Na Clachan Aoraidh 'Four Poster'

Topographic and Geophysical Survey Report

AOC 21977

27th January 2012

AOC Archaeology Group

ARCHAEOLOGY | HERITAGE | CONSERVATION

Na Clachan Aoraidh 'Four Poster' Stone Circle

Topographic and Geophysical Survey Report

On Behalf of:	**Forestry Commission Scotland** **Inverness Business and Retail Park** **1 Highlander Way** **Inverness**
National Grid Reference (NGR):	**NN 838 620**
AOC Project No:	**21977**
Prepared by:	**Graeme Cavers** **Duncan Hale**
Illustration by:	**Graeme Cavers** **Gemma Hudson** **Tony Liddell**
Date of Fieldwork:	**Geophysics: 29/11/11 to 30/11/11** **Topographic Survey: 17/1/12**
Date of Report:	**27th January 2012**

This document has been prepared in accordance with AOC standard operating procedures.	
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Draft/Final Report Stage:	**Date:**

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Abstract

A laser scan survey and geophysical prospection, involving resistivity and magnetometry was undertaken at Na Clachan Aoriadh 'four poster' stone circle on behalf of Forestry Commission Scotland. The geophysical results indicate the presence of significant buried archaeology extending beyond the visible remains. The results of the 3D survey above ground were integrated with the geophysical results to produce a 3D visualisation of all elements of the site.

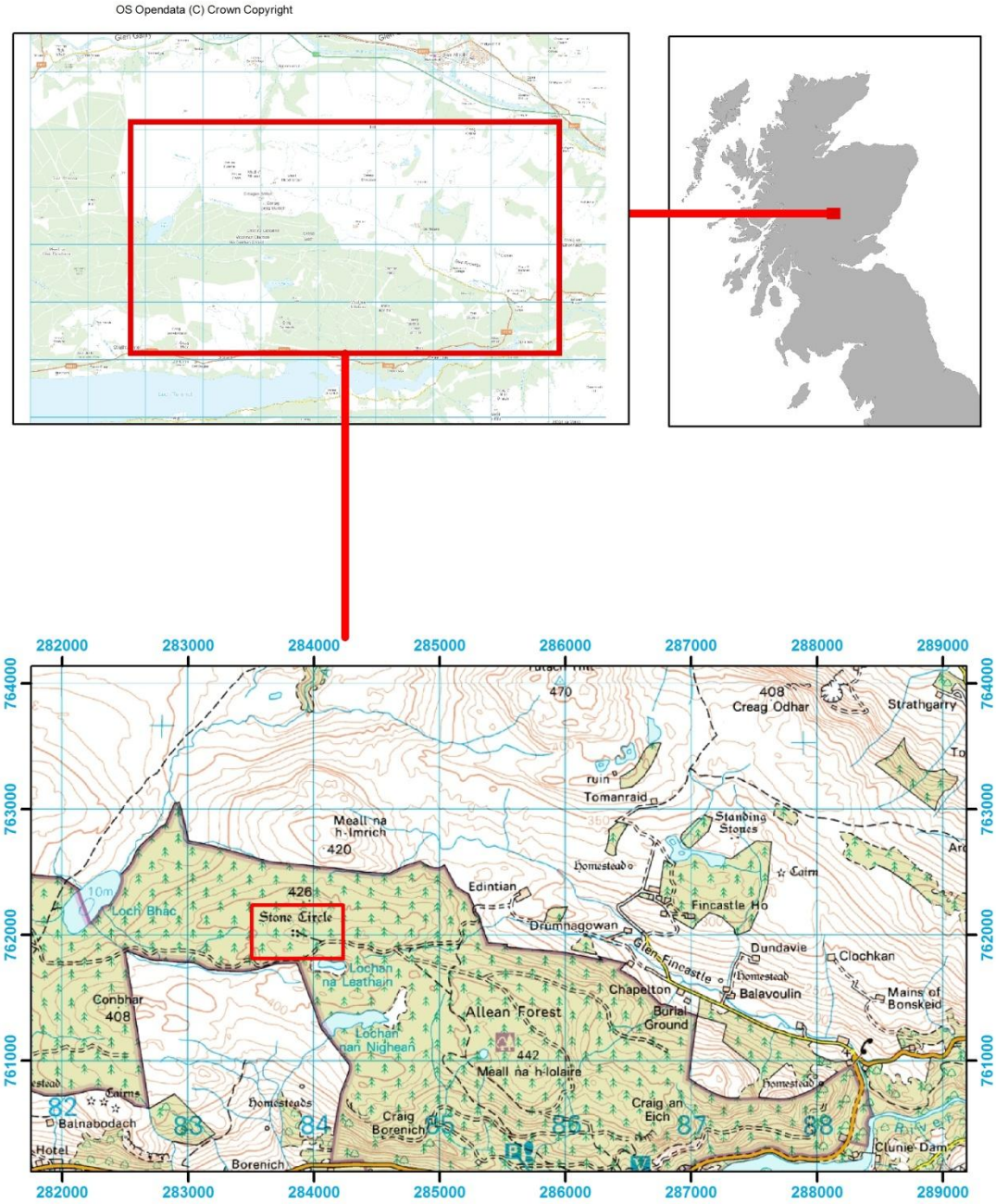

FIGURE 1: Location of Na Clachan Aoraidh

Na Clachan Aoraidh Stone Circle

Topographic Survey

1.0 Na Clachan Aoraidh

1.1 'Na Clachan Aoraidh' is the name given to the small 'four poster' stone circle located on near Edintian Farm, north of Loch Tummel in Perthshire (Figure 1; NGR: NN 8386 6200; NMRS No.: NN86SW 3). The name translates as 'Stones of Worship' (Watson 1915:20), although the location has also been known as 'Na Carraigean' (Coles 1908:106). The site attracted the attention of Coles (1908) during his survey of stone circles in Perthshire, and that of Watson (1915), who was primarily concerned with the later prehistoric settlements of the area. The site drew the attention of both for its dramatic location, situated on a prominent ridge with dramatic views over the Perthshire mountains. Coles remarked that at this location 'site, scenery, megalithic remains and location all combine to render the investigation of this group especially interesting' (1915:106). There can be little doubt that the panoramic views commanded by the site were indeed central to the builders' choice of location.

1.2 The site is considered to be a 'four poster' stone circle; that is a quadrilateral arrangement formed by four large orthostats, generally dating to the later Neolithic and early Bronze Age period. There is a particularly dense concentration of such sites in northern Perthshire, with examples scattered through the Tay, Earn and Tummel valleys.

1.0 Earlier Surveys

1.2 The site was surveyed by both Coles and Watson (see figures 2 to 5). The current survey constitutes the first modern detailed archaeological survey, however.

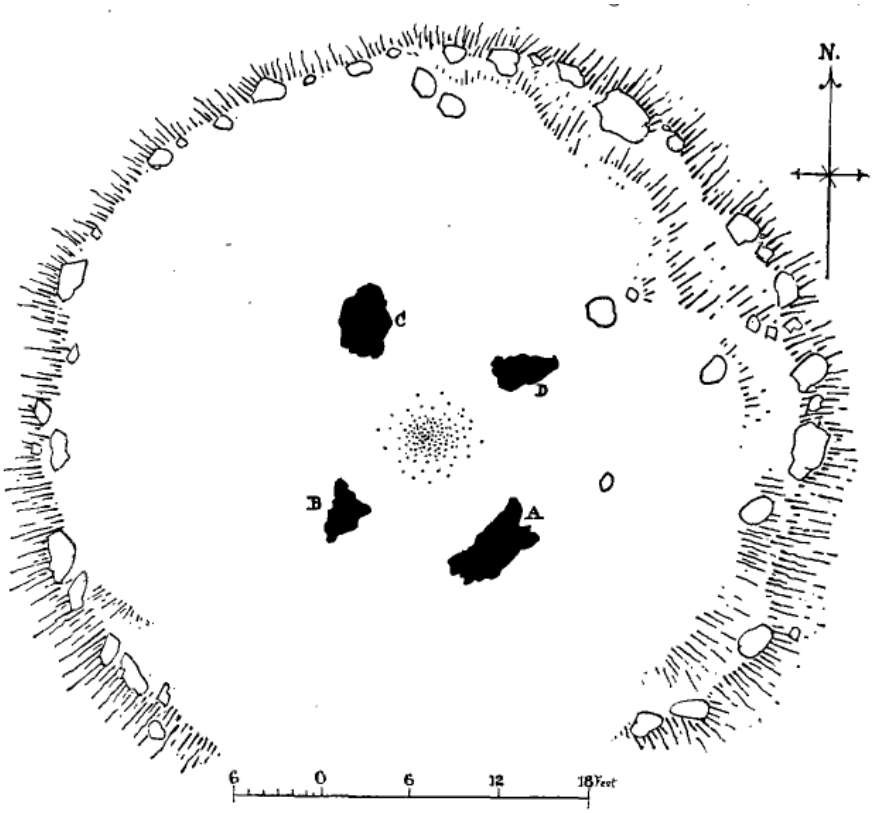

Fig. 12. "Na Carraigean," Edintian ; general Ground-plan.

Figure 2: Plan of the site made by Coles (1908:106).

