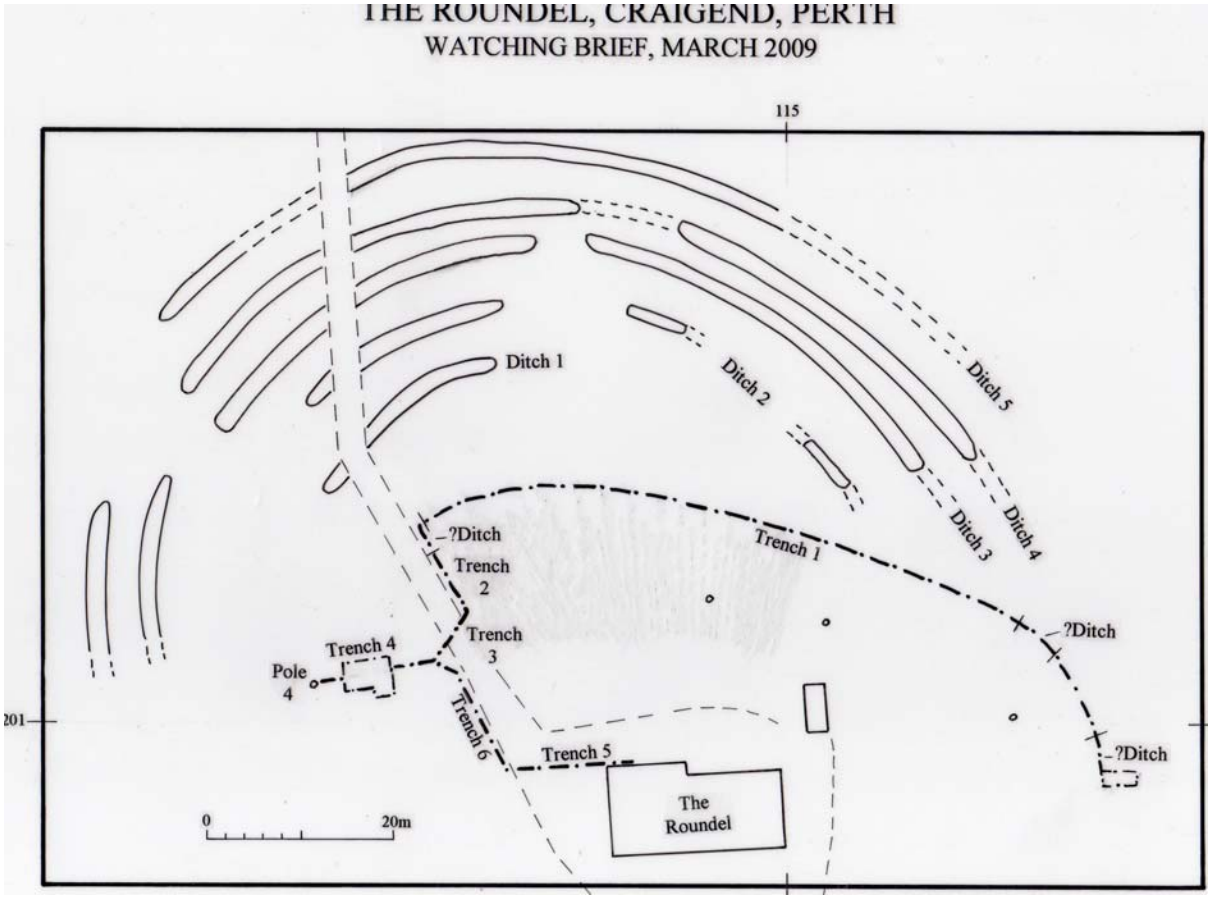

Figure 6: Location of watching brief trenches in relation to ditches (Lewis 2009)

At the time of the survey the owner of the Roundel informed us of masonry which he encountered while ploughing the field and currently is found along the edge of the wooded area (*pers comm* Douglas Johnston). It was hoped that geophysical survey may help define the feature or structure from where this material originated.

Geology, Topography & Vegetation

According to the 1:50,000 British Geological Survey a fault line, aligned from NW to SE, is situated tangential to the edge of the Roundel (*see Figure 7*). To the SW of this line the underlying geology is igneous: pyroxene andesite of the Ochil volcanic formation (BGS 1:50,000). To the NE of the fault line the solid geology is sandstone of the Dundee flagstone

formation (*ibid*). The superficial geology is a poorly sorted mix of silts, sands and clays which is likely to be glacial in origin (BGS 1:50,000).

At the time of the survey the arable crop had been recently cut leaving stubble as ground cover. Along the boundary of the Roundel there was a mix of vegetation, including nettles. A mound of silt and loam with overgrown vegetation, including nettles and bramble, was present on the N side of the Roundel and was impossible to survey. Another mound of fermented grass and straw was located near the edge of the arable field also on the N side.

