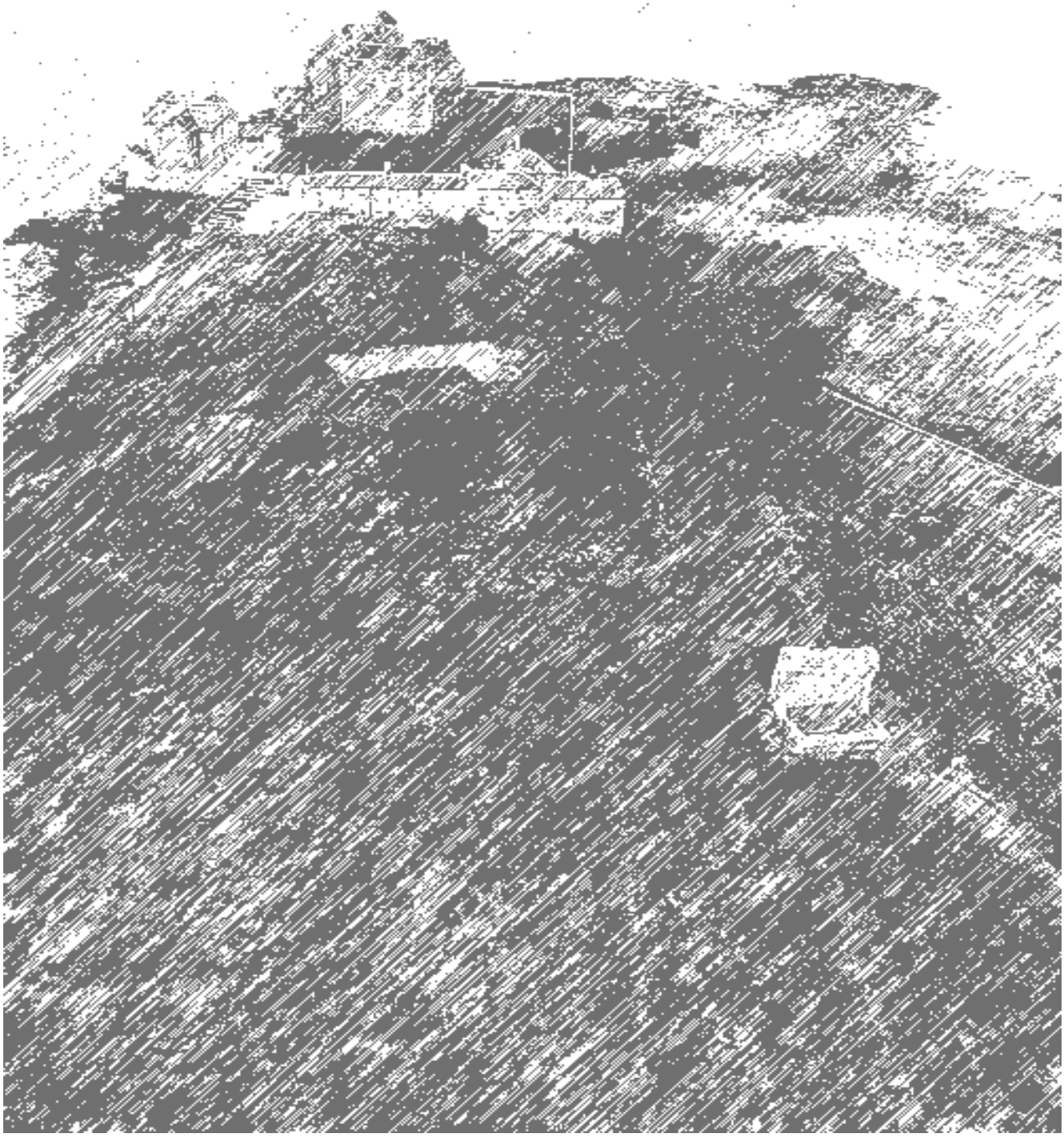
Geophysical Survey Report

Blackness, Castle Field

Earth Resistance Survey

Report No: WLAG 001(Revised)

March 2013



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Geophysical Survey Report, Earth Resistance Survey

West Lothian Archaeology Group Report No: WLAG 001 (Revised)

National Grid Reference (NGR): NT 05440 80083

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Summary

An earth resistance survey was carried out over the weekend of the 9th to the 10th of October 2010, in the field to the south of Castle Hill at Blackness Castle by members of the West Lothian Archaeological Group. An area of 0.4 hectares was covered across a number of features identified in a previous kite aerial photographic survey. The results identified a number of discreet irregular features and a linear feature running to the south-west of the site. It is thought these features are associated with a multi-period site, ranging from prehistoric burials through to wartime defences. A further programme of survey using a gradiometer is planned for the future.

Acknowledgements

I would like to thank the members of the West Lothian Archaeological Group for all their tireless dedication and hard work to make this survey possible. I would also like to thank Historic Scotland for their help and Falkirk Council for permission to carry out the survey.

1 Introduction

1.1 Background

1.1.1 The area under scrutiny lies within the parish of Falkirk. The area is known as ‘Castle Field’ and is to the south-west of Blackness Castle. The field covers some 200 linear metres in length with an area of rough ground containing the remains of St.Ninian’s Chapel on a small hillock (NT 05480 80122). Below the outcrop of the monastic site is an area of manicured pasture forming Castle Field. A kite aerial photographic survey was carried out on the field by the West Lothian Archaeology Group during a weekend in August 2010. The survey identified numerous features of archaeological interest and it was decided that a geophysical survey should be carried out to try and understand the nature of some of these features. The results of both surveys will be discussed below.

1.2 Site Location

1.2.1 The site (centred on NGR: NT 05440 80083) is currently open ground of managed pasture in use as a public recreation area. It lies 100 metres due south-west of Blackness Castle (NT 054 800) and below Castle Hill, the site of St Ninian’s Chapel (NT 05480 80122). To the south of the chapel site within the eastern side of the field is the site of a ruined dovecot (NT 5477 80065). The site is bounded by mature trees to the east and by fencing to the west.

1.3 Historical and Archaeological Potential

1.3.1 Blackness Castle (NT 054 800) or 'the ship that never sailed' is an excellent example of a formidable artillery fortification. The castle stands on a rocky outcrop looking out towards the Firth of Forth. Sir George Crichton, Earl of Caithness and Admiral of Scotland was said to have designed the castle in the form of a ship to create 'the unsinkable ship'. This could just be a romantic story due to his naval connection, but the shape of the promontory does look distinctively like a sea vessel. The curtain wall runs all the way round making it look like a ship’s hull. The main towers are set to 'stem and stern', with another in the middle which could be seen as the main mast. Shortly after its completion around the mid-15th century, the castle was taken into ownership by King James II to be used as the royal residence. It has remained state property to this day, with the next few hundred years seeing it used as either a garrison or the state prison to house political and religious prisoners. The fortification has seen military conflict numerous times during the Mary Queen of Scots and Cromwellian periods. It has survived quite well with repairs and additions in order to strengthen it militarily. The early 20th century saw the national historical importance of the site and it was further repaired, with a number of the earlier mid-19th century buildings removed, giving it the mediaeval castle appearance it once had.

