ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
The Friends of Coldingham Priory

Glebe Field
Coldingham
Scottish Borders

geophysical surveys

report 3533
September 2014

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted close to Coldingham Priory as part of ongoing research by the Friends of Coldingham Priory. The works comprised detailed geomagnetic and earth resistance surveys of the Glebe Field.

1.2 Additional current research involves a desk-based assessment of existing documentary, photographic, cartographic and digital records for the study area. This work is presented in a separate report.

1.3 The works were commissioned by the Friends of Coldingham Priory and conducted by Archaeological Services Durham University.

Results

1.4 Many anomalies, particularly geomagnetic anomalies, were detected in the surveys and many of these are probably of archaeological interest. It is likely that the anomalies reflect successive phases of activity here. There is generally a good correlation between the resistance and geomagnetic anomalies.

1.5 Several probable boundaries and enclosures were detected, both rectilinear and curvilinear in form. The remains of an arcuate ditch in the north-west of the field are almost certainly a continuation of ditches previously excavated in the north-east corner of Abbey Yards Field and dated to the early medieval period, which would be contemporary with an Anglian monastery. If the arc of this ditch continued round to form a circle, its centre would be close to the priory.

1.6 A large rectilinear ditched enclosure in the north of the field may be contemporary with an adjacent trackway to the east.

1.7 A concentration of anomalies in the central part of the field probably reflects several features, including at least two curvilinear ditches, and possibly burnt or industrial materials. Two further possible enclosures were detected in the southern part of the field.

1.8 No clear geophysical evidence for stone-founded buildings was detected, however, some anomalies in the north and south could reflect stone footings. It is also possible that such features are present elsewhere but are beneath larger areas of stone rubble.

1.9 Two of the probable curvilinear ditches detected in the west of Glebe Field are not apparent in the earlier geophysical surveys to the immediate west, in Abbey Yards Field. Anomalies detected in the geomagnetic survey of that field are typical of former ploughing (Johnson 1999) and this could have truncated earlier features in the area.

1.10 Earlier geophysical surveys in the south of Glebe Field (Glendinning 1998) identified a probable, penannular ditched enclosure, principally from the resistance data. Although the earlier anomalies are broadly similar to those recorded in the present surveys, they are not here interpreted as reflecting a large ditched enclosure. The anomalies are very broad (up to 10m across), irregular and disjointed, and generally

absent from the present geomagnetic survey. Given that several other, smaller ditches have been readily detected as positive magnetic anomalies across the field, it seems unlikely that a larger ditch would remain undetected.

1.11 The surveys cannot provide definitive evidence for the remains of an Anglian monastery in Glebe Field; that could only be determined by excavation. However, the surveys have detected many probable features, which almost certainly reflect several phases of activity at the site. At least one of the ditches can confidently be dated to the Anglian period.

2. Project background

Location (Figure 1)

2.1 The survey area comprised the Glebe Field in Coldingham, near Eyemouth, Scottish Borders (NGR centre: NT 9054 6600). The field lies to the east of the Scheduled Monument of Coldingham Priory, which includes the conventual remains of a Benedictine priory and an area which may have been occupied by outlying monastic buildings to the east of the church and cloister. It was anticipated that remains associated with the earlier, Anglian monastery might also be present within the glebe field.

2.2 The survey area covered approximately 1.6ha, being the whole of Glebe Field. To the north is Chariot Road and housing, to the east is a caravan and camping ground, and to the south is St Andrew's Burn with an arable field beyond.

Objectives

2.3 The principal objectives of the surveys were threefold:

- to determine the nature and extent of any sub-surface features of potential archaeological or historic significance through geophysical survey, with a specific aim of locating any remains that might be associated with the early monastery
- to contribute to ongoing research by the Friends of Coldingham Priory
- to engage members of the community with archaeological geophysics by way of an introductory lecture and presentation of the survey results

2.4 Additional current research involves a desk-based assessment of existing documentary, photographic, cartographic and digital records for the study area. This work is presented in a separate report (Archaeological Services 2014).

Methods statement

2.5 The surveys have been undertaken following discussions with the Friends of Coldingham Priory and Dr Chris Bowles (Archaeology Officer for Scottish Borders Council and advisor to the Friends), and in accordance with a methods statement prepared by Archaeological Services Durham University (ref DH 14.44) and national standards and guidance (see para. 5.1 below).