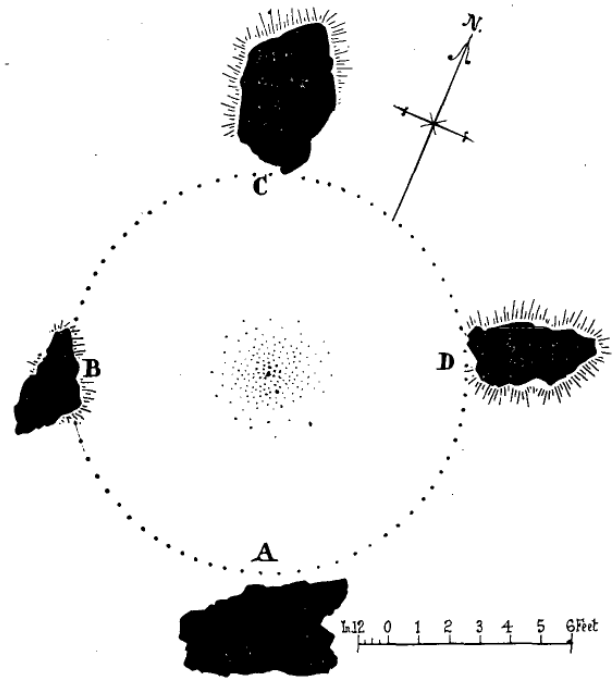

Fig. 13. "Na Carraigean," Edintian ; Ground-plan.

Figure 3: Detail of the ground plan, made by Coles (1908:108).

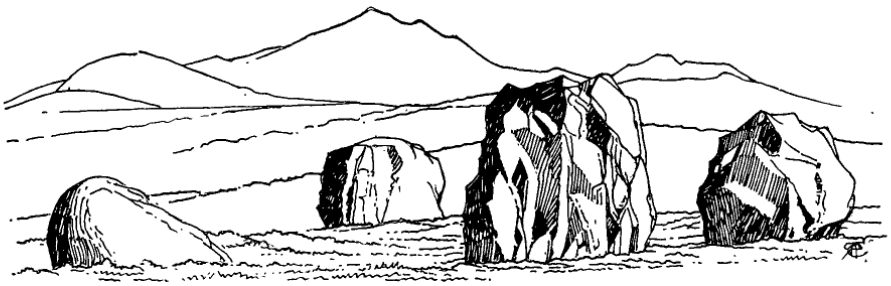

Fig. 14. "Na Carraigean," Circle at Edintian ; View from the West.

Fig. 15. "Na Carraigean," Circle at Edintian ; View from the East.

Figure 4: Views of the site published by Coles (1908:109).

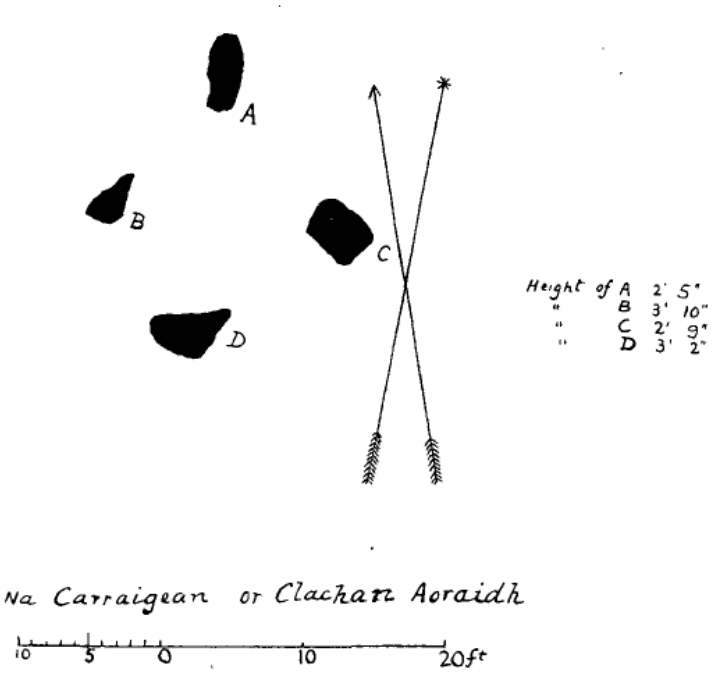

Figure 5: Plan of the stones published by Watson (1915:19).

3.0 Laser scan survey

Objective

3.1 The topographic survey aimed to produce a detailed 3-dimensional record of the stone circle and its immediate environment. The products of the 3D survey were designed in a format designed to allow the integration of the gephysical results and visualisation in 3D.

Methods Statement

3.2 The survey was carried out using a Faro Focus 3D laser scanner, controlled using a Trimble S3 total station. Given the dense coverage of heather on the site, the total station was used to produce a ground surface elevation model, reaching areas that could not be seen by the scanner. A point cloud of the site and surrounding topography was produced containing 280 million measurements- the data was registered in Faro Scene and edited in Trimble Realworks. The raw pointcloud was processed to detailed geometric meshes using Trimble Realworks. 3D visualisations of the site were produced using Blender 2.5 to integrate the geophysical and topographic data. 3D views and animated flythroughs were produced to assist in the interpretation of the combined datasets (see section 2).

Dates

3.3 The topographic survey was carried out on 17th January 2012.

Personnel

3.4 The topogrphic survey was carried out by Graeme Cavers and Jake Streatdfeild-James.

OASIS

3.5 An OASIS entry has been created for the topographic survey, linked to that created for the geophysical survey. AOC Archaeology Group's OASIS ID is for this project is **aocarcha1-118614.**

4.0 Description of the site

4.1 The site is generally as described by previous surveyors. The most visible element of the site are the four large orthostats of the local schist. Only the south-western one of these stands upright to a height of 1.05m, the rest have fallen outward at varying angles. The four stones form a square approximately 3.2m by 3.6m, and stand upon a raised platform of cairn material which is sub-circular in plan, measuring 8.85m SW/NE by 14.0m SE/NW. Th cairn rises above the surrounding terrain by 0.92m, and contains a shallow depression in the centre of the four stones: this has been interpreted by previous surveyors as the result of excavation in relatively recent times.

4.2 Coles depicts the cairn beneath the stones as delimited by a distinct kerb, although he notes that this was very overgrown by heather. At the time of the current survey, only three kerb stones were visible, on the S side of the site. No further features of the site are visible above ground.

5.0 Condition

5.1 The site is generally in good condition, with few obvious imminent threats to its integrity. Tree growth has been managed, although there are several stumps on and close to the site. Some evidence for animal burrowing was seen, including rabbit burrows and mole hills, although these do not seem to be eroding the site to a significant extent.

Geophysical Survey

6.0 Objective

6.1 The principal aim of the surveys was to detect and map any sub-surface features associated with the stone circle, in order to broaden the understanding of the Na Clachan Aoraidh monument and to inform any further heritage management and conservation issues at the site.

Methods statement

6.2 The surveys have been undertaken in accordance with instructions from the client and to current national standards and guidance (see para. 5.1 below).

6.3 Since the survey was within a Scheduled Monument the surveys were undertaken in accordance with a licence granted by Historic Scotland under Section 42 of the Ancient Monuments and Archaeological Areas Act 1979.

Dates

6.4 Fieldwork was undertaken on the 29th and 30th November 2011. This report was prepared for 12th December 2011.

Personnel

6.5 Fieldwork was conducted by Tony Liddell and Richie Villis (Supervisor). The geophysical data were processed by Richie Villis. This report was prepared by Richie Villis and Duncan Hale, the Project Manager, with illustrations by Tony Liddell.

Archive/OASIS

6.6 The site code is **NCA11**, for **N**a **C**lachan **A**oraidh 20**11**. 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 **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-115344**.

7. Landuse, topography and geology

7.1 At the time of survey the area comprised moorland with heather and former tree planting. The site was under snow at the time of survey.

7.2 The area was predominantly level with a mean elevation of approximately 420m OD.

7.3 The underlying solid geology of the area comprises Neoprotozoic metalimestone strata of the Blair Atholl Dark Limestone and Dark Schist Formation.

8. Geophysical survey

Standards

8.1 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 *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

8.2 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.

8.3 In this instance, it was considered likely that cut features such as stone-holes, post-holes, ditches and pits might be present on the site, and that other types of feature such as stone or timber burial chambers (for example cists), trackways, wall foundations and fired structures (for example cremations, kilns and hearths) might also be present.

8.4 Given the anticipated depth and nature of targets and the geological environment of the study area, two complimentary techniques were considered appropriate in this instance: fluxgate gradiometry and earth electrical resistance survey.

8.5 Fluxgate gradiometry involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field, which are caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect, for example, ferrous, stone, brick and soil-filled features. Electrical resistance survey is suitable for detecting stone features such as walls, paths and culverts, but can also detect soil-filled features, depending on ground conditions at the time of survey. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

Field methods

8.6 A 20m grid was established across the survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS15 global navigation satellite system (GNSS) with real time kinematic (RTK) correction typically providing accuracy of 10-15mm.

8.7 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 0.5m, thus providing 3,200 sample measurements per 20m grid unit.

8.8 Measurements of earth electrical resistance were determined using a Geoscan RM15D resistance meter 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 set to 0.1ohm, the sample interval was 0.5m and the traverse interval was 0.5m, thus providing 1,600 sample measurements per 20m grid unit.

8.9 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

8.10 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) 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/high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla for the geomagnetic data and ohm for the electrical resistance data.