The remains of St Ninian’s Chapel (1466) can be seen on a hilly outcrop on Castle Hill to the SSW behind Blackness Castle. The remains of the chapel have been reduced to mere wall footings by the rampage of the Reformation. Supposedly, the chapel suffered further still during the 1650 siege of Blackness when Cromwell positioned his artillery battery there using it as redoubt. Most of the chapel’s extent seems to have been further destroyed with building works to the cottages further north. Just to the south of the chapel, in the field below, can be seen the remains of the walls that formed a contemporary dovecot.

Nothing is known about the field below the chapel site and what, if any, purpose it had in relation to earlier and later developments in the area. The cartographic evidence dating from the earliest known maps of the area shows nothing of significant interest.

1.3.2 *Archaeological Notes of Interest*

Towards the end of 1944 -1945 the then custodian of Blackness Castle reported that two burials had been discovered in the area of interest. The location is described as being 'on the top of the ridge with the castle at its end'. There are no descriptions of the graves themselves only that one grave contained the cremated remains of an adult and child. The other grave contained the remains of two further adults interned with a food vessel. The funerary vessel was subsequently donated to the National Museum of Antiquities of Scotland with the remains sent to Professor Low. (Low 1964b, 174)

A visit to the site by an Ordnance Survey team in 1956 identified the possible location of the burials at NT 0545 801. The area was covered with rough pasture and gorse. They identified "small earthworks" which were the remains of a wartime military post where a ditch was being dug that exposed the graves. (RCAHMS OS 1978b, 18)

Also, the broken remains of a Celtic figure were possibly found at the chapel site and stored in a workshop within the castle. (A Ross 1967, 142-3)

1.4 Survey Objectives

1.4.1 The objective of the survey was to locate and identify any possible archaeological sub-surface anomalies within the area of interest. These features can be compared with the kite aerial photographs as an aid to ascertain their nature.

1.5 Survey Method

1.5.1 Kite Aerial Photography Survey

Aircraft are routinely used to photograph areas of archaeological interest. This methodology is expensive and not easily available to the general public. One method that is cheaper, convenient and accessible by all is the use of kite aerial photography. A kite can be flown anywhere with the permission of the landowner and within legal boundaries. The use of kites with a camera suspended from the kite string has been employed by scientists and photographers for around a century. A simple camera fitted with a device to control the shutter release either electronically or manually can take hundreds of images flown over an area. The images can be joined together to form a large mosaic across the landscape or to provide single images of potential features.

A Premier Kites Power Sled 24 kite, with Canon S90 and Fuji Finepix F30fd (converted for near infra-red) cameras fitted onto a 360 degrees rotating frame were used. The use of infra-red often brings out features not readily seen in the visible spectrum. The kite is flown at a height under 60m with the camera rig rotating one full revolution every minute. It stops every four seconds and the Canon is programmed to take an image every 4.5 seconds, with the Fuji taking images every second until the memory card is full. The results can be seen in Figures 8-10 and the subsequent interpretation in Figure 03. The photographs in Figures 8-10 have been enhanced by converting the colour images to grey scale and contrast enhanced in order to strengthen any less prominent features.

1.5.2 Earth Resistance Survey

Soil resistance measurements were carried out in order to locate any archaeological features. The use of resistivity is considered an effective method of delineating any possible pits or ditches present. A more detailed description of the resistance survey method is detailed below.

The local geology divides the field into two areas. The northern half of the field has no superficial deposits and the southern half of the field is formed of raised tidal flat deposits, late Devensian - silt and clay. The underlying bedrock is composed of Dinantian to Westphalian sills of Lothians and Fife - olivine analcime-microgabbro. (http://www.bgs.ac.uk/education/geology_of_britain/home.html)

2. Methodology

2.1 Date of Fieldwork

2.1.1 The survey was carried out over a single weekend on the 9th and 10th of October 2010. The weather was generally fine and dry for the duration of both days.

2.2 Grid Location

2.2.1 The location of the survey grid can be seen below in Figure 3 with the origin located at NT 05462 80098. The survey was carried out over an area of 0.4 hectares or 4000 m^2.

2.3 Description of Techniques and Equipment Configuration

2.3.1 Soil resistance relies upon the ability of the soil to conduct an electrical current passed through it. In turn this is affected by the moisture content, porosity of the soil, underlying geology and any other anomaly within this complex matrix. If an electric current is passed through the soil it will find the easiest path of least resistance, such as through a moisture retaining ditch (more conducting). The resulting resistivity response will therefore be low. Likewise, the electrical current will find it more difficult to flow through a more dense structure such as a stone wall (more insulating) and will find an easier path by flowing around it. The resulting resistance response in this case would be expected to be higher. These two examples can be considered as extremes and any other anomalies differing in conductivity will produce intermediate results.

The earth resistance survey employed the use of MM Instruments 216M earth resistance meter incorporating a twin probe array. The mobile probes were set at a fixed distance of 0.5m with the remote probes set at 15m outside of the nearest grid edge in order to reduce background resistance and variation. The 216M uses an internal data logger so that the information collected can be recorded automatically as the survey progresses and can be downloaded later to a computer for processing and interpretation.

The collected data is initially measured in volts and converted later to ohms within a Microsoft Excel template during the processing phase. The results can be considered in ohm-metres as this is directionally proportional to resistivity due to the probe placements being the same distance apart throughout the survey. This relationship is important if we want to calculate an estimated depth of an anomaly.

High contact resistance caused by a thin layer of topsoil over the geology required the gain and voltage to be increased to help reduce background noise and increase resolution.

2.4 Sampling Interval, Resolution and Depth

2.4.1 Sampling Interval

Sample readings were recorded at 1m centres along a standard 1m traverse in a zigzag fashion across a 20m grid. This methodology provides up to 400 samples across the grid. This was to facilitate speed and ease of operation over a more detailed sampling regime.

2.4.2 Resolution and Depth

A twin probe spacing of 0.5m provided a good depth resolution of up to 0.75m. A greater probe separation using an extended 'Wenner' array, could have provided an increased depth of seeing, but the results would have been more complicated to process due to complex peaking caused by the close proximity of the point sampling across the survey. In this case the increased depth requirement was not used to avoid slowing the survey down considerably.

2.5 Processing and Presentation of Results

2.5.1 Processing

The processing of the data sets was initially carried out using dedicated templates within Microsoft Excel in order to put the data into grid order. This was followed by correcting any basic errors in the data sets and then exporting the data into .XYZ format for further manipulation by dedicated software. The data was then entered into another geophysical software package called 'Snuffler' for further data processing and final visualisation. This is freeware software and can help visualise data using special algorithms. The initial data was arranged into composite sets for viewing and then processed. Basic data processing was carried out using the 'despike' operative in order to remove any high resistance data spikes, such as large stones in the ground. Then a standard 'high pass' filter was applied to the data in order to reduce the effects of the background geology (reduce the large variations caused by geology) and to enhance any archaeological features. Finally the data was interpolated or smoothed to make it more readily comprehensible.