Dates

2.6 Fieldwork was undertaken on 3rd July 2014. This report was prepared for August 2014.

Personnel

2.7 Fieldwork was conducted by Duncan Hale (Senior Archaeologist) and Andy Platell (Project Archaeologist). Geophysical data processing and report preparation was by Duncan Hale with illustrations by David Graham and Janine Watson (Graphics Technician).

Archive/OASIS

2.8 The site code is **BCM14**, for **B**erwickshire **C**oldingham **M**onastery 20**14**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline

Acces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-190553**.

Acknowledgements

2.9 Archaeological Services is grateful to the Friends of Coldingham Priory, particularly Anne Dall and David Campbell (Secretary and Treasurer, respectively) for their assistance prior to and during fieldwork, and to the landowner and Scottish Borders Council for their support.

3. Historical and archaeological background

3.1 The historical and archaeological background to the site is presented in detail in a separate report (Archaeological Services 2014). The report focuses on the Anglian monastery of Coldingham, as described in Bede, but includes information for other periods. Further background to the Anglian monastery is also presented in Stronach (2005) and elsewhere.

Previous archaeological work

3.2 One possible candidate for the monastery site at Coldingham is a mound known as St Michael's Knowe in the caravan park to the immediate east of Glebe Field. Cist burials are described there in early reports, and recent excavations to the immediate north also recorded Christian burials of adults and children (Dent 1994).

3.3 Both geomagnetic and earth resistance surveys were undertaken in the southern part of Glebe Field in 1998, prior to the proposed extension of Scoutscroft Holiday Centre (CFA 1998). A number of anomalies were identified, including "a probable, penannular, ditch-defined enclosure about 60m in diameter with an entrance to the north-east" (*ibid*., 3), principally from the resistance data. The feature was thought likely to be broadly prehistoric in date though this remained uncertain and others have suggested a medieval date is as likely.

3.4 Further geophysical surveys were undertaken in Abbey Yards Field to the immediate west in 1999, which also identified probable archaeological features including possible former land boundaries and pit-type alignments (Johnson 1999). The identification and interpretation of "the partial remains of a large sub-circular enclosure" in the west of the field was "offered extremely tentatively" (*ibid*., 13).

3.5 An excavation was subsequently undertaken in the north of Abbey Yards Field, prior to a proposed extension to the existing graveyard (Stronach 2005). Amongst other features, three ditches crossed the area aligned north-west/south-east and one was wood-lined. Radiocarbon dating indicated that this boundary had been created in the 7th or early 8th century AD (*ibid*.). Bede referred to an Urbs Coludi as the location of a monastery and nunnery presided over by St Æbbe in the mid-7th century. The location of this foundation has been identified as Kirk Hill, situated on the coast to the north of Coldingham. However, following a review of available evidence, Stronach concludes that Coldingham is as likely a location for the ecclesiastical site, with Kirk Hill a contemporary secular fort (*ibid*.).

4. Landuse, topography and geology

4.1 The survey area comprised one field, recently cut for hay. The field was generally bounded by hedges and wire fences, with stone walls to the west and south-west around the Manse. Telegraph poles were present in the north-west, central and south-eastern parts of the field. A large steel roller was present near the north-eastern corner, close to the gate.

4.2 The northern half of the field is predominantly level with a mean elevation of approximately 57m OD, while the southern half slopes gently down to the south-east, to St Andrew's Burn at approximately 51m OD.

4.3 The underlying solid geology of the area comprises Early Devonian andesite and basalt of the Eyemouth Volcanic Formation, which are generally overlain by Devensian till except in the south where a band of alluvium flanks the burn.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service & Digital Antiquity *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2013).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on previous work, it was anticipated that cut and built features such as ditches and wall footings might be present on the site, and that other types of feature such as pits, trackways and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets, and the geological environment of the study area, both geomagnetic and electrical resistance survey techniques were considered appropriate. A geomagnetic technique, fluxgate gradiometry, involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features. Despite the magnetic nature of the bedrock, this technique has previously been proven to be effective in numerous surveys by the author over similar geology, for example in East Lothian (see Haselgrove 2009).

