# A Geophysical Survey at Whirlow Hall Farm, Sheffield

**ARS Ltd Report 2011/56**
May 2011
Oasis I.D: archaeol5-101888

**Compiled By:**
Karl Taylor

Archaeological Research Services Ltd
Angel House
Portland Square
Bakewell
Derbyshire
DE45 1HB

**Checked By:**
Clive Waddington
Tel: 01629 814540
Fax: 01629 814657

admin@archaeologicalresearchservices.com
www.archaeologicalresearchservices.com

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## Executive Summary

*The Whirlow Hall Farm Trust received a Heritage Lottery Grant to undertake a programme of heritage research and archaeological investigations into the history of Whirlow Hall Farm. The project comprised a professionally-led programme of training, participation, learning activities and public engagement. Part of the project involved carrying out a non-intrusive geophysical survey over several areas around the farm in order to identify anomalies of possible archaeological origin. The surveys are intended to provide information on the potential extent and significance of buried archaeology within the farm boundaries. A number of volunteers assisted in both the collection of survey data and setting out the survey grids.*

*Whirlow Hall farm is situated on the edge of the city of Sheffield, South Yorkshire, approximately 8km to the south-west of the city centre (NGR SK 31233 83177). The farm extends to some 55ha (138 acres) and occupies a sloping site from north to south. Each field is named individually, the geophysical survey being carried out within six fields; Long; Lane Side (Areas 1 and 2); Barley (Area 3); Lane End (Area 4); Hall (Area 5) and Rose Cottage (Area 6). The total area surveyed extended to approximately 8ha.*

*The geophysical survey identified a number of anomalies, several of which may relate to features of potential archaeological significance. In particular, those features within Area 5 (Hall field) offer the most potential for archaeological remains to be present. The most remarkable feature is a rectilinear enclosure measuring some 70m long by an unknown distance wide, although it can be traced for at least 36m, possibly with a double ditch or inner palisade trench and certainly with two visible entrances. Within the feature, further anomalies suggest that some activity has taken place within the interior. A potentially significant feature that lay just outside the enclosure was sub-rectangular in appearance with a semi-circular feature at the north-west side. The other significant features within this area may relate to former field boundaries or even a droveway linked to the enclosure. A collection of small pits arranged in alignments is of interest and potentially archaeologically significant. Numerous other pits are present in each of the survey areas, however, none exhibit any sort of alignment or grouping.*

*The other areas with the potential to contain features of archaeological significance are Areas 1 and 2 (Long and Lane Side fields). Within Area 2, especially, there are a number of linear anomalies suggestive of former field patterns, possibly strip fields. A feature at the west end of this field is interesting and represents a narrow strip some 12m wide bounded by L-shaped features suggestive of field boundaries. Very weak anomalies suggestive of ridge and furrow add to the evidence of past cultivation.*

*The other fields are largely devoid of features of possible archaeological potential but two features, a curvilinear anomaly and pit-like feature, within Area 3 (Barley field) may prove to be of archaeological interest. Also of potential interest are two features, one linear anomaly and a collection of discrete pits, within Area 4 (Lane End field), together with two curvilinear anomalies within Area 6 (Rose Cottage Field).*

*Recommendations for further work include agreement of a programme of archaeological evaluation trenching to investigate the most significant anomalies, and in particular the rectilinear enclosure and surrounding features in Area 5.*

# 1 Introduction

## 1.1 Scope of Work

1.1.1 The Whirlow Hall Farm Trust received a Heritage Lottery Grant to undertake a programme of heritage research and archaeological investigations into the history of Whirlow Hall Farm. The project comprises a professionally-led programme of training, participation, learning activities and public engagement. The Trust invited local schools, community groups, volunteers and visitors to participate in a range of activities to help record the buildings and discover and record the history of Whirlow Hall Farm.