8.11 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
destagger	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

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

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic

add adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges

despike 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

8.13 Colour-coded geophysical interpretation plans 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

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

high resistance regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble

low resistance regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

Interpretation: features

8.15 A colour-coded archaeological interpretation plan is provided.

8.16 A sub-circular, weak, positive magnetic anomaly, with stronger discrete positive magnetic anomalies along its length, has been detected encircling the standing stones. This corresponds to a similar band of anomalously high resistance. Given the strength of the discrete positive magnetic anomalies and the uncertain and variable magnetic characteristics of the local rock, these anomalies together almost certainly reflect the location of a stone kerb or revetment around the

edge of the platform on which the standing stones are set. It is understood that some kerbstones are visible under normal conditions, however, the site was under snow during the geophysical surveys.

8.17 Arcs of relatively low resistance have been detected just outside the presumed kerb. These may reflect the remains of a soil-filled ditch feature, possibly associated with the construction of the raised platform.

8.18 The four stones that make up the circle have been detected as high resistance anomalies, which may give an indication of the sub-surface extent of each stone.

8.19 Two small negative magnetic anomalies have been detected on the platform; these could reflect stone features or voids, such as cist burials. The high resistance data collected in this area also indicates the possibility of stone features or voids.

8.20 A positive magnetic and low resistance anomaly has been detected in the centre of the four stones. This may reflect a soil-filled feature, possibly the result of the back-filled antiquarian investigation.

8.21 A secondary, weak, sub-circular positive magnetic anomaly has been detected to the immediate west of the stone circle. This could reflect a soil-filled ditch feature.

8.22 A broadly north-west/south-east aligned magnetic and high resistance anomaly has been detected to the south of the stone circle. This could reflect the remains of a stone wall or dyke.

8.23 A rectilinear, negative magnetic anomaly has been detected to the east of the stone circle; this broadly corresponds to an area of high resistance data. These anomalies may reflect a concentration of stone.

8.24 An area of high resistance has been detected to the south of the stone circle, which could reflect an area with a high concentration of stone or free-draining soils. The broad, strong magnetic anomalies in this southern corner may also indicate near-surface bedrock.

8.25 Further areas of high resistance have been detected along the northern and western edges of the survey area. These anomalies may also reflect shallow bedrock; those along the northern side may reflect the former forestry track there or its shoulder.

9. Conclusions

9.1 High resolution geomagnetic and earth electrical resistance surveys were undertaken at Na Clachan Aoraidh four-poster stone circle near Blair Atholl in Perth & Kinross.

9.2 Several features associated with the stone circle have been identified, including a stone kerb/revetment at the edge of the raised platform; possible ring-ditches outside the platform; possible cist burials.

9.3 Other features haven also been detected, including a possible stone wall or dyke.

9.4 Features associated with former tree planting and probable near-surface geology have also been identified.

10. References

Coles, F.R. 1908 'Report on Stone Circles Surveyed in Perthsire: North Eastern Section; with measured plans and drawings', *Proceedings of the Society of Antiquaries of Scotland*, vol.42, pp.95-165

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

Watson, W.J. 1915 'Circular forts in Lorn and North Perthshire; with a note on the excavation of one at Borenich, Loch Tummel', *Proceedings of the Society of Antiquaries of Scotland,* vol.49, pp.17-32

Acknowledgements

AOC and Archaeological Services Durham University are grateful for the assistance of personnel of the Tay Forest District branch of the Forestry Commission Scotland for facilitating this scheme of works.

Na Clachan Aoriadh 'Four Poster' Stone Circle

Survey Report

Section 2: Site Surveys and Plates

AOC Archaeology Group

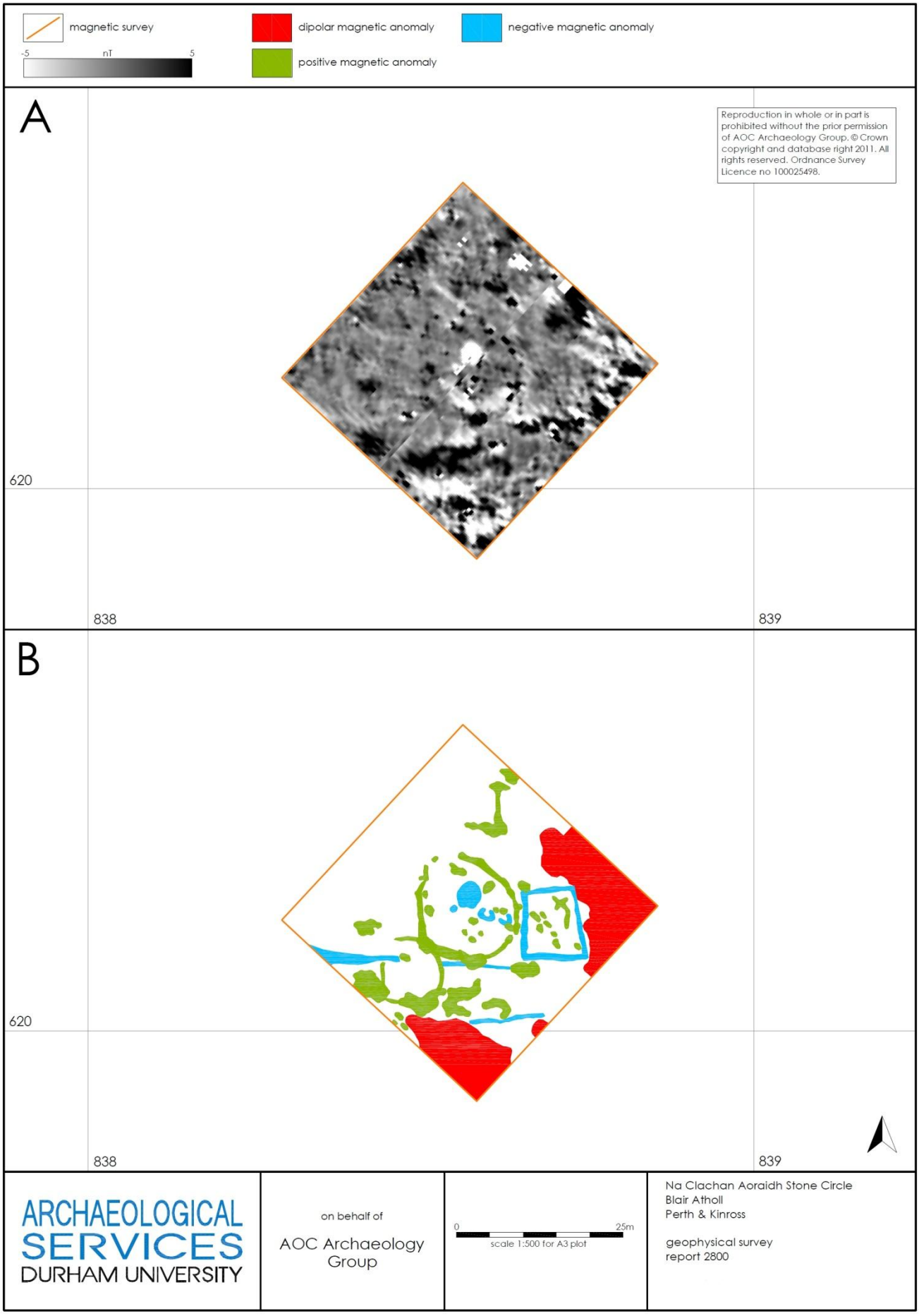

Figure 6: Geomagnetic survey and geophysical interpretation.