5.5 Earth electrical resistance survey can be particularly useful for mapping stone features, irrespective of the magnetic component of bedrock. When a small electrical current is injected through the earth it encounters resistance, which can be measured. Since resistance is linked to soil moisture content and porosity, stone features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

Field methods

5.6 A 20m grid was established across the field and related to the Ordnance Survey National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.7 Measurements of vertical geomagnetic field gradient were determined using a Bartington Grad601-2 dual fluxgate gradiometer. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 1,600 sample measurements per 20m grid unit.

5.8 Measurements of earth electrical resistance were determined using a Geoscan RM15D Advanced resistance meters and MPX15 multiplexers, with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was 0.1ohm, the sample interval was 1m and the traverse interval was 1m, thus providing 400 sample measurements per 20m grid unit.

5.9 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.10 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed, unfiltered) data. The greyscale images and interpretations are presented in Figures 2-4; the trace plots are provided in Figure 5. In the greyscale images, positive magnetic and high resistance anomalies are displayed as dark grey, while negative magnetic and low resistance anomalies are displayed as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla/ohm, as appropriate.

5.11 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
de-stagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses

interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.12 The following basic processing functions have been applied to the resistance data:

add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
de-spike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretations are provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

5.14 Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect wall footings, surfaces, tracks and other concentrations of stone rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

Interpretation: features

5.15 A colour-coded archaeological interpretation plan is provided. Many anomalies, particularly geomagnetic anomalies, have been detected in the surveys and many of these are probably of archaeological interest. For ease of reference, anomaly numbers in the text below (eg **m2**, **r6**) are also shown on the interpretation drawings.

5.16 Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

5.17 Small, discrete dipolar magnetic anomalies have been detected throughout the survey area. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments. In this instance, it is also likely that some of the anomalies will be associated with other archaeological materials, such as metal-working waste, and with igneous rocks.

5.18 In the north-west of the field, a slightly arcuate, strong positive magnetic anomaly has been detected (**m1**). This corresponds to a linear low resistance anomaly (**r1**) and almost certainly reflects a former ditch. Further geomagnetic and resistance anomalies to the south indicate that the ditch probably continues southwards in a gentle arc. This feature appears to be a continuation of three closely spaced ditches revealed by excavation to the immediate north-west in 2000 (Stronach 2005) but not detected in an earlier geophysical survey (Johnson 1999). The three ditches merged into two just before entering the glebe field; each ditch or re-cut was as a successor to the previous one. The geophysical anomalies detected in the glebe field appear to reflect one ditch, presumably with re-cuts. When the ditches to the north-west were excavated they were found to contain iron-working waste; this would account for the strength of the geomagnetic anomalies at places along the ditch. An apparent wood lining in the earliest of the three ditches excavated was radiocarbon dated, providing an early medieval calibrated age range of AD 620-780 (*ibid*.). The feature therefore appears to be an Anglian boundary ditch, which could have been associated with an early monastery at Coldingham. Two undated features recorded in an earlier watching brief, further to the north-west, are now also believed to be continuations of this early boundary (*ibid*.; Mudie 2001).

5.19 Two perpendicular positive magnetic anomalies (**m2**) have been detected immediately east of the early boundary. These anomalies also correspond to low resistance anomalies (**r2**) and almost certainly reflect further ditches, here possibly forming two sides of a large ditched enclosure or small former field. A third, eastern side to the feature is formed by another positive magnetic/low resistance anomaly (**m3/r3**), which has been detected parallel to the existing eastern field boundary. This latter anomaly is one of a pair of parallel anomalies detected along the eastern side of the field, which appear to reflect drainage ditches associated with a former double-ditched track.

5.20 There are relatively few anomalies within the large rectilinear feature in the north, however, a few narrow negative magnetic anomalies (**m4**) could reflect sedimentary stone. These anomalies could possibly reflect sandstone wall footings for former buildings, as was used to construct the priory and associated buildings, and which can be sourced nearby to the south. The interpretation of these anomalies is, however, rather tentative as the anomalies are so limited in extent and there are no corresponding high resistance anomalies, as would be expected of stone features. The most striking resistance anomaly within the large rectilinear feature comprises a large area of high resistance (**r4**). This probably reflects a concentration of stone, either as a laid surface or as a spread of rubble. It is considered unlikely that the anomaly reflects localised near-surface rockhead here, since the underlying bedrock

is expected to have a significant thermoremanent magnetism associated with its volcanic origins, and this is not apparent in the geomagnetic survey. The concentration of stone appears to be cut by two narrow ditches or gullies (**r5**), one of which has also been detected geomagnetically (**m5**).