1.1.2 Part of the project involves carrying out a non-intrusive geophysical survey over several areas around the farm in order to identify anomalies of possible archaeological origin. The surveys are intended to provide information of the potential extent and significance of buried archaeology within the farm boundaries. Following the results of the survey, it is hoped that a strategy of further investigation in the form of archaeological excavation will target features of potential significance. A number of volunteers assisted in both the collection of survey data and setting out the survey grids.

1.1.3 This report outlines the results from the geophysical survey together with recommendations for further investigation.

## 1.2 Location & Geology

1.2.1 Whirlow Hall farm is situated on the edge of the city of Sheffield, South Yorkshire, approximately 8km to the south west of the city centre (NGR SK 31233 83177 (centre)) (Figure 1). The farm extends to some 55ha (138 acres) and occupies a sloping site from north to south. Each field is named individually, the geophysical survey being carried out within six fields; Long (Area 1); Lane Side (Area 2); Barley (Area 3); Lane End (Area 4); Hall (Area 5) and Rose Cottage (Area 6) (Figure 2). The total area surveyed extended to approximately 8ha.

1.2.2 The underlying geology consists of Rough Rock Sandstone, which is a coarse-grained feldspathic sandstone. There are no recorded superficial deposits (bgs.ac.uk/opengeoscience). The soils are classified as freely draining slightly acid loamy soils (landis.org.uk/soilscapes).