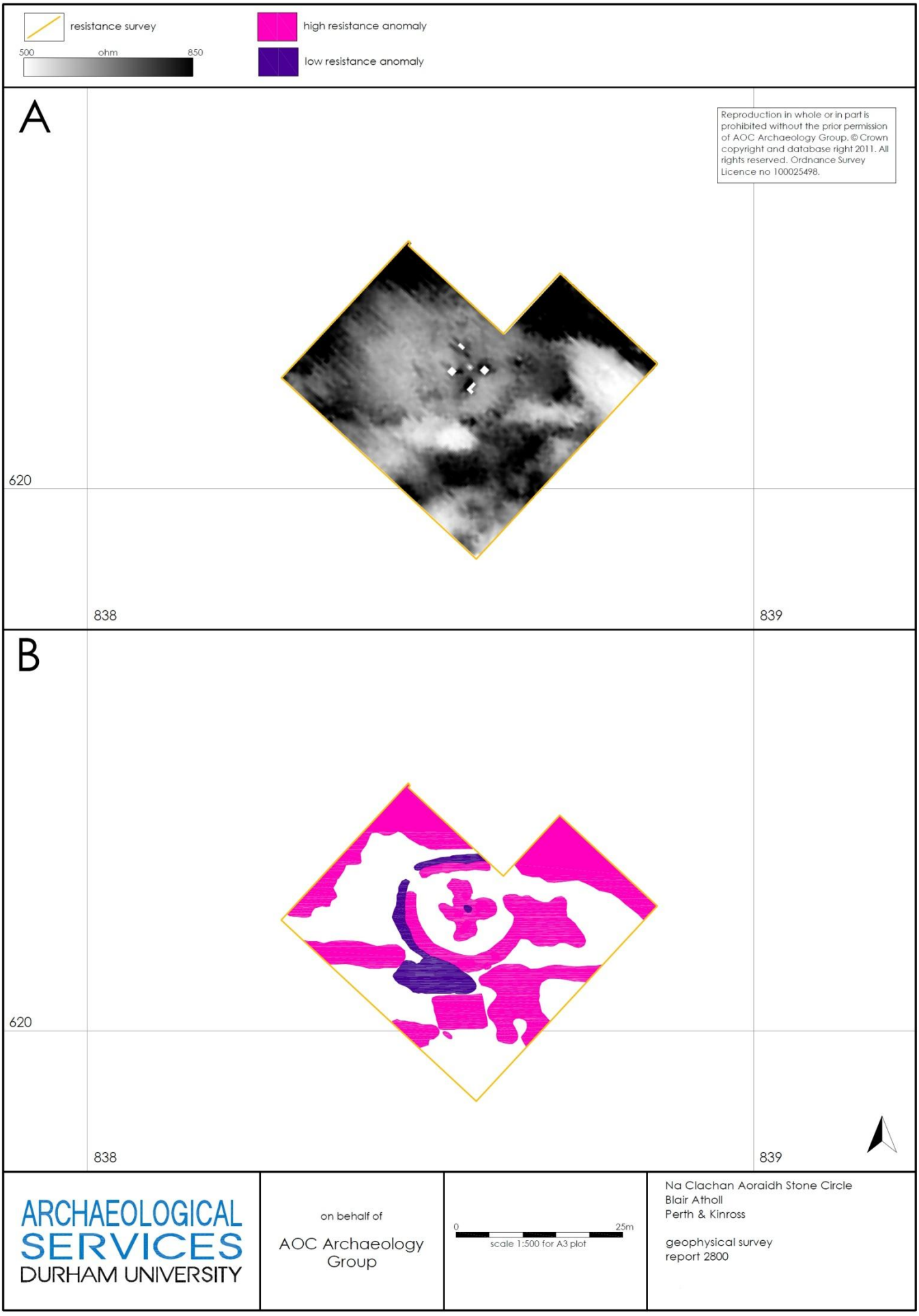

Figure 7: Resistance survey and geophysical interpretation.

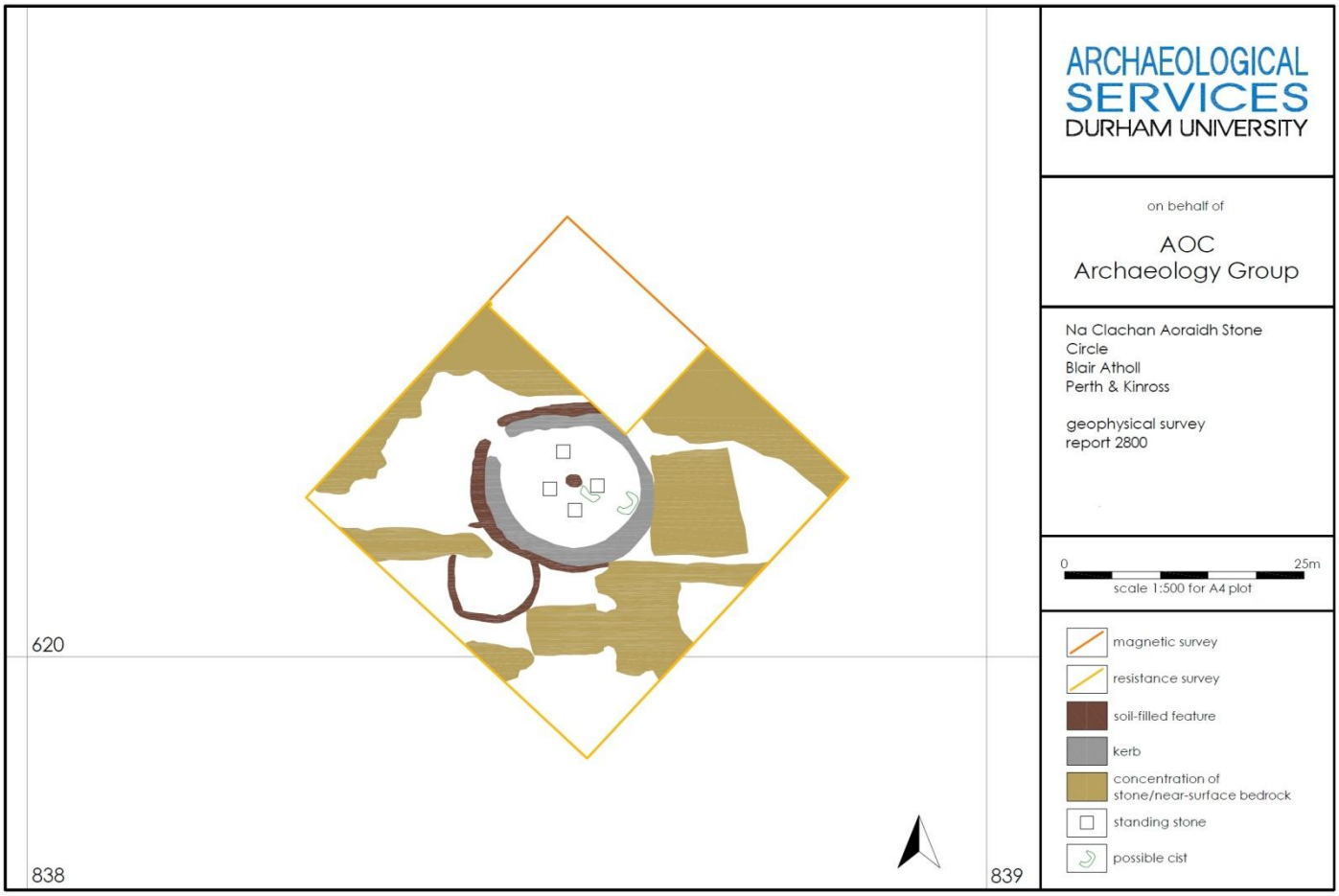

Figure 8: Archaeological interpretation of the geophysical results.

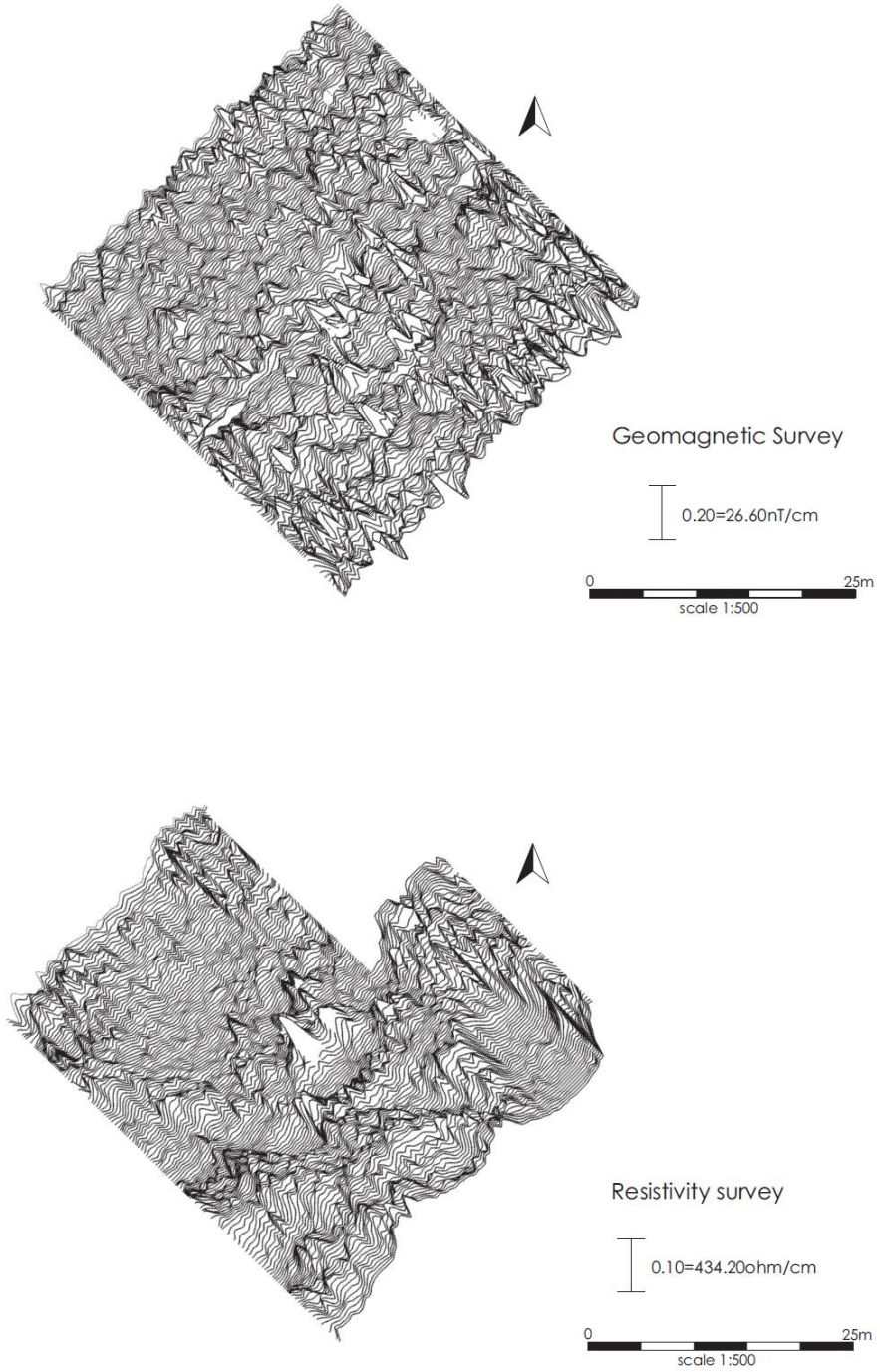

Figure 9: Trace plots of the geomagnetic (above) and resistivity data (below).