As mentioned above, the approach to the Roundel is most gradual on the N side. The E side can also be described as gradual. The slope, however, steepens towards the S & W sides, which were not surveyed (*Figure 8*).

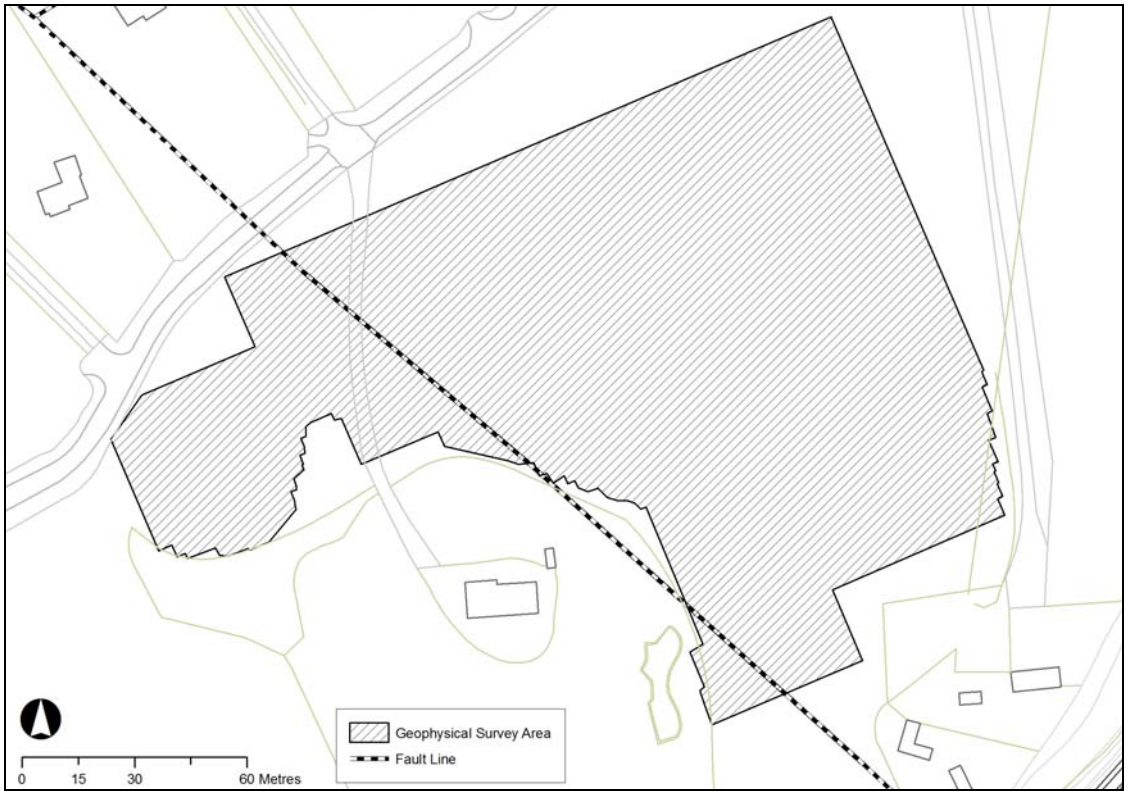

Figure 7: Location of Geophysical Survey and Line of Geological Fault (BGS 1:50,000)

Figure 8: (Top) view of the Roundel from the NE; (Bottom) view of the Roundel from the SW

Methodology

Survey Methodology

Gradiometry was the only technique employed during this survey. A gradiometer detects and records variations in relative magnetic strength across a surveyed area. The gradiometry survey was conducted using a dual sensor Bartington Grad 601. Readings were recorded within 20m by 20m grids and taken every 0.5m (traverse) by 0.25m (sample). The total area surveyed by gradiometry was approximately 21,200m^2 (*see Figure 7*). Readings were recorded as close to the fence of the Roundel as possible. Readings were not taken in a 10m^2 area surrounding an upstanding telegraph pole, nor were readings taken over the mounds of vegetation to the N of the Roundel.

The location of the survey grids were recorded using a Leica 407 Total Station.

Processing Methodology

All the gradiometry survey data was first downloaded using Grad 601 software and then imported into GeoPlot v3 for processing. The data was analysed and presented as grayscale images where strong positive readings are black, strong negative readings are white and more subtle magnetic readings are grey (*see Figures 9-11*).