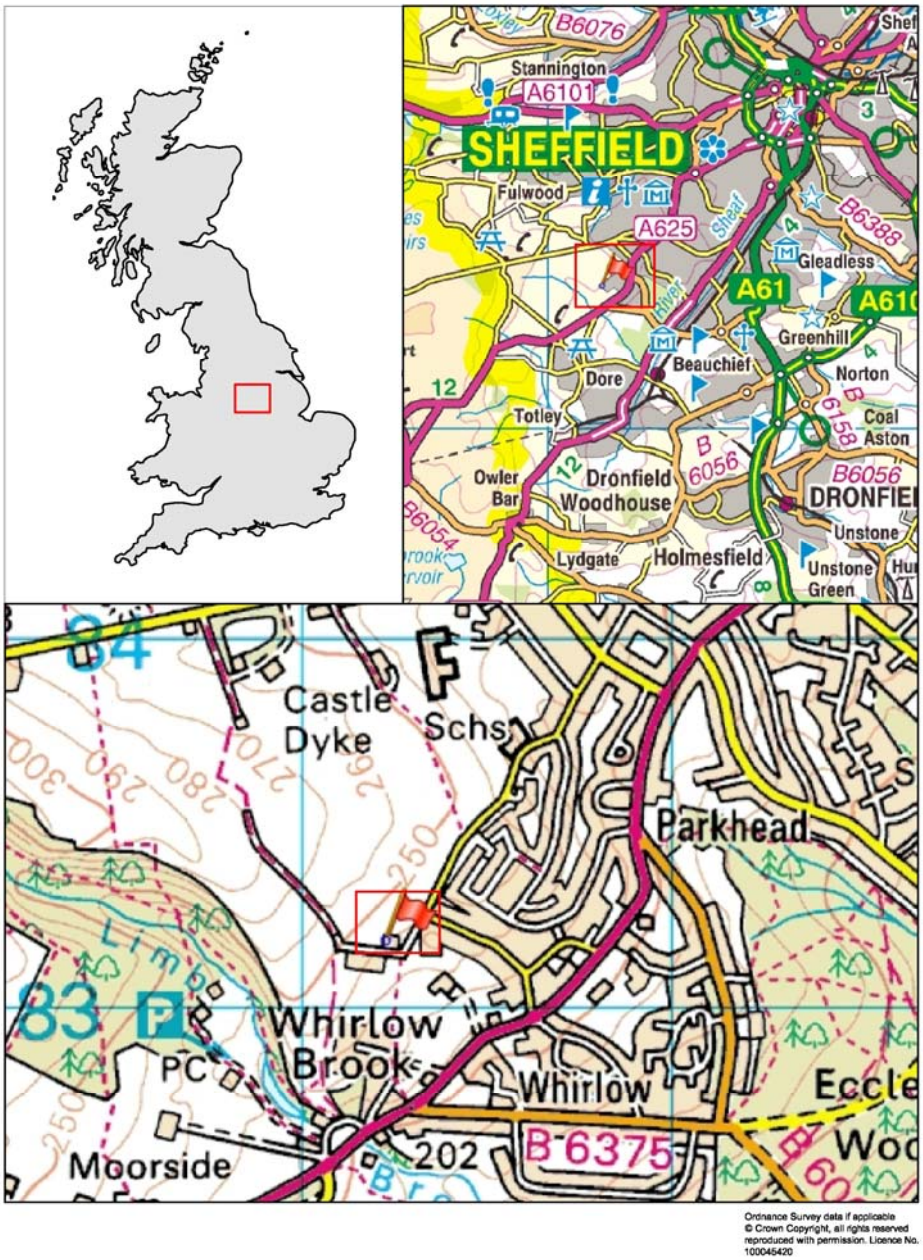


Figure 1: Site location

# 2 Methodology

## 2.1 Geophysical Survey

2.1.1 Magnetometry, using fluxgate gradiometer instruments, is the preferred geophysical technique utilised for the detection of buried features such as iron-based features and objects, or those subjected to firing such as kilns, hearths and even the buried remains of brick walls. It is also used to locate more subtle features such as boundary or enclosure ditches, pits and post holes which have been gradually in-filled by more humic material. The breakdown of organic matter through microbiotic activity leads to the humic material becoming rich in magnetic iron oxides when compared with the subsoil allowing features to be detected. In addition to this, variations in the magnetic susceptibility between the topsoil, subsoil and bedrock have a localised effect on the Earth's magnetic field enabling the detection of features such as backfilled ditches or pits due to the fact that the top soil has more magnetic properties than the sub-soil or bedrock, resulting in a 'positive' magnetic anomaly. Conversely, earthwork or embankment features can also be identified as 'negative' magnetic anomalies due to the action of placing less magnetic subsoil on top of more magnetic top soil.

2.1.1 The strength of the present magnetic field in the United Kingdom is approximately 50,000nT (nanotesla) and most buried archaeological features usually result in very weak changes of less than 1nT to the magnetic field. However, changes as low as 0.03nT can be detected by using a fluxgate gradiometer such as the Bartington Grad 601.

2.1.2 The Instrument used in this survey was a Bartington Grad 601-2 two sensor fluxgate gradiometer which has a typical depth penetration of approximately 0.5m-1m (however this would increase with stronger magnetic anomalies). The instrument has two sensor tubes mounted 1m apart and two fluxgate magnetometers are contained within each tube at 1m vertical separation. By having two sensors positioned one vertically above the other; the gradiometer can measure the earth's magnetic field with the top sensor while at the same time the lower sensor measures the same magnetic field but is affected by any buried feature that is closer to it. By removing the first reading from the second it is possible to detect the anomaly caused by the buried feature.

2.1.3 Each of the areas was divided into 30mx30m grid squares (Figures 3, 4, 9, 14, 19 and 24), each grid being surveyed at 1m traverse intervals with the sampling at 0.25m intervals equating to 3600 samples in a full grid. The survey was carried out in 'zigzag' mode with precautions to minimise heading error on site. The range of the instrument was set at 100nT (0.01nT resolution). A total of 128 30mx30m grids were surveyed covering an area of 7.8ha.

2.1.4 The survey was carried out on between 3rd and 20th of May 2011. The weather during the survey was mixed, consisting of wet and dry spells.