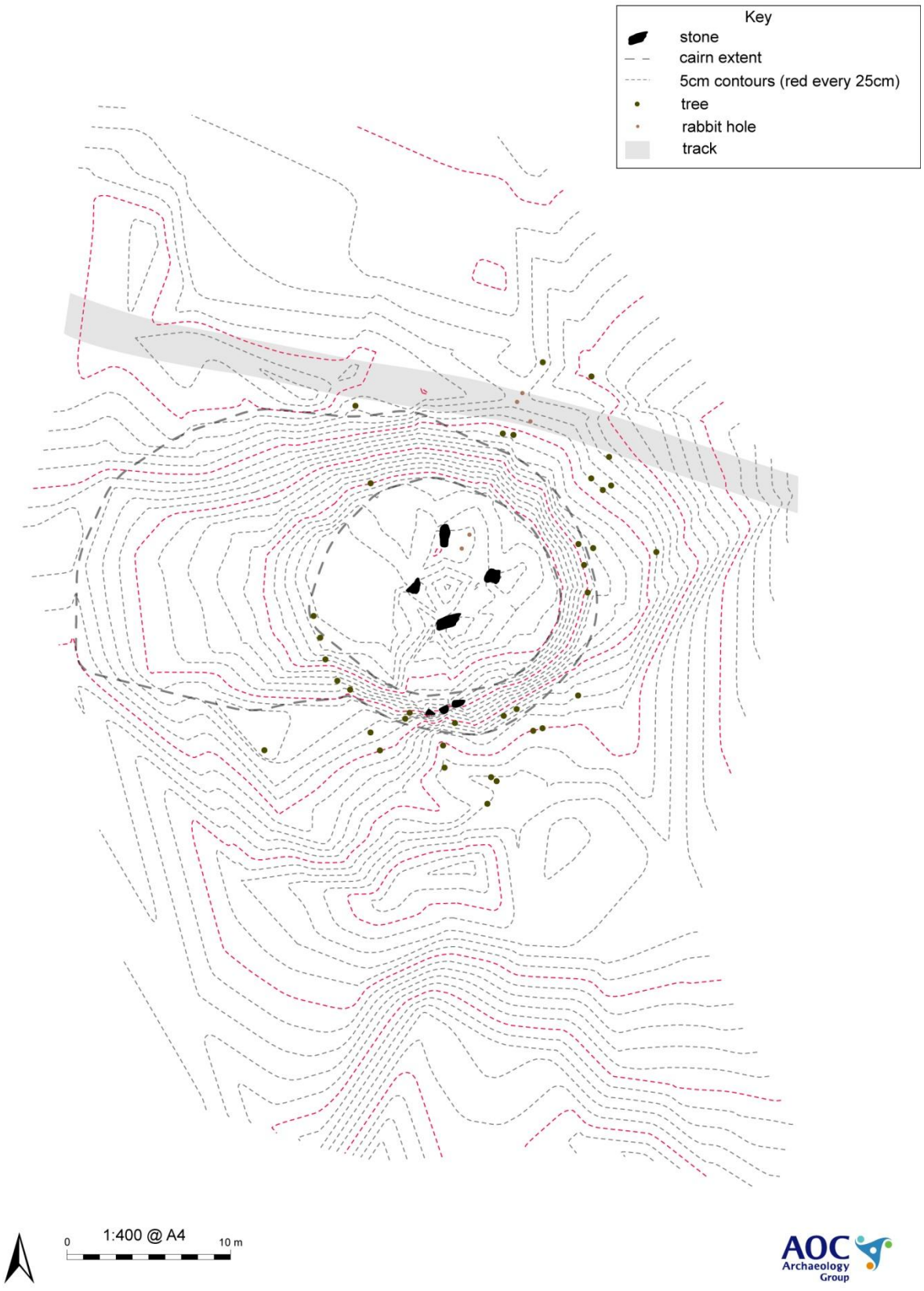

Figure 10: Condition survey of the site.

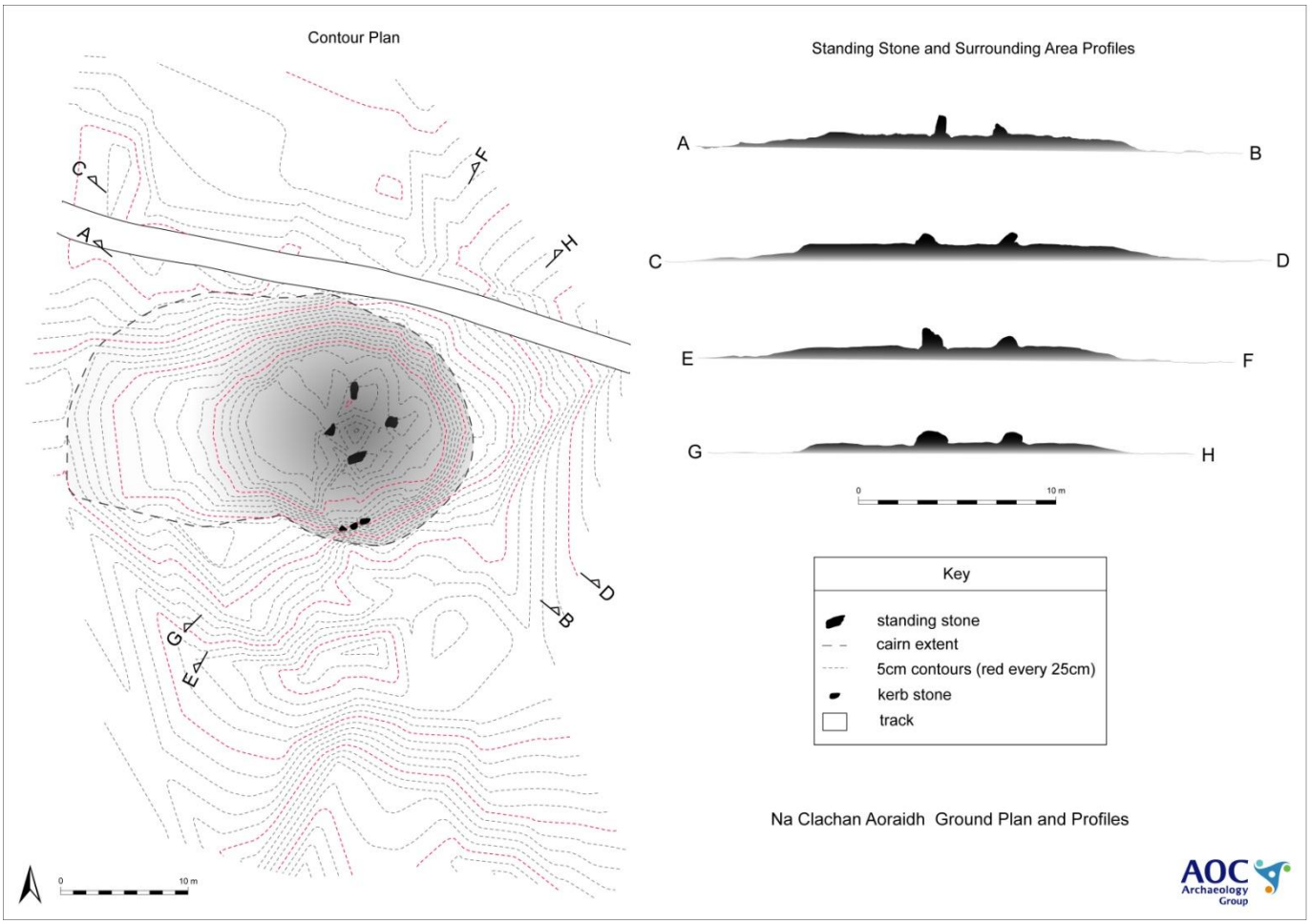

Figure 11: Topographic survey and profiles.