3 Results

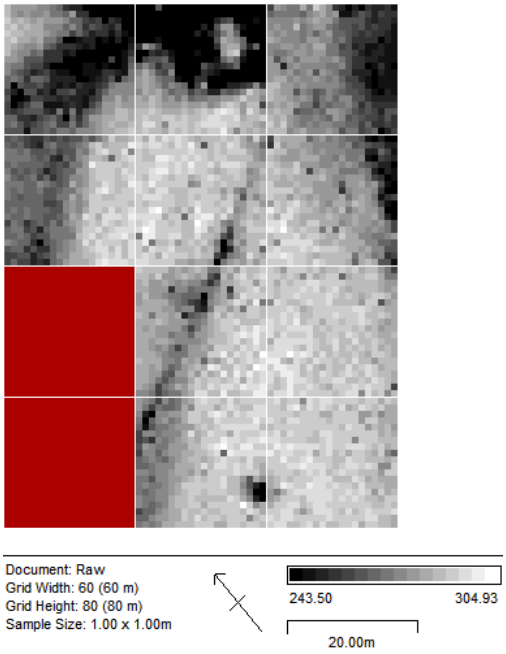
3.1 Introduction

3.1.1 The kite aerial photographs taken in the visible spectrum show numerous features with near infra-red photography adding little to the overall detail. The visible spectrum images are shown in Figures 9 - 11 and are discussed in the interpretation below.

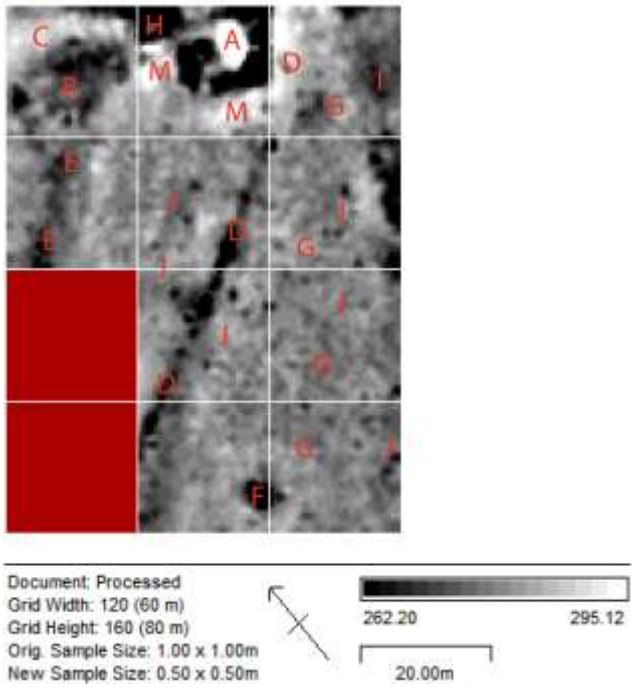
3.1.2 The raw (unprocessed) data and the final processed data are shown together for comparison. The lowest reading recorded was 185.86 ohms. The highest reading was 304.93 ohms and the average reading was 277.7 ohms. The highest readings are therefore shown in the image as white features of high resistance and black as low resistance features, with levels of grey in between.

Figure 1 – Showing Unprocessed and Processed Data

Raw Data



Processed Data



The processed results overlaid onto the site grid can be seen in Figure 5 and labelled in Figure 8. The top middle grid shows a central area of high resistance (labelled A), surrounded by an irregular area of low resistance and outside of this, discreet areas of high resistance (labelled M). In the next grid to the left there is an area of lower resistance (labelled B) forming a series of irregular anomalies, bounded to the rear by high resistance (labelled C). To the far right is an area of low resistance similar to 'B' (labelled I). From the top of the right upper most grid is a low resistance linear (labelled D) running down across the grid and southwards across the survey area to the lower left. From the western uppermost grid, a further low resistance linear (labelled E) appears to run to the front of 'B'. There is a large depression (labelled F) at the southern end of the field with a number of discreet linears running left to right across the survey area (labelled G). Between areas A and C, is a further discreet area of low resistance (labelled H). There are also numerous, discreet, low resistance, sub-circular features (labelled J) across the survey area. Many of the less prominent features across the survey area are masked by the close surface geology or larger areas of much higher and lower resistance as described above.

4 Interpretation

4.1.1 Discussion

The interpreted results overlaid onto the survey area can be seen in Figures 6, 7 and 8.The kite aerial photographic results can be seen in Figure 9.

The area to the south-west of the survey area has thin topsoil straight onto the geology, creating contact resistance problems. The geology is dominant across this area and is evident in the image. The high and low resistance anomalies within the topmost middle grid (labelled A), dominates the grid, affecting the surrounding grids and therefore masking any weak archaeological features. The area on the ground is formed of well-manicured pasture leading up a gradient onto more rough ground forming the southern part of the mound to the chapel site. The rough grassed area has been affected by animal burrows and has been disturbed at some previous time, possibly through soil

removal and build up to form the sloping bank of the terrace. The major disturbance (labelled A) can be seen as an area of scarring in the kite aerial photographs (Figure 9). There is an area of discreet low resistance to the top left of this grid (labelled H) again reflecting the bottom of the sloping bank. Just below this to the right, is an irregular shaped low area of resistance (labelled B). This can also be seen as an area of disturbance due to human intervention or could be geological in nature. To the immediate front of this feature is a curvilinear running downwards (labelled E). This appears to be part of the geology following the natural slope of the land. On the top of this slope and joining across to the far right (labelled I), appears (as seen in the aerial images) to be either a terrace or enclosure around this part of the field. The area of higher resistance (labelled C) runs around the rear of the depression (labelled B) and is probably the natural geology caused by the slope of the hill. This could also be where people have constantly walked across the front of the mound causing the ground to become more compact and creating a high resistance feature. The areas of low resistance to the far right (labelled I) reflect the lower side of the terrace/enclosure, leading to the area where the dove cot is located. The earth resistance survey did not record any ditches associated with the east-west running linear (labelled G) features, which can be seen in the aerial photographs (Figures 9-11). These could be suggested as forming cultivation terraces as part of a garden feature or monastic complex. The possible enclosure just below the chapel mound could be from a much earlier period of occupation, with graves interred within its confines.

The area of disturbance (labelled A and B) described above could otherwise be where a military post was placed. The positioning of a military post on the lower blind side of the hill would not prove effective in repelling or locating enemy approaching from the east. The military post may not have been defensive and could have functioned within a larger military complex.

A linear (labelled D) runs from the bottom corner of the far right most grid and can be see exiting the lower left. This linear reflects the course of an old path running west from the chapel site and across the site. It is not very clear on the ground, but visible in the aerial images.

The large depression (labelled F) can easily be identified on the ground and was observed in the earth resistance results. The feature also has a series of irregular-shaped depressions (labelled K) running to the south-west around the back of the feature. These could be extraction pits or of some other nature. The large depression was first thought to be a large tree bowl, but it also gives the impression of an artillery emplacement due to its size and nature. Again, these could be disturbed funerary features from an earlier period. The pits further south-west in the field were not surveyed due to the close surface geology and trying to record valid data was impossible without compromising the rest of the survey data.

There is a further strange feature in the ground that is difficult to see on the ground but is readily seen in the kite aerial photographs (Figures 10 and 11) as a 'W' shape (labelled L). This could be identified as representing some form of defensive element, but it was not recorded by the earth resistance meter due to its lack of depth and surrounding contrast. These features together could represent wartime defences (Cromwellian or later), with the large depression seen as an artillery or pill box emplacement.

The number of low resistance anomalies across the site that could be identified as pits (labelled J) are probably the remains of numerous animal burrows and these can be encountered across the site.

Any information about the existence of local wartime defences on Castle Hill has been difficult to obtain. Discussions with the local inhabitants relating to memories of any wartime defences on the field area have proven to be inconclusive. A further map and photographic archive study was carried out during the periods of 1940 to 1950, but was again inconclusive.