2.1.5 The data were captured in the internal memory and then downloaded into a computer and archived on the ARS Ltd server. The data were downloaded using Bartington Instruments' *Grad 601 Communication Application* and processed using Geoscan Research's *Geoplot 3* software. The data were minimally processed to remove any instrument error or survey effects in order to enhance any more subtle anomalies associated with archaeological

features. The following processing schedule was applied to all data labelled as processed in this report:

- Zero mean grid — Threshold = 0.25 std dev
- Zero mean traverse — Least mean square fit = off
- Despike — X radius = 1 Y radius = 1; Threshold = 3 std dev; Spike replacement = mean

2.1.6 The data are presented as plots of raw data both a grey-scale plot (Figures 5, 10, 15, 20 and 25) and a trace plot (Figures 6, 11, 16, 21 and 26), together with a grey-scale plot of the processed data (Figures 7, 12, 17, 22 and 27). Magnetic anomalies have been identified and presented separately on the 'Abstraction and Interpretation of Anomalies' plots (Figures 8, 13, 18, 23, 28 and 29).

# 3 Geophysical Survey Results

## 3.1 Introduction

3.1.1 The geophysical survey has identified a number of anomalies which are illustrated on Figures 8, 13, 18, 23, 28 and 29. Each of the areas has been abstracted separately and will be discussed in turn in the following sections. An overall plot of the abstraction is provided on Figure 29.

## 3.2 Areas 1 and 2

3.2.1 These areas are located immediately to the north of the main farm buildings, within Long (Area 1) and Lane Side (Area 2) fields (Figures 2, 3 and 4). At the time of the survey, Long field (Area 1) was under cultivation with some areas of protective fleece being present, resulting in the reduction of the survey area. The field had been ploughed and potatoes were being planted in an area with deep furrows and high ridges, which affected the quality of the results in this field. Area 2 was laid down to pasture and is used as the setting for the annual Whirlow Farm Show. A number of obstructions such as metal drinking troughs and general farm equipment were present around the edges of both fields.

3.2.2 There are a number of areas of interest within both of these fields, the most immediately obvious being the long, linear, positively magnetic anomalies running along each field from east to west (Figure 8). A slightly curving anomaly present in Area 1 (Figure 8, A) appears to be a continuation of the south boundary in the adjacent field to the west (Horse field). A similar curving anomaly parallel to it is also visible in Area 2. To the west of these, are further positively magnetic linear L-shaped anomalies. All of these anomalies are reminiscent of former field boundary ditches. In addition to these are two parallel positively magnetic linear anomalies (Figure 8, C), which may be due to modern disturbance. Other, short, positively magnetic linear anomalies are present which although not adhering to any clear pattern and of uncertain origin, appear to be ditches of some description.

3.2.3 Possibly associated with anomalies A and B, are a number of weak linear positively magnetic parallel anomalies that are present in both fields (Figure 8, D). These are quite weak in magnitude but their general appearance is suggestive of ridge and furrow.

3.2.4 There are a number of negatively magnetic linear anomalies, visible in both fields, one of which lies to the south of, and is parallel to, the curving positive anomaly at the south side of Area 1 (Figure 8, E). This may be associated with the field boundary or due to modern ploughing activity resulting in raised banks at the edges of the field. There is a long very straight negatively magnetic linear anomaly running along the northern part of Area 2, which may be due to modern disturbance. Two areas of general magnetic noise are also present, probably of recent origin.

### 3.3 Area 3

3.3.1 This area is situated within a field called Barley, towards the north end of the farm (Figures 2, 3 and 9). The field slopes to the south and was fallow at the time of the survey, although the field had been ploughed previously.

3.3.2 Positively and negatively magnetic linear anomalies are present at the northern boundary of the site which run parallel to the northern field boundary (Figure 13, A) and may be associated with modern ploughing activity. There are two, quite straight, negatively magnetic linear anomalies running in the direction of the plough lines that may also be due to modern farming activity (Figure 13, B). Situated within the eastern part of the field are a number of sinuous amorphous positively magnetic anomalies that are reminiscent of natural features such as palaeochannels (Figure 13, C). Also within this area is a small collection of discrete anomalies, their general appearance being suggestive of pits or localised quarrying (Figure 13, D).

3.3.3 The most interesting feature present within this area is a curvilinear positively magnetic anomaly situated in the south west corner of the area (Figure 13, E). The nature of this anomaly, suggests the feature may be of archaeological origin.