5.21 An intense dipolar magnetic anomaly (**m6**) and low resistance anomaly (**r6**) has been detected near the north-western edge of the field. This almost certainly reflects a ferrous pipe, which was also detected to the north-west in a geophysical survey of Abbey Yards Field in 1999 (Johnson 1999).

5.22 A curvilinear positive magnetic anomaly (**m7**), and a partial low resistance anomaly (**r7**), almost certainly a ditch, has also been detected in this part of the field, to the north and north-east of the manse. This ditch does not appear to have been detected in the Abbey Yards Field surveys (Johnson 1999), perhaps due to more intense ploughing of that field in the past.

5.23 Many more geophysical anomalies have been detected across the central part of the glebe field. Some of the geomagnetic anomalies are particularly strong and have associated 'shadow' effects, and some of the anomalies are also rather irregular in shape. To some extent these factors have hindered the identification and interpretation of the features giving rise to these anomalies, however, some probable features are shown on the interpretation plans. One of the better defined features is a probable curvilinear ditch (**m8**) near the corner of the manse property. This could be part of an enclosure ditch. Several very strong anomalies (**m9**) within the possible enclosure may be associated with extreme heating or burning, possibly reflecting small-scale industrial activities. Several parts of possible rectilinear and curvilinear features have been detected throughout this central area. The features are generally interpreted as soil-filled, such as ditches and pits, or burnt.

5.24 Two further possible enclosures have been detected in the southern part of the field. Just south of the central complex of anomalies are two perpendicular geomagnetic anomalies (**m10**) which could reflect the north-western and north-eastern sides of a rectilinear ditched enclosure; the south-eastern side may also be present but is obscured by anomalies (**m11**) associated with a second possible enclosure to the south. This latter enclosure is more sub-circular in shape. In each case the enclosures are evident as both positive and negative magnetic anomalies, and to some extent as low resistance anomalies. It is possible that the negative magnetic components, particularly on the north-eastern side of **m10**, could reflect sandstone wall footings.

5.25 A small area of high resistance (**r8**) in the east of the field could reflect another concentration of sedimentary stone, perhaps former building rubble.

5.26 A negative magnetic anomaly (**m12**) and weak, low resistance anomaly (**r9**) aligned north-east/south-west across the southern part of the field almost certainly reflects a utility.

6. Discussion and conclusions

6.1 Geomagnetic and earth resistance surveys were undertaken across the Glebe Field in Coldingham, Scottish Borders, as part of ongoing research by the Friends of Coldingham Priory.

6.2 Many anomalies, particularly geomagnetic anomalies, were detected in the surveys and many of these are probably of archaeological interest. It is likely that the anomalies reflect successive phases of activity here. There is generally a good correlation between the resistance and geomagnetic anomalies.

6.3 Several probable boundaries and enclosures were detected, both rectilinear and curvilinear in form. The remains of an arcuate ditch in the north-west of the field are almost certainly a continuation of ditches previously excavated in the north-east corner of Abbey Yards Field and dated to the early medieval period, which would be contemporary with an Anglian monastery. If the arc of this ditch continued round to form a circle, its centre would be close to the priory.

6.4 A large rectilinear ditched enclosure in the north of the field may be contemporary with an adjacent trackway to the east.

6.5 A concentration of anomalies in the central part of the field probably reflects several features, including at least two curvilinear ditches, and possibly burnt or industrial materials. Two further possible enclosures were detected in the southern part of the field.

6.6 No clear geophysical evidence for stone-founded buildings was detected, however, some anomalies in the north and south could reflect stone footings. It is also possible that such features are present elsewhere but are beneath larger areas of stone rubble.

6.7 Two of the probable curvilinear ditches detected in the west of Glebe Field are not apparent in the earlier geophysical surveys to the immediate west, in Abbey Yards Field. Anomalies detected in the geomagnetic survey of that field are typical of former ploughing (Johnson 1999) and this could have truncated earlier features in the area.