In conclusion, the area has been identified as possibly having enclosures, funerary features, cultivation terraces and the remains of possible military defences, making this a very interesting multi-period site with exciting archaeological potential.

5 Recommendations

5.1.1 Overall the earth resistance survey proved problematic due to the nature of the geology and a further programme of survey works will be proposed, with permission sought in the future, employing a gradiometer to delineate some of the less prominent features.

6 References

Bibliographical References

Low, A (1946b) Burials near Blackness Castle. *Proc Soc Antiquity Scotland* **79**, 174.

RCAHMS (1978b) The Royal Commission on the Ancient and Historical Monuments of Scotland. The archaeological sites and monuments of Clackmannan District and Falkirk District, Central Region, The archaeological sites and monuments of Scotland series no 1 Edinburgh **11**, 18. Held at RCAHMS A.1.2.ARC(1)

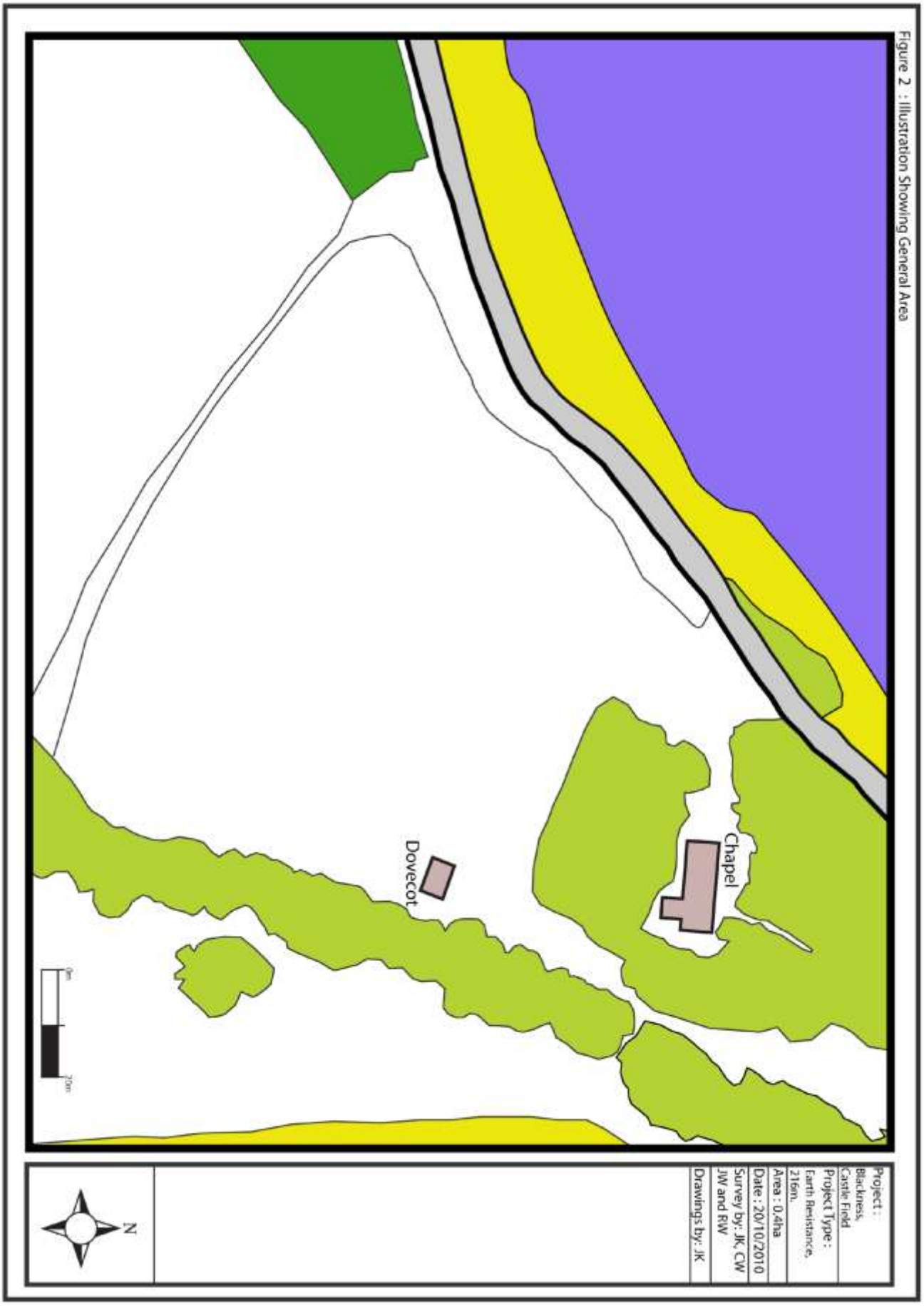
Ross, A (1967) Pagan Celtic Britain, London.

Snuffler : Geophysical Software (http://sussexarch.org.uk/geophys/snuffler.html)