### 3.4 Area 4

3.4.1 Area 4 is situated to the south west of the main farm buildings and extends to two fields, Lane End and the north eastern corner of Wigley (Figures 2, 3 and 14). The survey was originally confined to Lane End field but was extended into Wigley in order to investigate the area immediately to the west of Area 5. At the time of the survey, both fields were laid down to pasture. Lane End field contained a number of items of farm machinery in the eastern part of the field which limited the size of the survey area.

3.4.2 Running almost down the centre of the survey area is a parallel arrangement of negatively and positively magnetic linear anomalies suggestive of a ditch with an embankment either side (Figure 18, A). The anomaly is very straight and may be associated with modern farming operations such as drainage or services. A further positively magnetic linear anomaly is located at the north end of the area on an east-west alignment parallel to the northern field boundary (Figure 18, B). The general appearance is suggestive of a ditch, possibly of archaeological origin. Situated in the middle of Lane End field is a small collection of discrete

positively magnetic anomalies suggestive of pits or localised quarrying (Figure 18, C). A short linear anomaly appears to connect two of the possible pits. There are large areas of magnetic disturbance on the north and east edges of the field caused by modern farm equipment. The small area to the south, in Wigley field contains anomalies which appear to be due to modern farming practices such as ploughing.

### 3.5 Area 5

3.5.1 At the time of the survey, Area 5 which is situated within Hall field was divided into several smaller areas by post and wire fences. This reduced the scope of the survey as some of the areas were too small to survey effectively. A chicken house was also present at the north-east corner of the area. Three main areas were surveyed therefore, together with a very small area (Area 5a) within the garden of the Hall (Figures 2, 3 and 19). The field was laid down partly to rough pasture and grass.

3.5.2 Immediately visible in the survey data is the large rectilinear enclosure situated in the south-west corner of the field which is bisected by the southern field boundary (Figure 23, A). This consists of a rectangular positively magnetic linear anomaly, with two breaks within the east and west sides. The west side also features a second, internal, slightly weaker, positively magnetic anomaly, together with an almost semi-circular positively magnetic anomaly in the north-west corner (Figure 23, B). This feature is of clear archaeological origin, the western part of which appears to be a double-ditch feature. The interior of the rectangular feature contains a discrete positively magnetic anomaly, reminiscent of a pit or small quarry together with two sets of curvilinear and linear positively magnetic anomalies of possible archaeological origin (Figure 23, D and E). There are two further short linear anomalies to the east of the feature, which may be of archaeological origin.

3.5.3 Lying close to the north-west side of Feature A, is an L-shaped positively magnetic linear anomaly together with a short linear and a semi-circular positively magnetic anomaly (Figure 23, F). These may be associated with one another and may be part of the same feature. This feature is of possible archaeological significance.

3.5.4 Extending roughly to the north from the north-east corner of Feature A, are twin, parallel positively magnetic anomalies (Figure 23, G). One of the anomalies turns ninety degrees to the east and continues, weakly, to the edge of the survey area. There is a further weaker, slightly wider linear anomaly aligned east-west. All of these features are suggestive of former field systems or relict settlement patterns. Laying either side of G, are collections of small pits which appear to be aligned in rows (Figure 23, H). There are four obvious groupings of these pits, two with six pits, one with four and one with a possible five. Two groups are aligned almost north-south and two northeast-southwest. There is no apparent pattern in the layout of the groupings but they are possibly of archaeological significance. There are many similar probable pits within the survey areas but none with such obvious groupings.

3.5.5 The east side of the survey area contains further positively and negatively magnetic anomalies which may or may not be associated with the anomalies already described above. They are all aligned east-west and are on a slightly different orientation to A and G. They may simply be due to modern farming practices such as ploughing. A discrete, almost semi-

circular, anomaly is visible at the north-east corner of the survey area (Figure 23, I). This is of unknown origin but is reminiscent of a pit or small quarry and may be of significance.