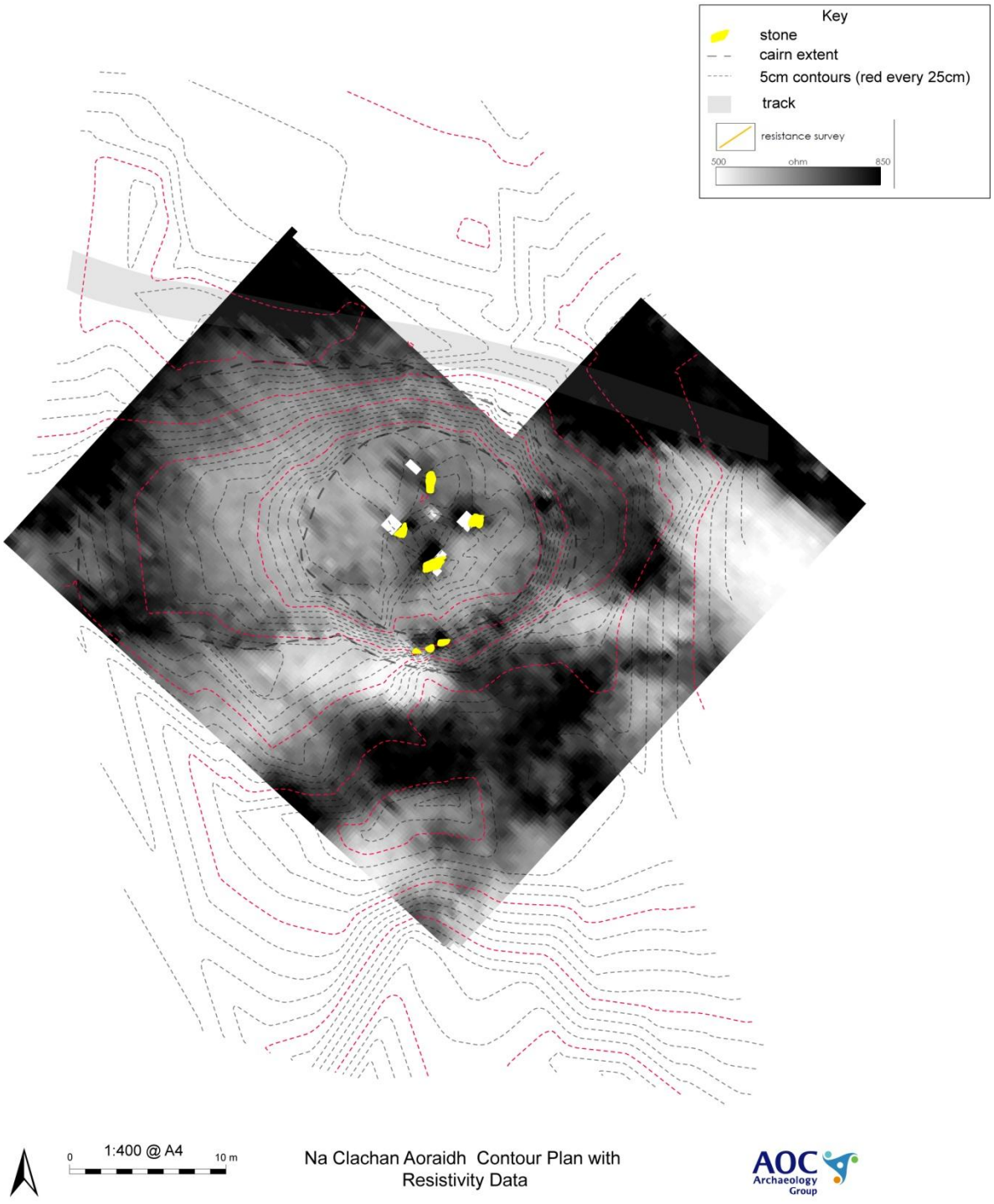

Figure 12: Topographic contours and resistivity data.

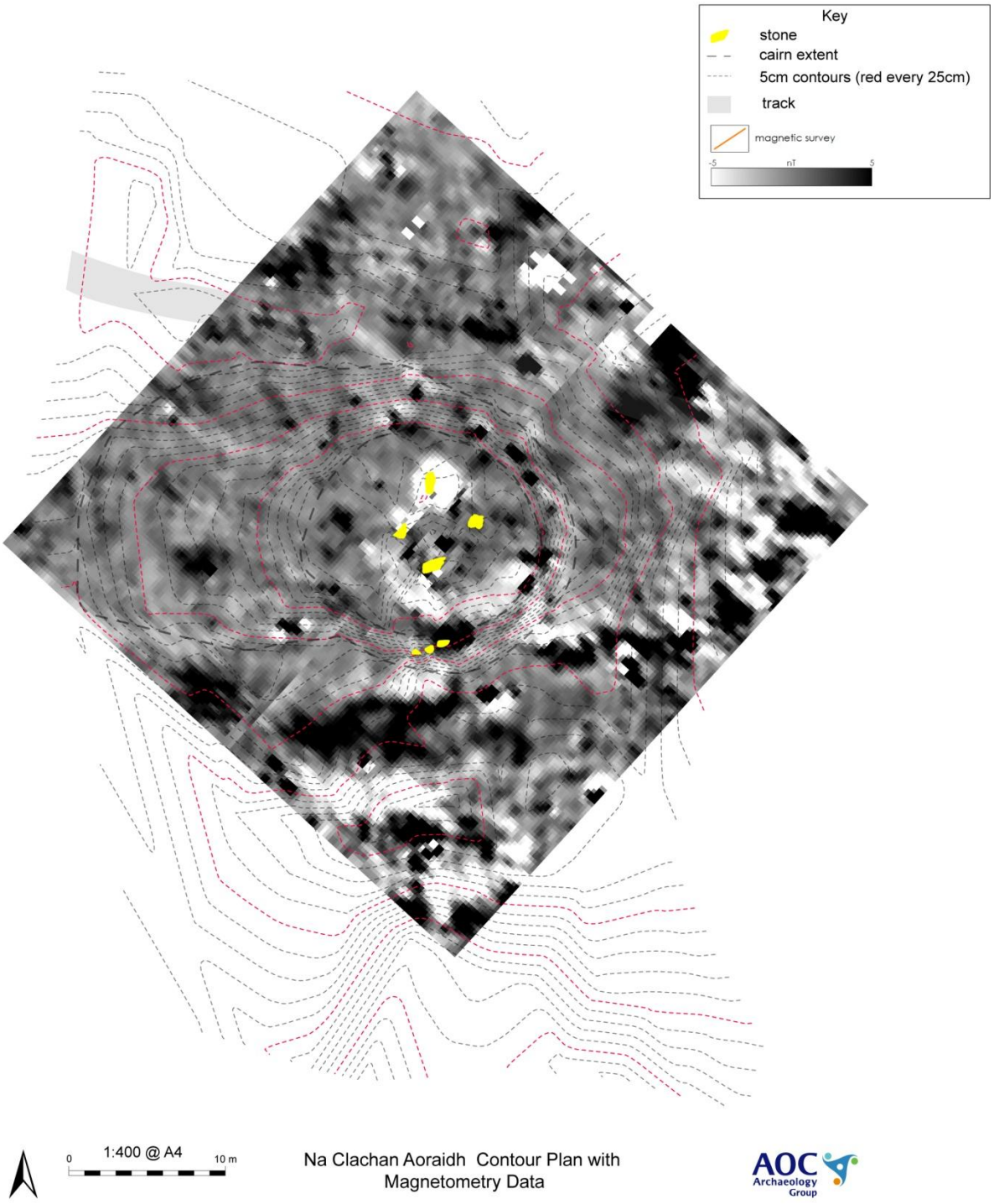

Figure 13: Topographic survey with geomagnetic data.

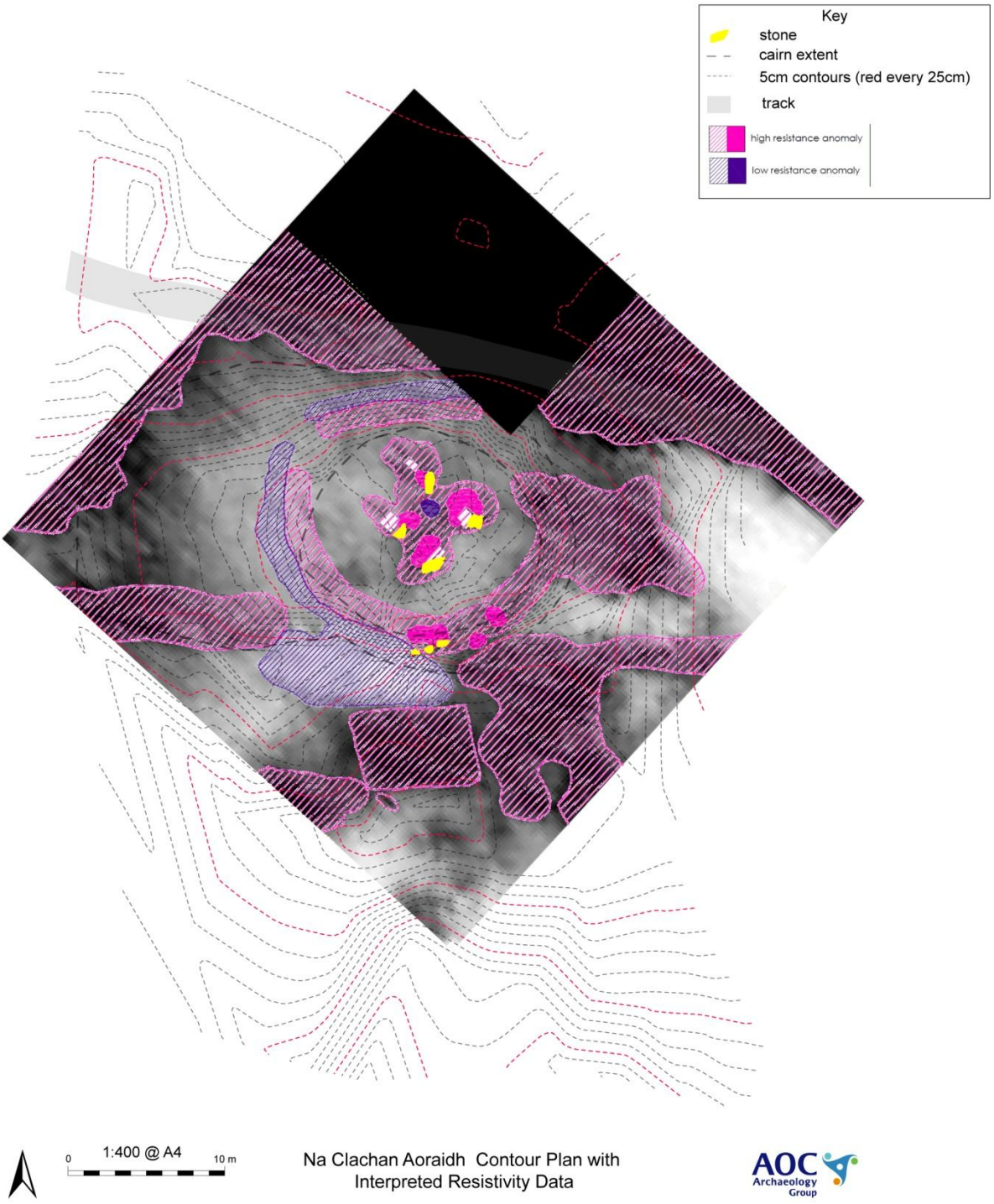

Figure 14: Topographic survey with interpreted results of the resistivity survey.