Cartographic References

http://www.bgs.ac.uk/education/geology_of_britain/home.html

7 Illustrative Figures



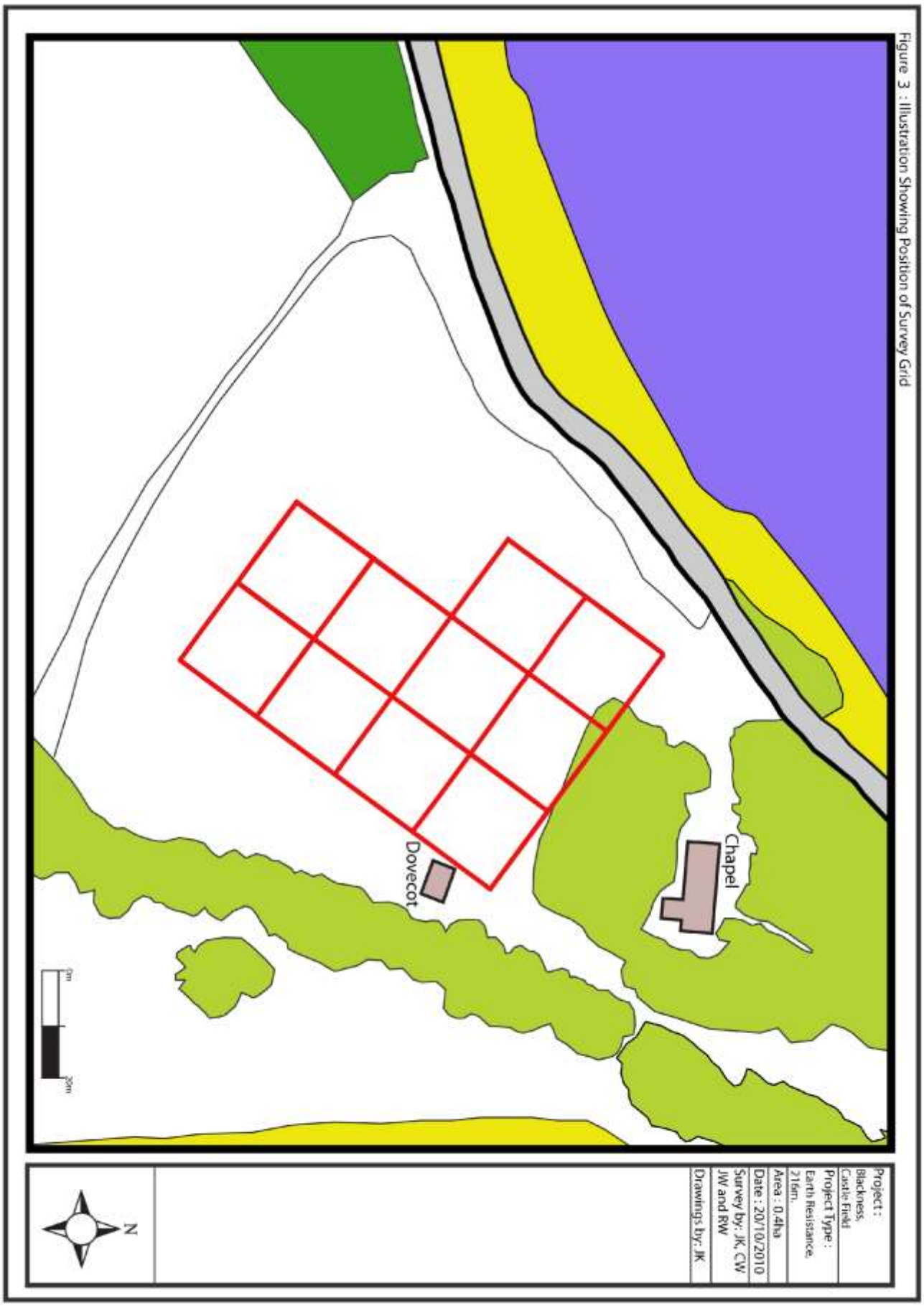


Figure 3 : Illustration Showing Position of Survey Grid

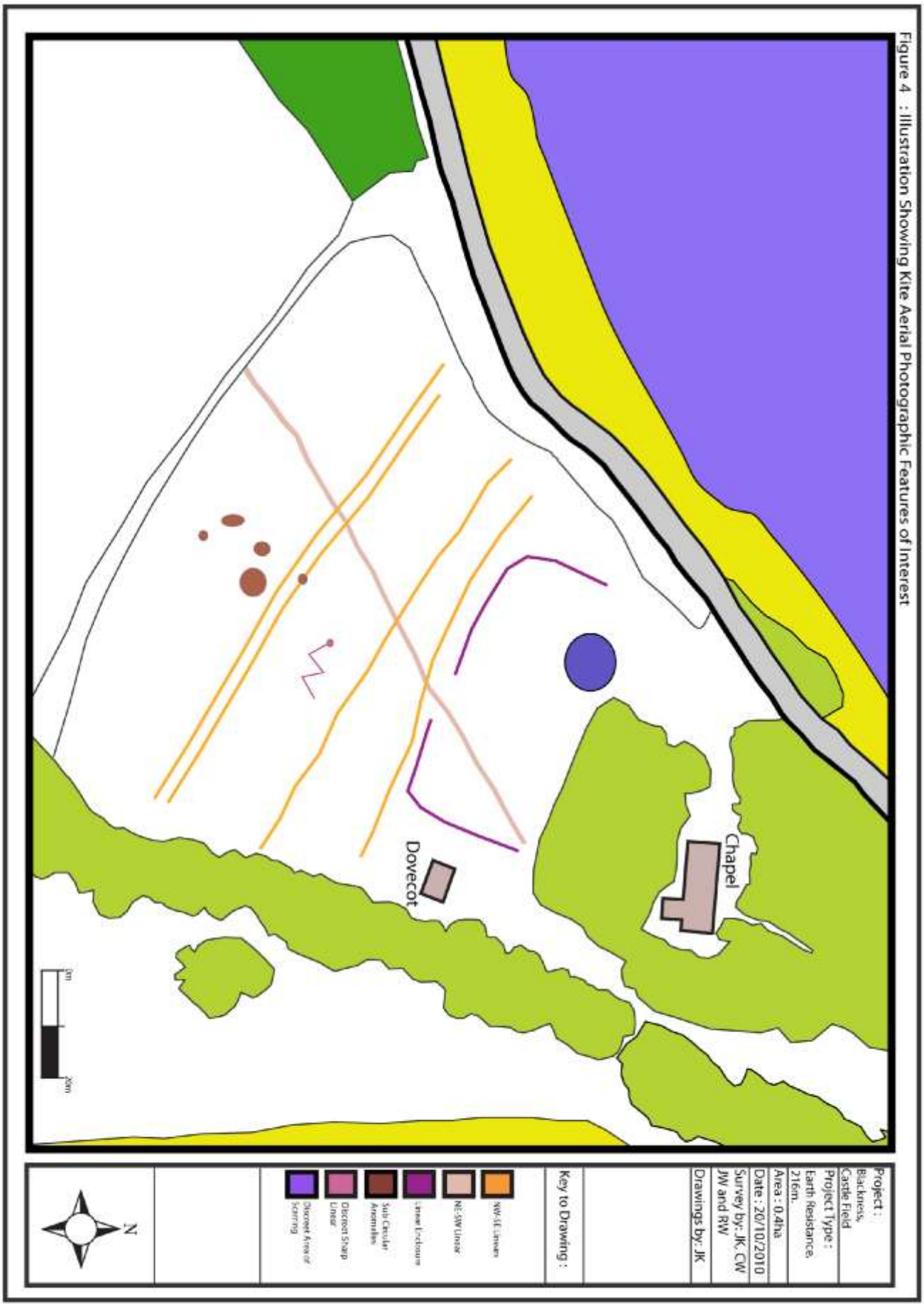


Figure 4 : Illustration Showing Kite Aerial Photographic Features of Interest