In order to reduce the dominating effect of very high magnetic readings across the whole survey the data was processed by setting the absolute readings to a minimum of -30nT and a maximum of 30nT. Furthermore, to compensate for the slight discrepancy between the 'balancing' of the two sensors of the Bartington Grad 601, which produced a 'striped' appearance, a 'zero mean' process was applied to selected grids as necessary. Also there was an occasional staggered effect between the readings of individual lines due to the large number of measurements taken every metre and the difficulty of absolute consistency in the surveyor's walking pace. Therefore a 'destagger' was applied to the data (*see Figure 10 for final processed image*). A high pass filter was used as a secondary processing tool (*see Figure 11*). The results produced by this filter, which highlights the higher readings, were then compared with the primary processed data.

Table 1: Processing Flow for Gradiometer Survey
Absolute -30nT/30nT Zero Mean Traverse Destagger (2)
Secondary Processing: High Pass Filter (8/8)

The geophysical images were imported into ArcMap v. 9.3 in order to georeference the data. Potential archaeological features were then outlined and a colour coded interpretive image was produced (*see Figure 12*).

Results

Gradiometry Survey (*Figures 9-13)*

Ditches

Concentric curvilinear ditches, similar to that identified on aerial photographs, are visible in the gradiometry survey results on the N side of the hill. The outer three ditches are defined by consistent strong negative (white) magnetic bands, which contrast the generally neutral (grey) natural geology with occasional scattered small positive (black) and negative anomalies. The outermost ditch, Ditch A, measures roughly 2m in width and is about 5-4m from Ditch B. Ditch B also measures about 2m in width and is 3m from Ditch C. The inner ditches (Ditches D, E & F), of which three are possibly detected, are less magnetically distinct. These ditches are defined by discontinuous thin bands of positive magnetism and slightly negative magnetism. Although these ditches were clear cropmark features identified on the aerial photographs, their magnetic signature is less well-defined and therefore suggesting they may be of different character from the outer ditches. Some of the positive anomalies situated between all of the ditches may be remnants of up cast material from the original ditch cuts.

A 10m wide gap in the ditches on the NW side of the hill conforms to the gap identified on the aerial photographs and supports the assertion that this is an entrance. To the SW of this entrance a short segment (about 14m long) of the outermost ditch (Ditch A) and a faint trace of Ditch B is just identifiable. Immediately outside the entrance there is a discrete high positive and negative anomaly (a dipole) which may relate to a buried metal object or igneous stone. Once a high pass filter is applied to the results a band of slightly positive magnetism aligned roughly N to S can be identified within the gap of the entrance (see Figure 11). This may simply reflect a variation in the underlying geology, but may also be an indication of an intentionally deposited entrance feature such as a cobble or stone path.

Towards the NE and E side of the hill the underlying geology becomes more magnetically dominant, producing a pattern of strong circular positive anomalies separated by more amorphous areas and bands of strong negative readings. According to the BGS the igneous pyroxene andesite lies to the W of the fault line which itself is roughly positioned just to the W of this area. However, the geophysical survey clearly demonstrates a band of igneous bedrock defining the SE slope of the hill and therefore suggesting the fault line should be more accurately located further E. At the N end of this band of geology the readings become more dispersed, perhaps reflecting an area of disturbed bedrock where smaller fractured pieces of igneous stone have been incorporated mixed into the plough soil. At the base of the hill on the SE side there are more isolated but similar strong positive circular anomalies. These can be interpreted to be eroded fragments of the bedrock from the knoll, likely moved down slope through glacial action.

Although the igneous bedrock is magnetically strong and would obscure more subtle features, the relationship of this bedrock and the ditches are intriguing. The line of the third ditch (Ditch C) appears to be identifiable through this igneous zone. This may suggest that this ditch cuts through the bedrock and is filled by a magnetically distinct material. However, the line of the outer two ditches (A & B) cannot be traced. Although it may be tempting to see concentric patterns within the igneous zone, nothing can be confidently matched to the possible line of the

ditches as recorded on the aerial photographs (*see Figure 13*). In fact, the second ditch (Ditch B), which is clearly visible as a cropmark, is not distinguishable at all in the gradiometric survey.

Other Features

Away from the Roundel, towards the E end of the survey area, the underlying geology becomes more magnetically subtle. Within this area very narrow curvilinear lines of positive magnetism can be identified. These lines may define the boundaries between different areas of superficial geology (i.e. areas of sandier material from more gravel). Some of these correspond to features noted on the aerial photographs. Also detected here was an area consisting of variable readings perhaps relating to disturbed subsoil. A neighbouring dipole (an anomaly comprising positive and negative readings together) suggests a buried metallic object.

The metal lid which was placed over the well noted on the 1st edition OS map was clearly identifiable as a series of dipoles (very strong positive and negative anomalies). Interestingly, extending in a NW direction from the well is a line of small positive circular anomalies roughly spaced every 3m apart. The source of this feature is clearly human made which is likely associated to the well and may either be a drainage feature or the remains of a post-defined fence.