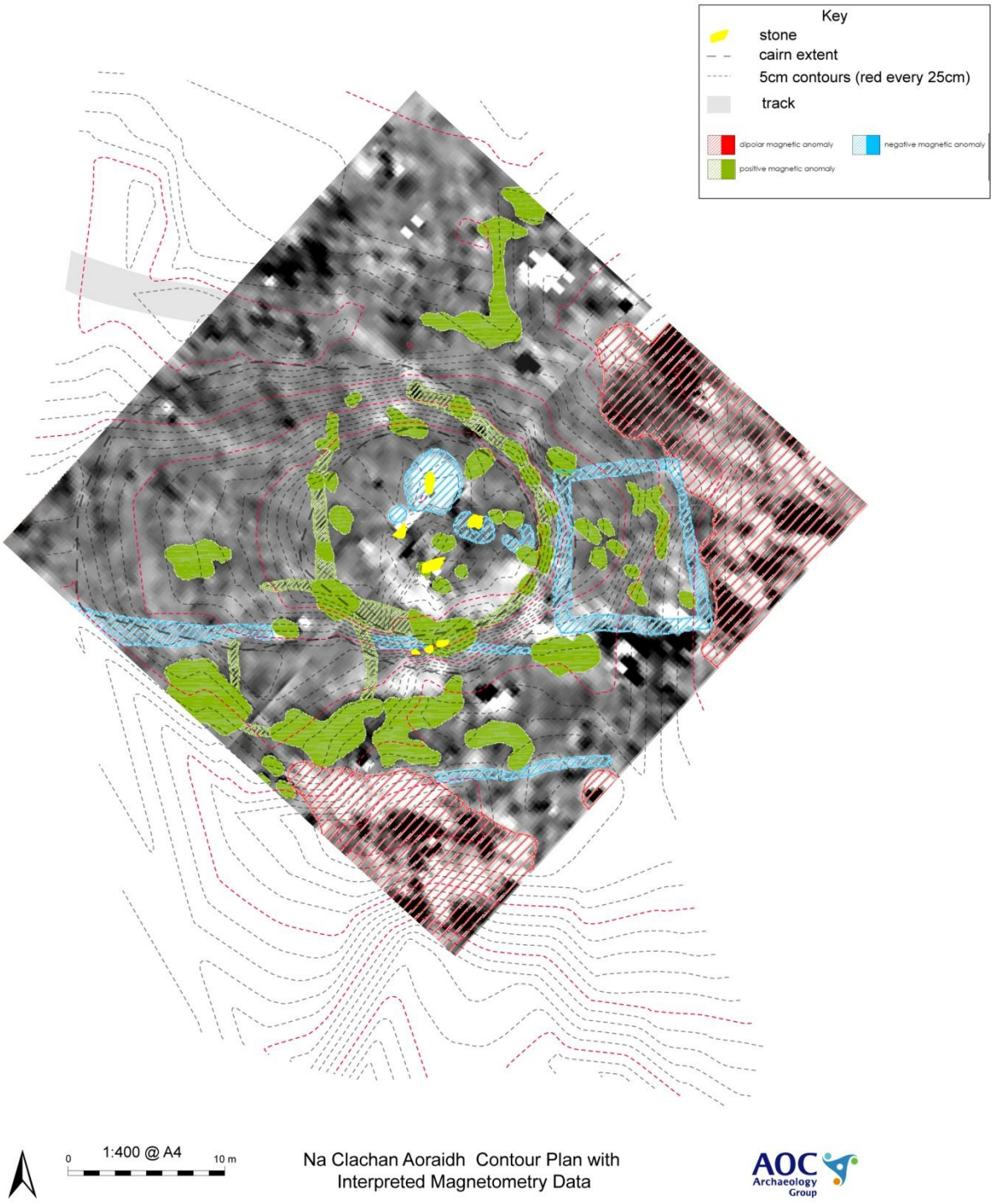

Figure 15: Topographic survey with the interpreted results of the geomagnetic survey.

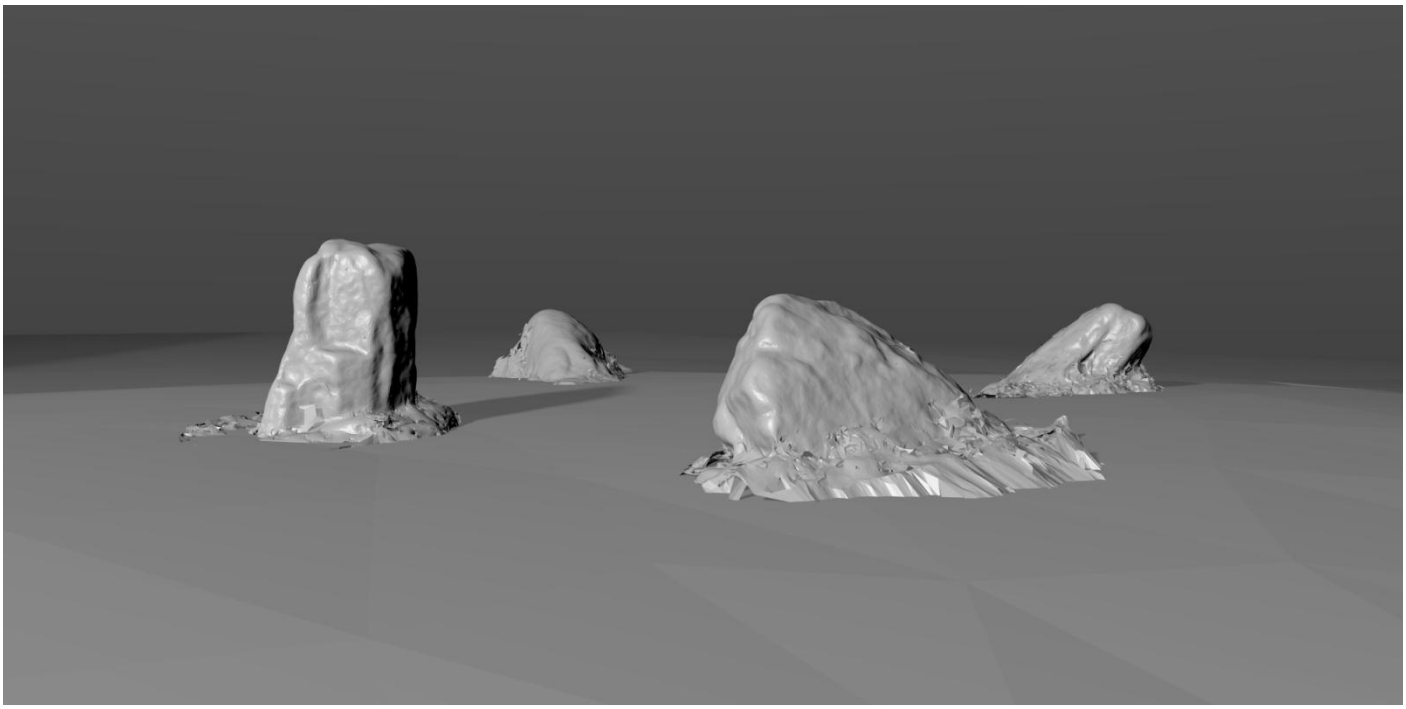

Figure 16: 3D view of the stone circle survey, from the SE using simulated lighting from the S.