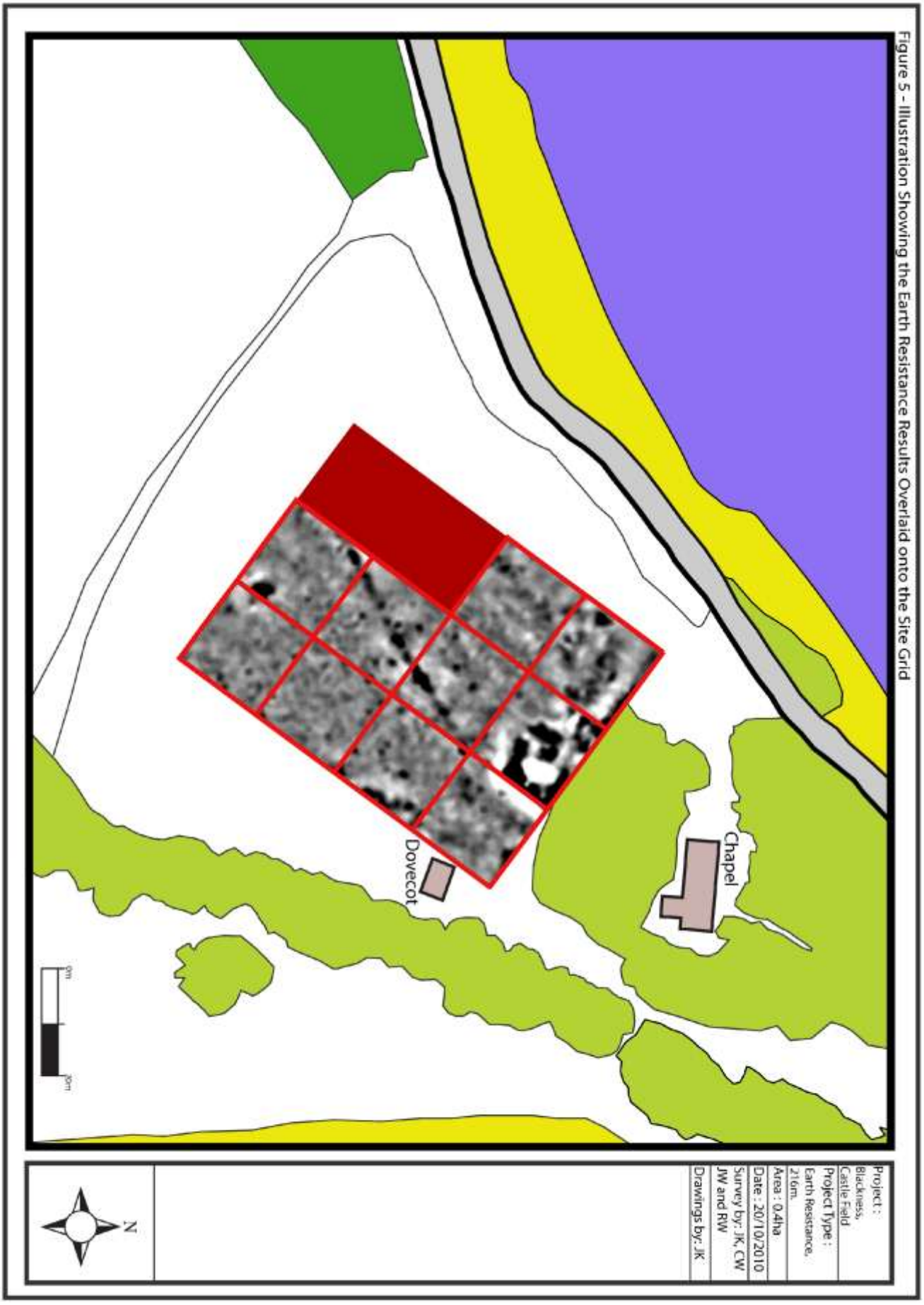


Figure 5 – Illustration Showing the Earth Resistance Results Overlaid onto the Site Grid

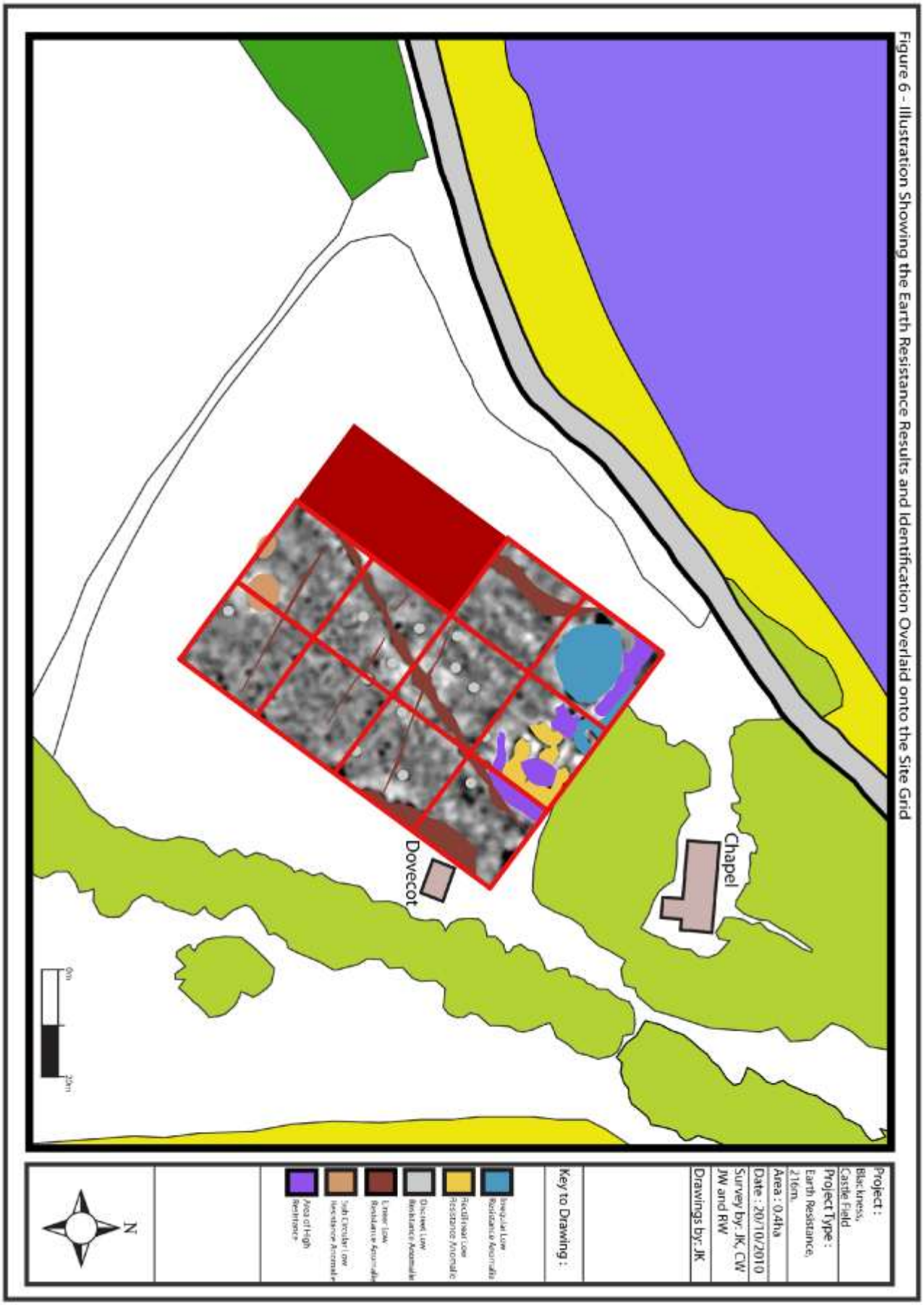


Figure 6 - Illustration Showing the Earth Resistance Results and Identification Overlaid onto the Site Grid