In the northern corner of the survey area modern plough marks can be recognised as faint lines of slightly negative readings running in a roughly N-S direction.

A linear feature defined by alternating strong positive and negative magnetic readings running from the SE edge of the knoll towards the sub-station, about 120m E of the house, is the response from an underground electricity cable. The archaeological watching brief undertaken in 2009 was to connect further underground cables to this line (Lewis 2009). A short linear band of negative magnetism on the NE edge of the Roundel, running parallel to the fence, may relate to these excavations.

The paved path which leads from the house to the main road has been detected as irregular, but largely parallel, bands of strong positive magnetism with a slight halo of negative magnetism. Although the path produces strong readings at its edge, the results show that the ditches survive under this path.

Faint linear marks in the W end of the survey area running downhill are the traces of worn all-terrain vehicle tracks leading to the next field, which were visible on the surface during the survey.

Discussion

The results of the gradiometry survey complement the previously known information from the aerial photographic record. This is particularly true in relation to the concentric ditches surrounding the Roundel on the NW, N and E. Together these two sets of data help define the nature and extent of the archaeological features.

A gap in the ditches on the NW side appears to be an entrance. From the geophysical survey the line of the two outermost ditches can be traced towards the N but no further. Aerial photography, however, shows that these ditches do continue further towards the NE and that one of these ditches reappears in the SE corner. Thus in the gradiometric survey the line of these ditches are obscured by the strong magnetic signature of the igneous bedrock.

The alignment of the third ditch on the N and E sides appears to be similar in both datasets. The appearance of this ditch in the gradiometry results suggests that it may be cut into the underlying bedrock on the E side. There is also evidence to propose, in contrast to the aerial photographic data, that the line of this ditch continues all the way from the NW entrance to the wooded area in the SE. If this is true, then it is unlikely that there is an entrance on this side of the knoll. The extent of each of the ditches on the E and SE sides is still unclear, and it may be that some of the ditches terminate or join together at this point. While up to six ditches were noted on the NW side, only two can be identified on the SE side, where the knoll steepens.

Additional to the two inner ditches recorded through aerial photography on the NW side of the knoll traces a possible third inner ditch was recorded during the gradiometry survey. The geophysical responses of the inner ditches were distinct from the outer ditches, suggesting that there were filled with different material or were constructed differently.

The NW entrance is up to 10m wide and the results of the geophysical survey suggest that it may be defined by a stone path. The results also indicate the potential survival of bank material relating to the ditches, in particular a low counterscarp on the outermost ditch in the NW corner.

Apart from the ditches most of the geophysical anomalies noted elsewhere relate to changes in the underlying geology and more recent agricultural activity. Also, the well, which was recorded on the Ordnance Survey 1st edition map (OS 1866) was clearly identified by the response of the metal lid which now covers it. Leading from the well a possible fence or drain was recorded.

Although areas of disturbance have been noted is several places in the geophysical results, no obvious features could be identified as the possible source of the masonry unearthed by the owner of the Roundel. No evidence for foundations relating to buildings, such as those depicted on Stobie's 1783 map, could be recognised. This does not mean the remains of buildings are not present, but that they cannot be detected through relative magnetic survey.

Conclusion

The results of the gradiometric survey have been successful in detecting the multi-ditched enclosure first identified through aerial photography in 1975. The results have added more details about the magnetic character and extent of this feature. Inevitably the survey also raises more questions about the overall nature of this monument. For instance, why do the inner ditches have a different magnetic response in comparison to the outer ones? Are these ditches contemporary? What is happening at the entrance? Why do some ditches terminate on the E side? Do some of these ditches join together? Other geophysical survey techniques such as resistivity and targeted excavation could help to better define these features.

Acknowledgements

The author would like to express gratitude to Douglas and Hazel Johnston for their support in this survey by giving us permission and access to the site. The survey would not have be possible without the enthusiasm and direction of Jennifer MacKay and the able assistance Cathy MacIver. The SERF project is sponsored by Historic Scotland.