3.5.6 Area 5a contains no features of significance, mainly illustrating general magnetic disturbance common with gardens.

### 3.6 Area 6

3.6.1 This area is situated within Rose Cottage field to the east of Area 5 at the south-east corner of the farm (Figure 2, 3 and 24). In common with Area 5, the field was divided into smaller areas by post and wire fences, reducing the scope of the survey. At the time of the survey, the field was laid down to pasture and was occupied by horses and rams.

3.6.2 The most noticeable features are the two linear anomalies of very high disturbance probably due to services crossing the field (Figure 28, A). A positively magnetic linear anomaly crossing the northern end of the field (Figure 28, B) is also probably associated with a service as a there was a slight ridge and manhole present at the east end.

3.6.3 Despite these, other anomalies are present including a twin alignment of quite straight positively magnetic linear anomalies running down the east side of the area (Figure 28, C). These are aligned with the eastern field boundary and may be associated with modern farming practices. To the west of these, there are two curvilinear positively magnetic anomalies (Figure 28, D) these are quite interesting may be of archaeological significance. Crossing these, are two weak negatively magnetic linear anomalies which are possibly due to modern disturbance. Two further, fairly short, linear anomalies are visible at the south end of the field (Figure 28, E) and may be former field boundaries.

## 4 Discussion

4.1.1 The geophysical survey has clearly identified a number of anomalies, several of which are of archaeological significance. In particular, those features within Area 5 (Figure 23 A-I) offer the most potential for archaeological remains to be present. The general appearance of Feature A, although truncated by later development, suggests it is a rectilinear enclosure measuring some 70m long by at least 36m wide (to the current field boundary), possibly with a double ditch, and certainly with two visible entrances. The sides are not perfectly straight, the west side apparently curving towards its southern extent. Within the feature, further anomalies suggests that some activity has taken place, Feature C being suggestive of a pit (measuring some 4.7m across) and D and E possibly relate to settlement activity. Large rectilinear enclosures such as this are typically of Late Iron-Age or Romano-British date and excavations elsewhere in northern England have characterised them as forming settlements. Feature F is also potentially significant, being sub-rectangular in appearance with a semi-circular feature at the northwest side.

4.1.2 The other significant features within this area are firstly, Feature G, which appears to be on a similar alignment to Feature A. The magnitude of the response is not as high as those from Feature A and the features may relate to former field boundaries. The collection of small pits arranged in alignments is of interest (Feature H). Numerous other possible pits are

present in each of the survey areas, however, none exhibit any sort of alignment. Feature I is of interest, its general appearance being suggestive of a pit or localised quarry.

4.1.3 The other area with the most potential for features of archaeological significance is Areas 1 and 2. Within Area 2, especially, there are a number of linear anomalies suggestive of former field patterns, possibly strip fields (Features A and B). Feature B is interesting and represents a narrow strip some 12m wide bounded by L-shaped features. Very weak anomalies suggestive of ridge and furrow add to the evidence (Feature D). The long positively and negatively magnetic features within Area 2 may relate to modern disturbance, although an archaeological origin for Feature C cannot be ruled out.

4.1.4 The other fields are largely devoid of features of archaeological potential but, Features D and E within Area 3 may prove to be of archaeological interest, also of potential interest are Features B and C within Area 4 and Feature D within Area 6.

## 5 Recommendations

5.1 Further investigation in the form of archaeological evaluation excavation is recommended in order to discover the date, form and extent of the archaeological features and their condition of preservation and significance, outlined in Section 4. Particular attention should focus upon the features within Area 5 (Hall field) relating to the rectilinear enclosure. A strategy of investigation and consultation will need to be devised with due regard to the nature of the features discovered.

## 6 Publicity, Confidentiality and Copyright

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## 8 Acknowledgments

8.1 Archaeological Research Services would like to thank all staff and volunteers at Whirlow Hall Farm for their help and assistance. Particular thanks are due to those volunteers who both assisted and helped to carry out the geophysical survey.

## 9 References

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## APPENDIX I: Figures

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