6.8 Earlier geophysical surveys in the south of Glebe Field (Glendinning 1998) identified a probable, penannular ditched enclosure, principally from the resistance data. Although the earlier anomalies are broadly similar to those recorded in the present surveys, they are not here interpreted as reflecting a large ditched enclosure. The anomalies are very broad (up to 10m across), irregular and disjointed, and generally absent from the present geomagnetic survey. Given that several other, smaller ditches have been readily detected as positive magnetic anomalies across the field, it seems unlikely that a larger ditch would remain undetected.

6.9 The surveys cannot provide definitive evidence for the remains of an Anglian monastery in Glebe Field; that could only be determined by excavation. However, the surveys have detected many probable features, which almost certainly reflect several phases of activity at the site. At least one of the ditches can confidently be dated to the Anglian period.

7. Sources

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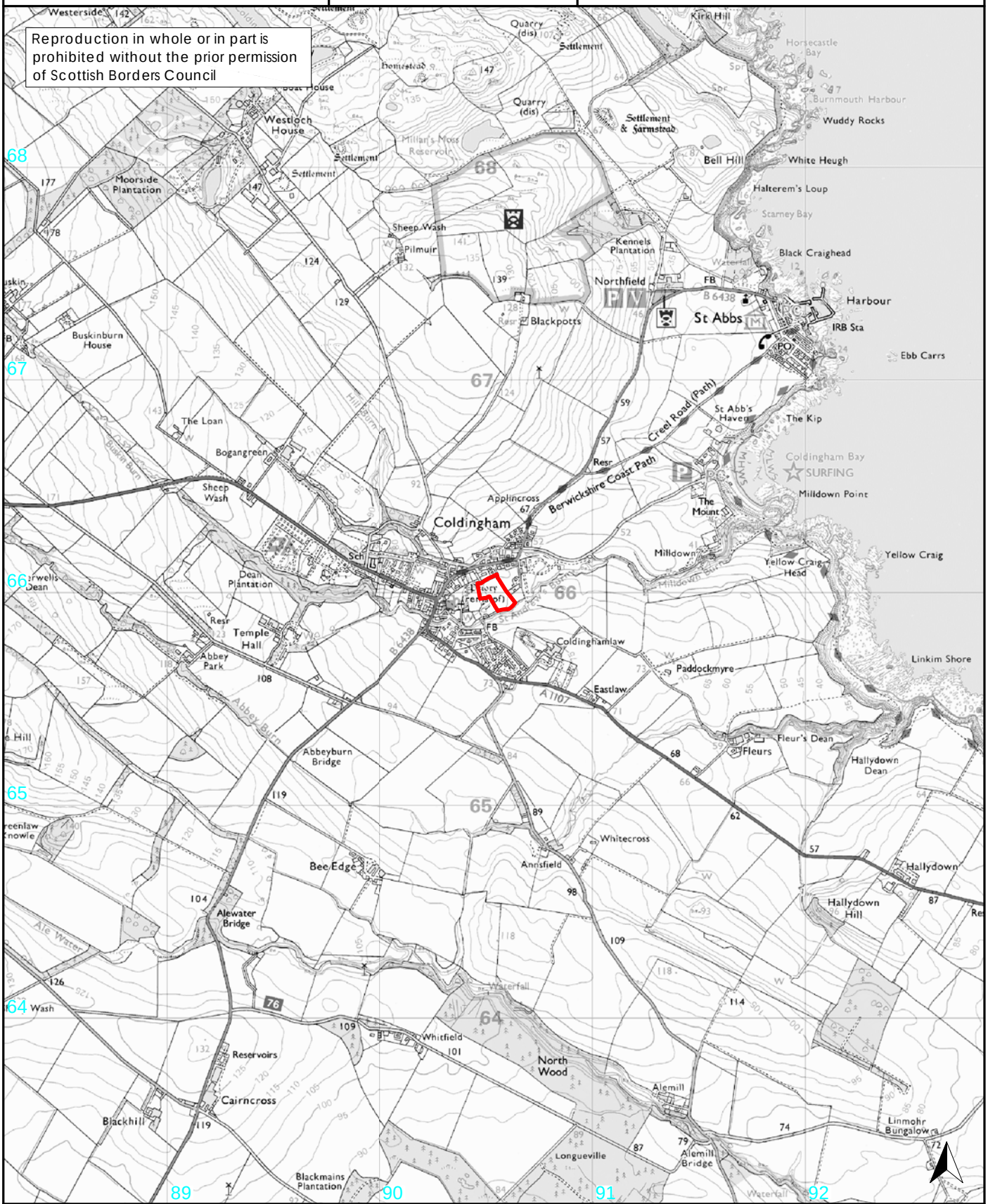
Figure 1: Site location



site location

0 1km

scale 1:25 000 for A4 plot

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magnetic survey

-8 nT 10

dipolar magnetic anomaly

positive magnetic anomaly

negative magnetic anomaly

0 50m
scale 1:1000 for A3 plot

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Figure 2: Geomagnetic survey and geophysical interpretation