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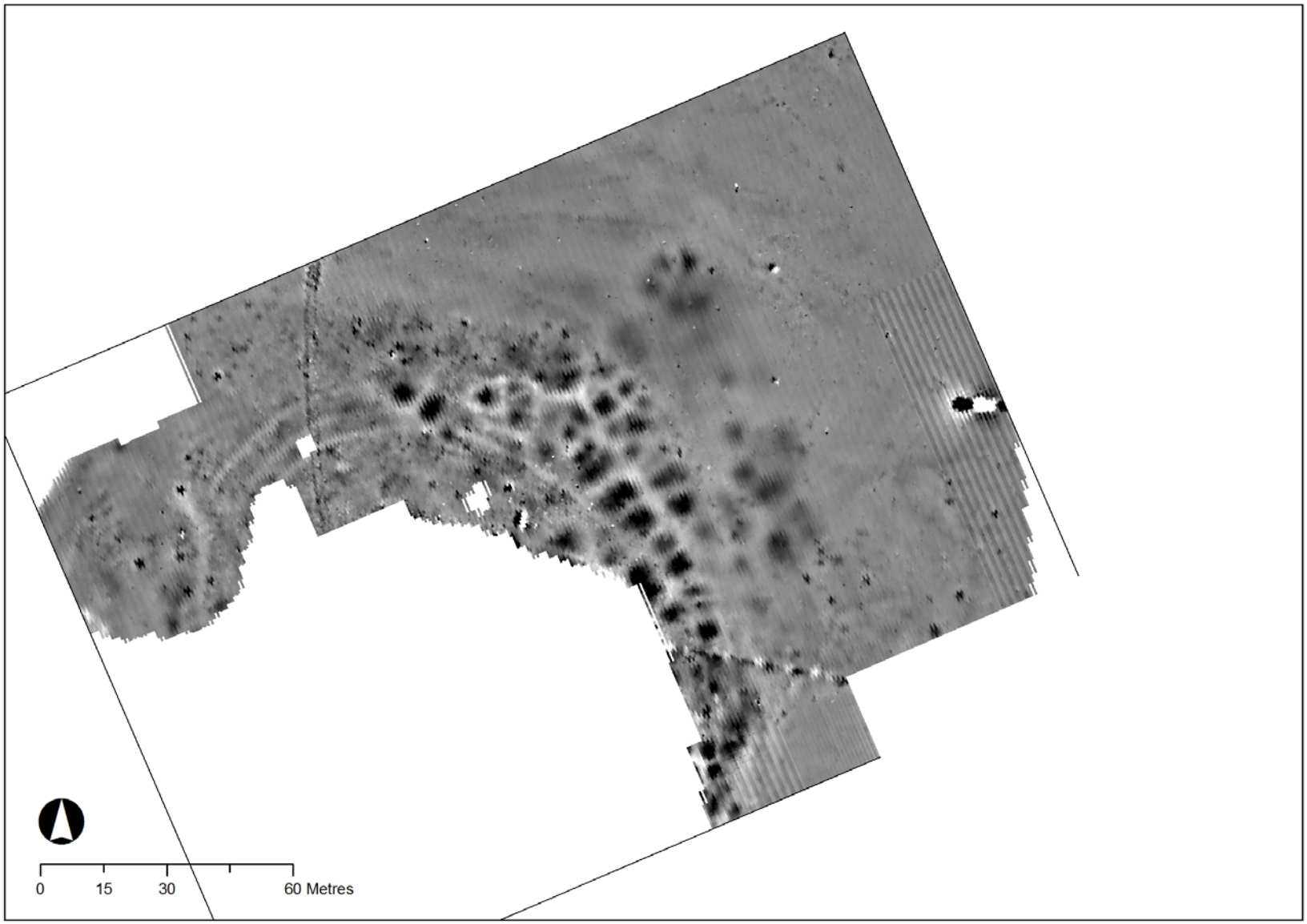