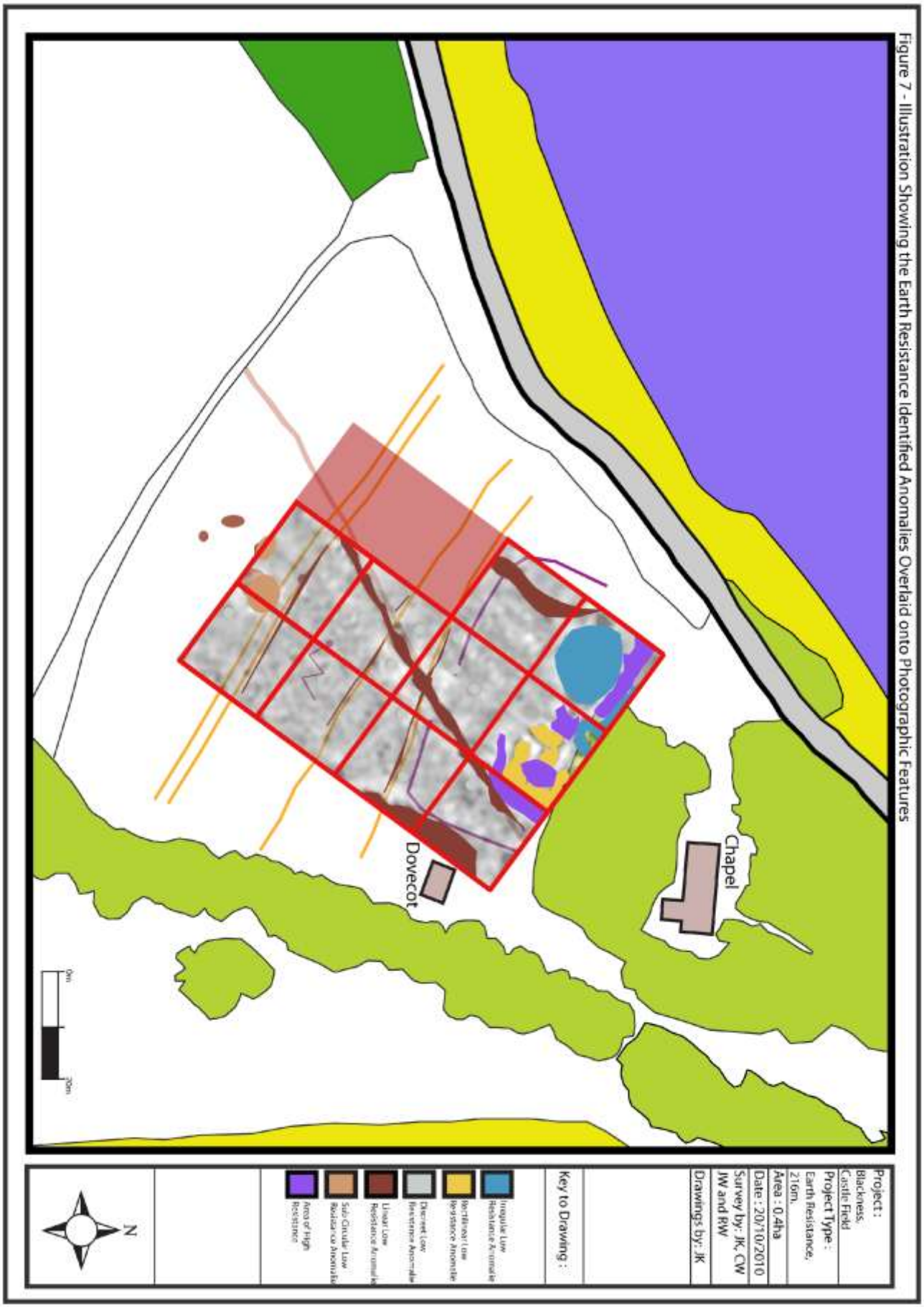


Figure 7 - Illustration Showing the Earth Resistance Identified Anomalies Overlaid onto Photographic Features

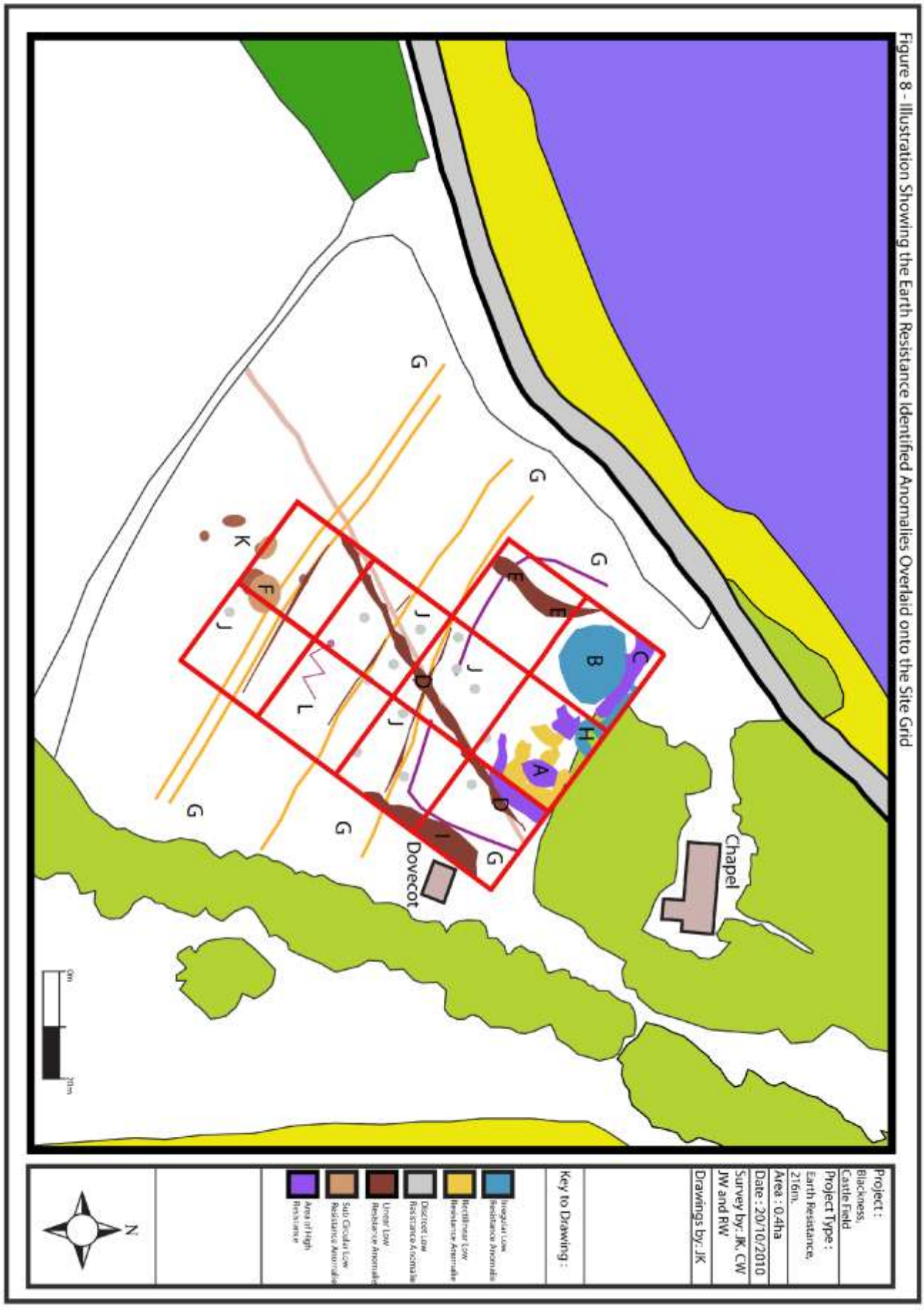
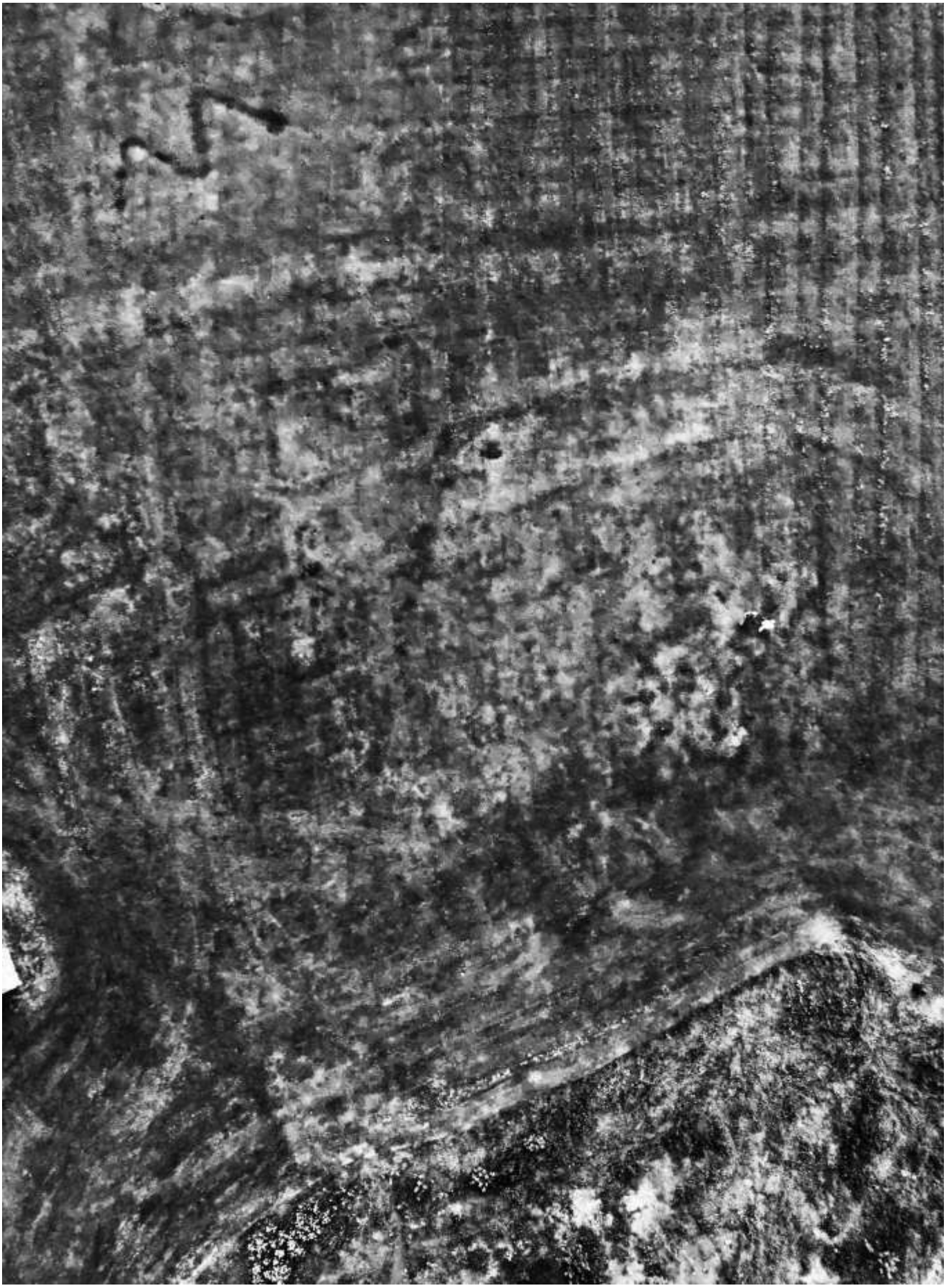