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resistance survey

25 ohm 70

high resistance anomaly

low resistance anomaly

0 50m
scale 1:1000 for A3 plot

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Figure 3: Resistance survey and geophysical interpretation

661
660
659
905
906

r1
r2
r2
r3
r4
r5
r5
r6
r7
r8
r9

m3/r3
m4
r4
m5/r5
m2/r2
m1/r1
m2/r2
m5/r5
r8
m6/r6
m9
m8
m7/r7
m3/r3
m10
m12/r9
m11
660
659
905
906

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Figure 4: Archaeological interpretation

0 30m
scale 1:750 for A3 plot

- magnetic survey
- soil-filled feature
- possible stone footings
- stone / rubble
- services
- former ploughing
- telegraph pole

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0 50m
scale 1:1000 for A3 plot

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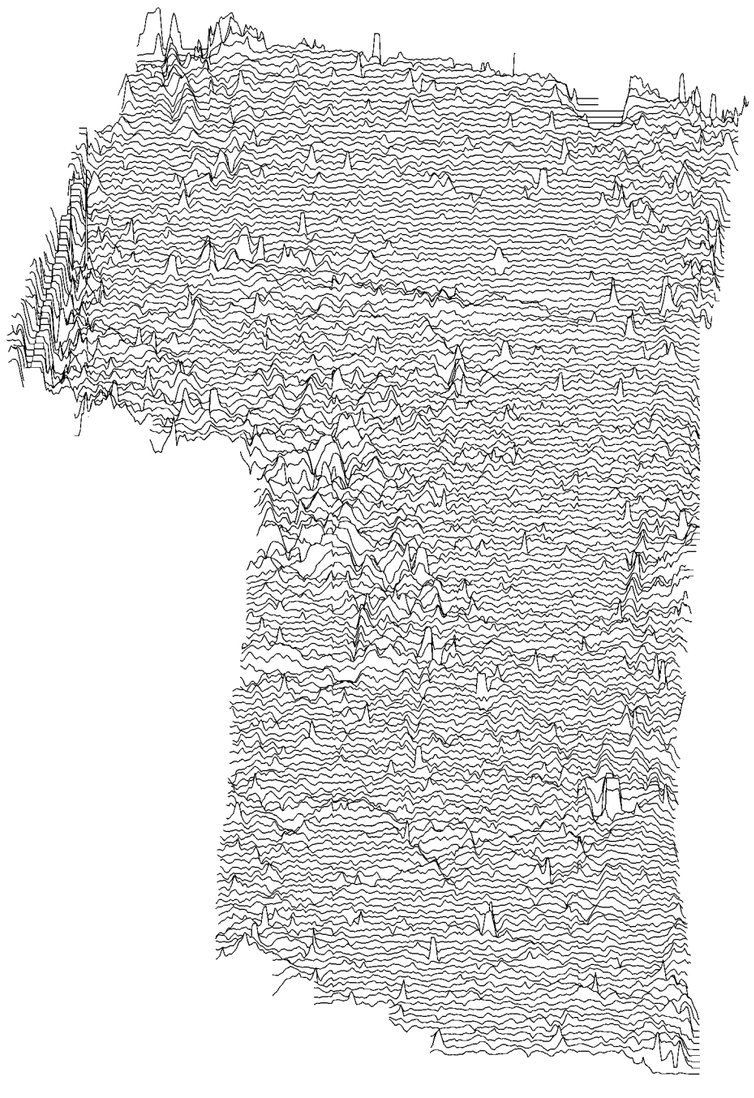
Figure 5: Trace plots of geophysical data

Geomagnetic survey

55.80nT/cm



Resistance survey

93.70ohm/cm