Figure 9: Raw gradiometry data

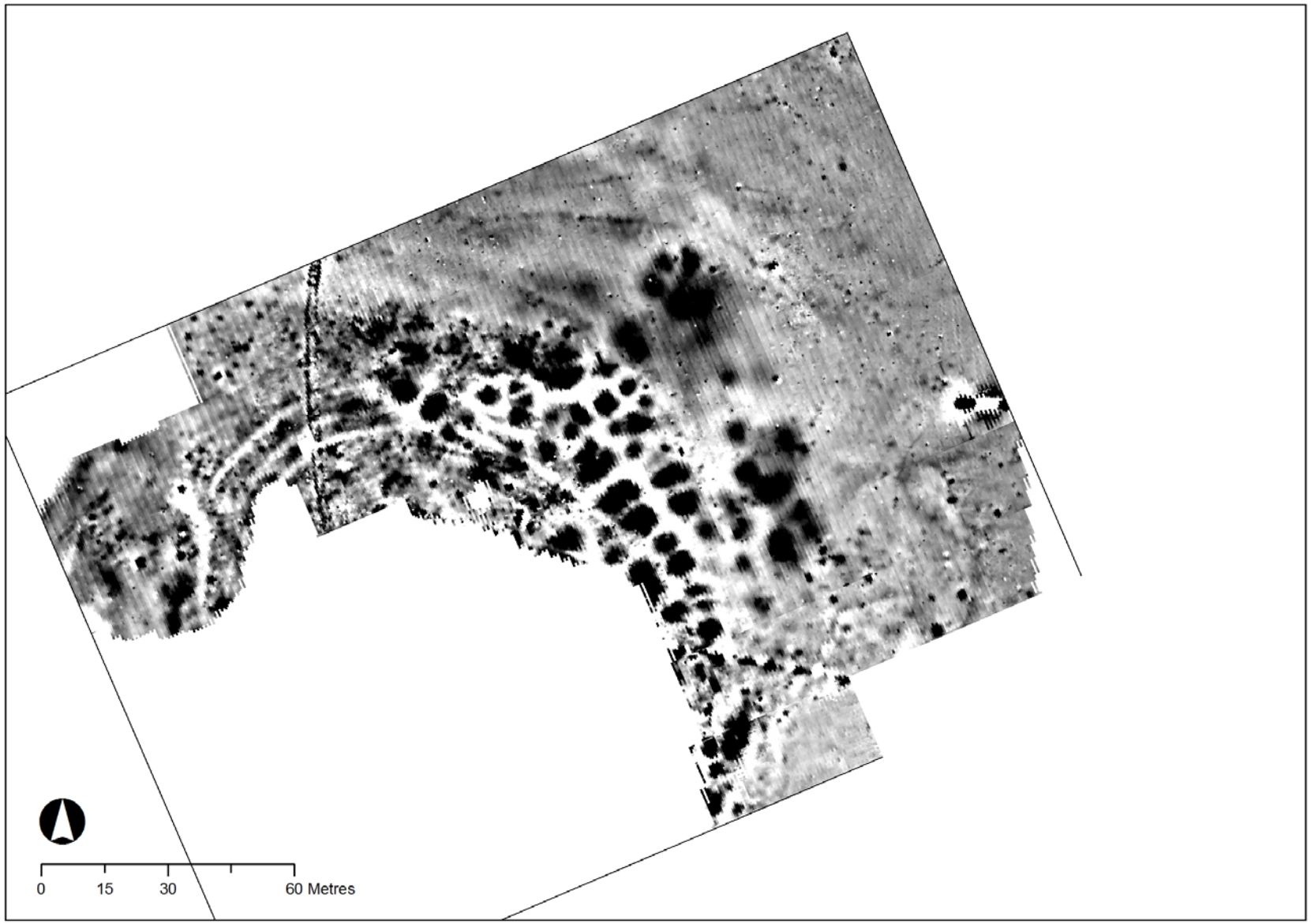

Figure 10: Processed gradiometry data