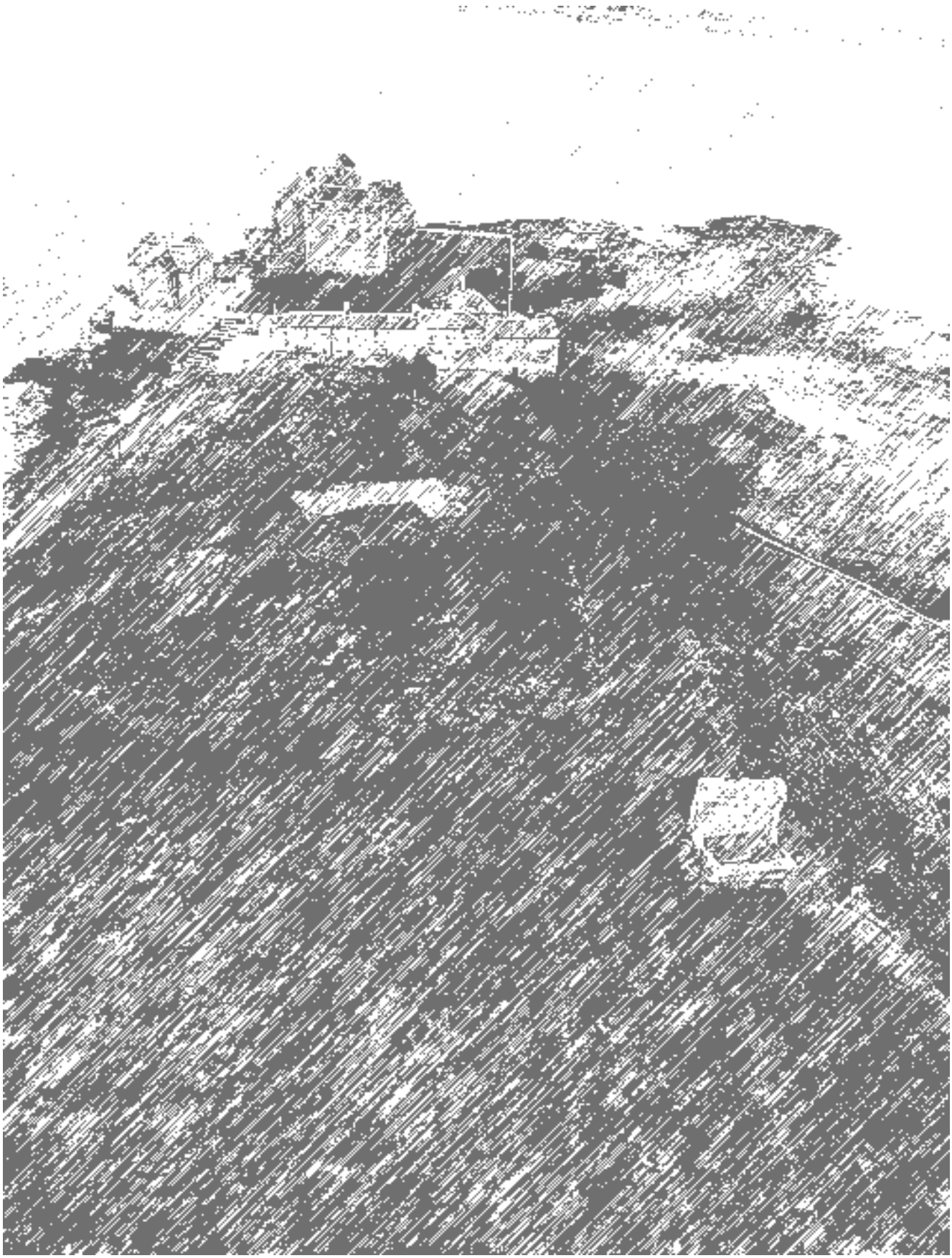
Figure 8 - Illustration Showing the Earth Resistance Identified Anomalies Overlaid onto the Site Grid

Figure 9 – Image (Visible Spectrum) of the View to the WSW Showing Enclosure and Scarred Features

Figure 10 – Image (Visible Spectrum) of the View to the NW Showing Depression, Pits and 'W' Feature

Figure 11 - Image (Visible Spectrum) of the View Overhead Showing the Central Area of the Site





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