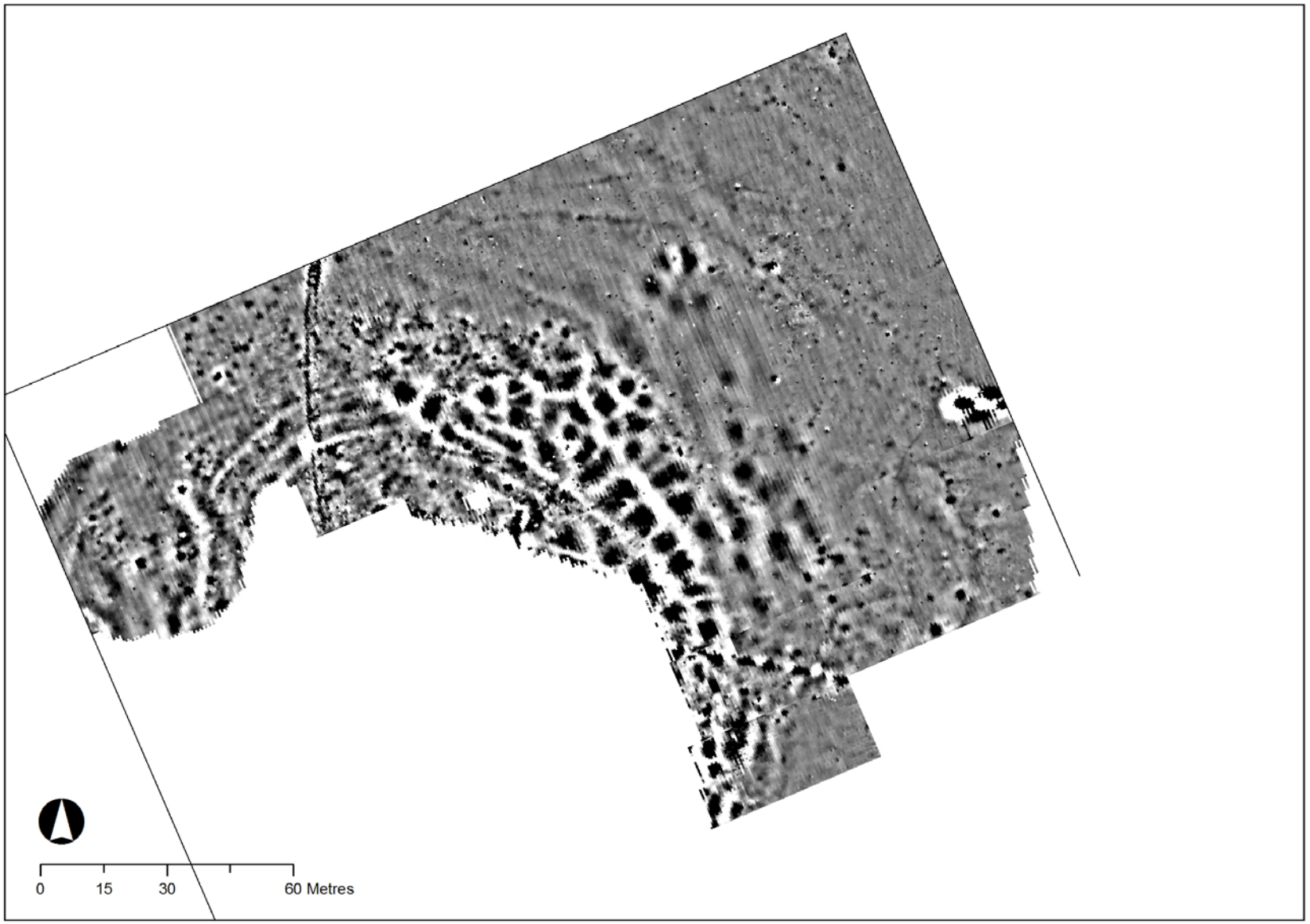

Figure 11: High Pass Filter

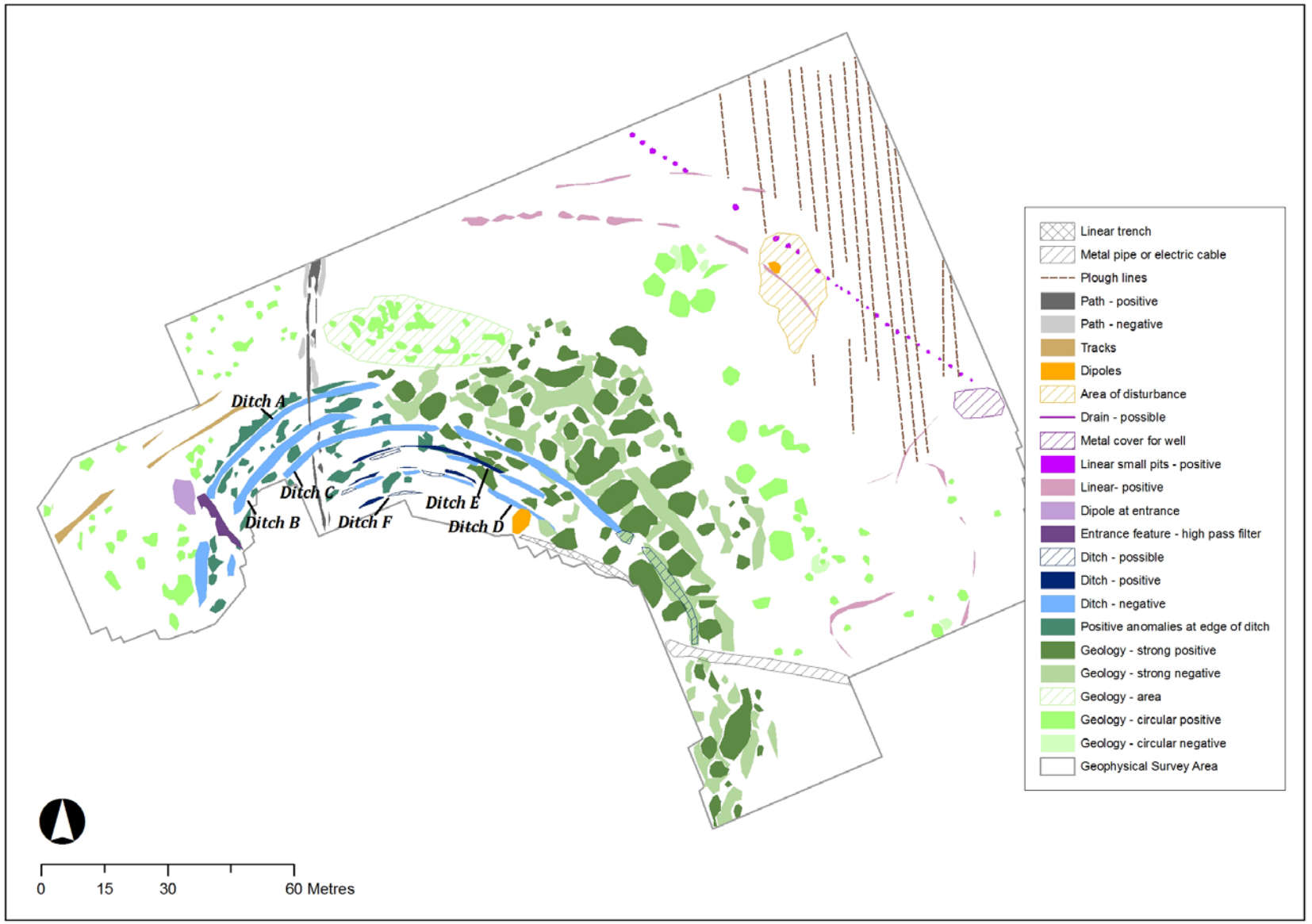

Figure 12: Interpretation of processed gradiometry data

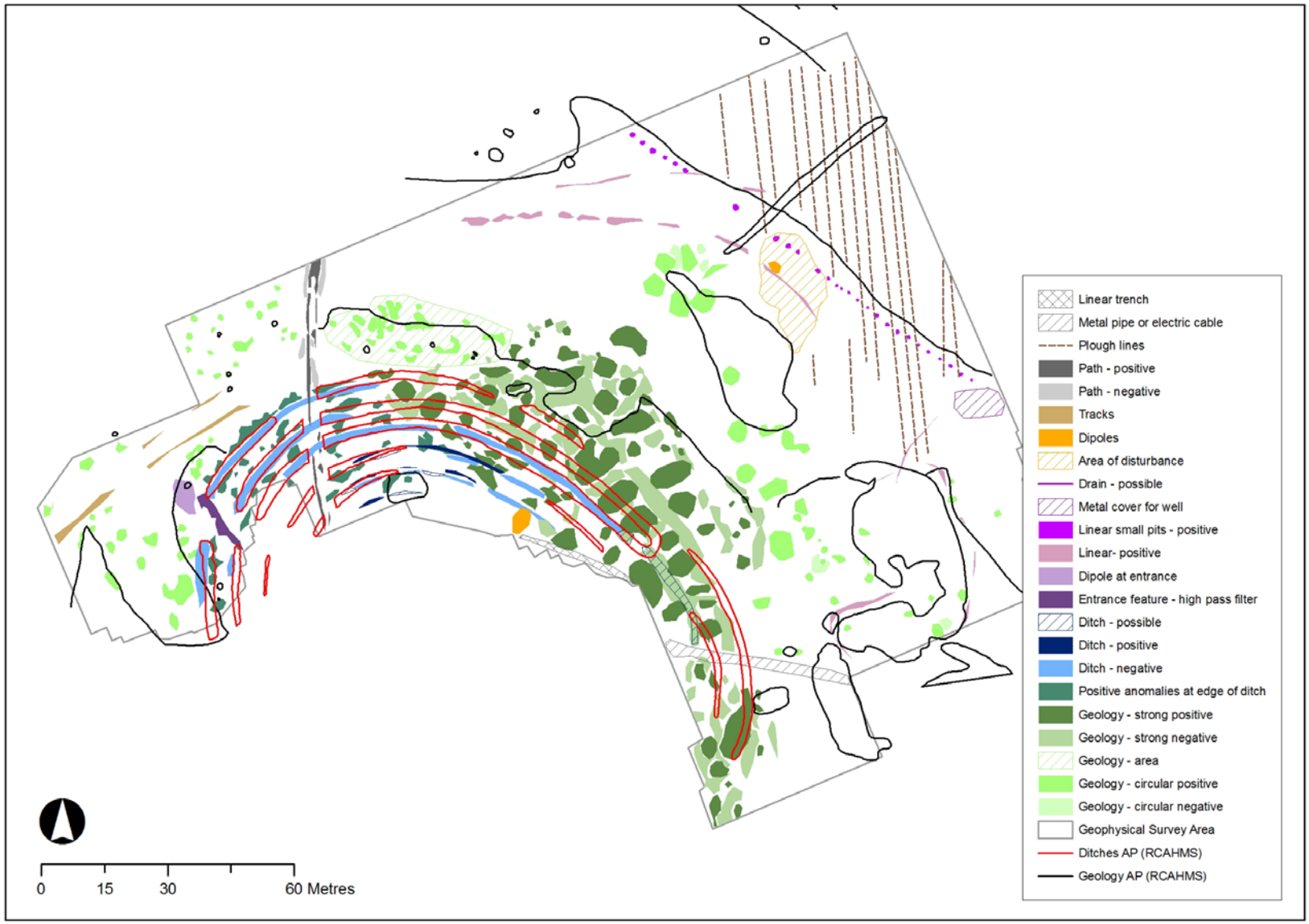

Figure 13: Interpretation of survey with transcription