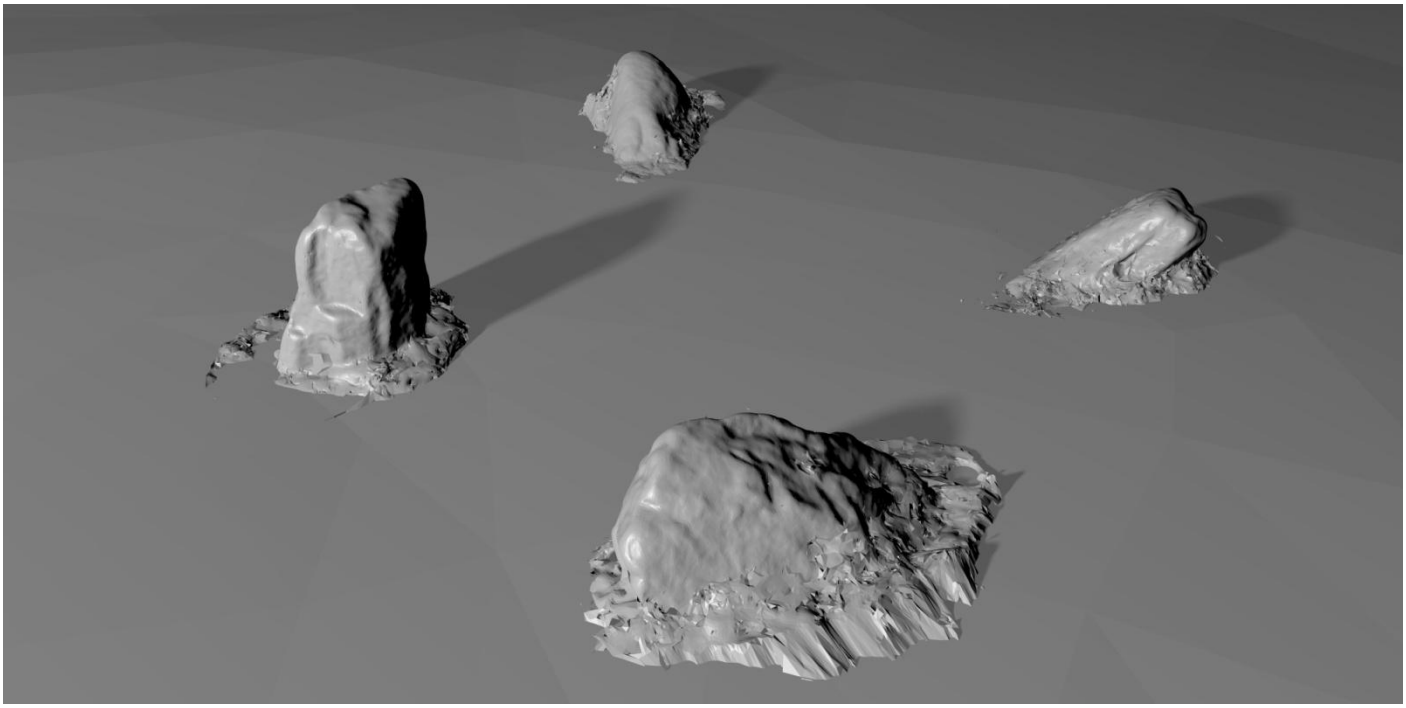

Figure 17: 3D view of the stone circle survey, from the SE, above, using simulated lighting from the S.

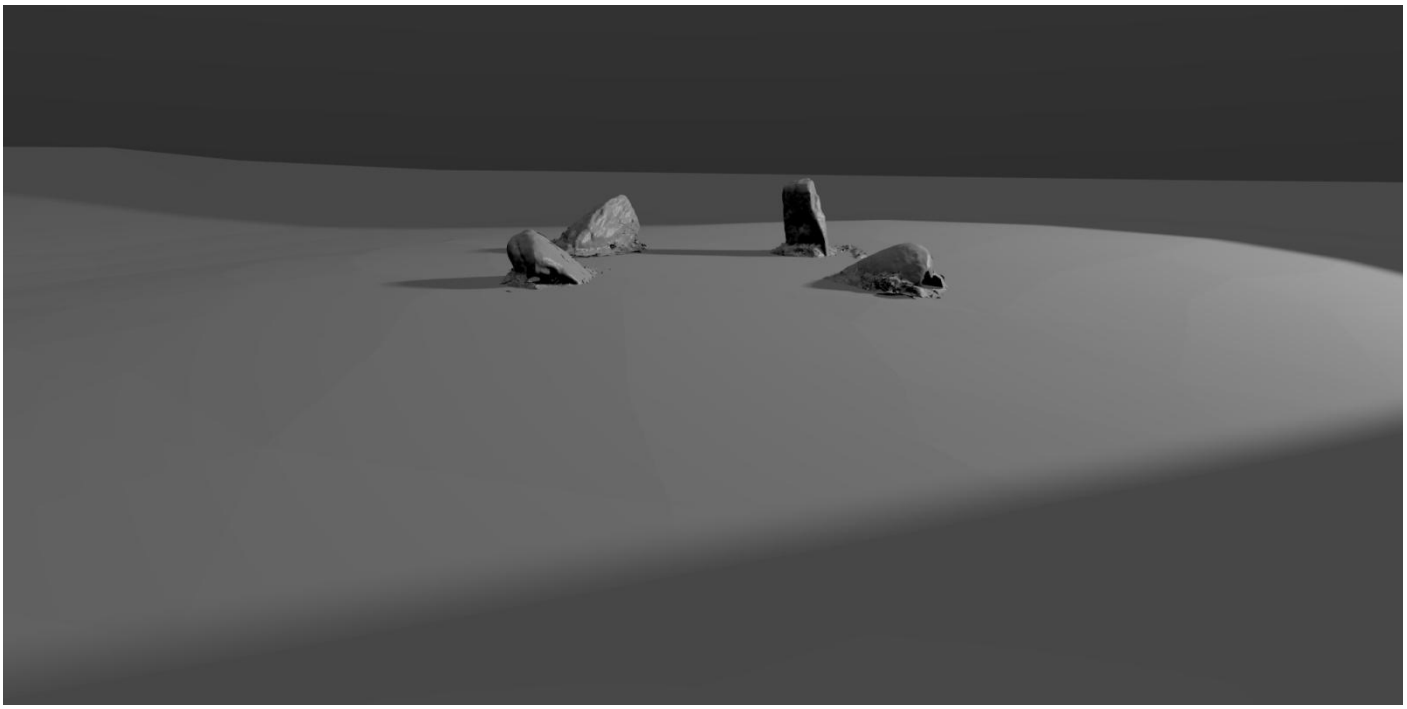

Figure 18: 3D view of the laser scan data from the N, with simulated lighting from the W.

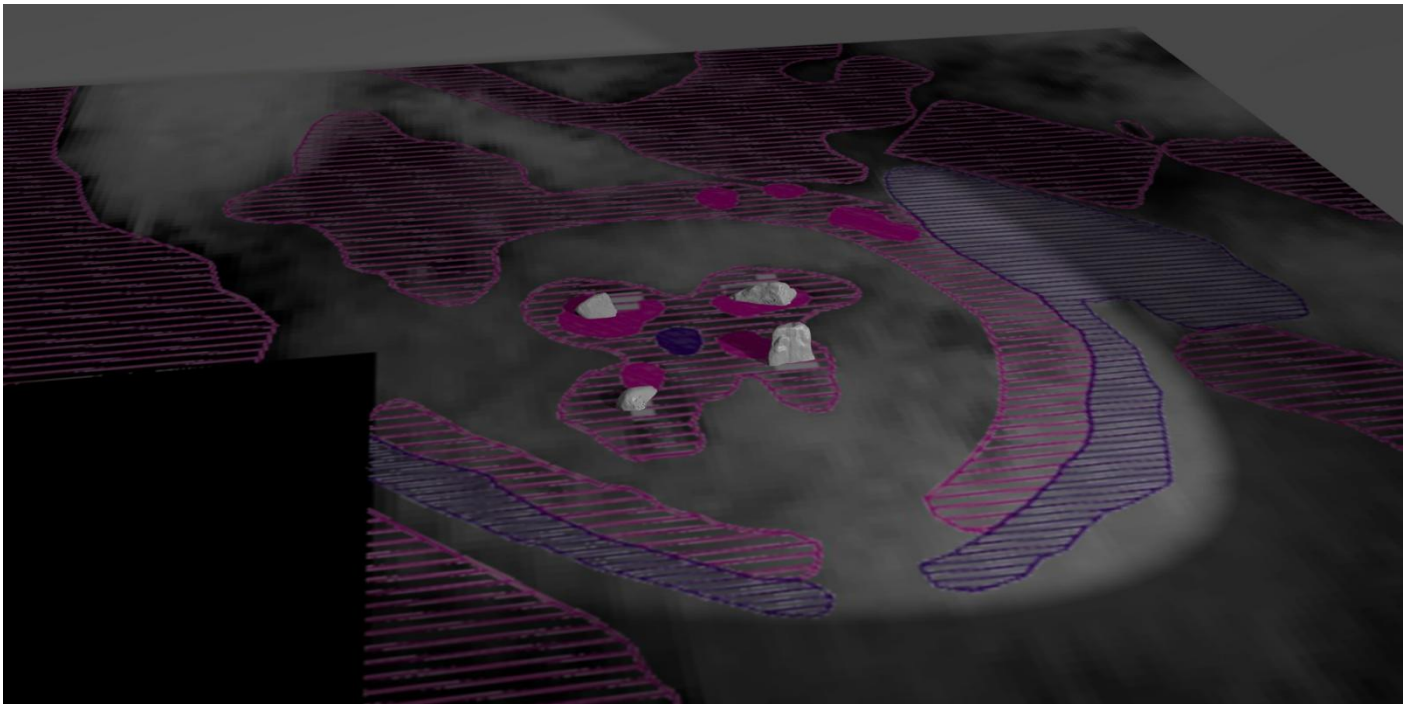

Figure 19: Simulated 3D view of the integrated laser scan survey and the interpreted resistivity results, from the NW.

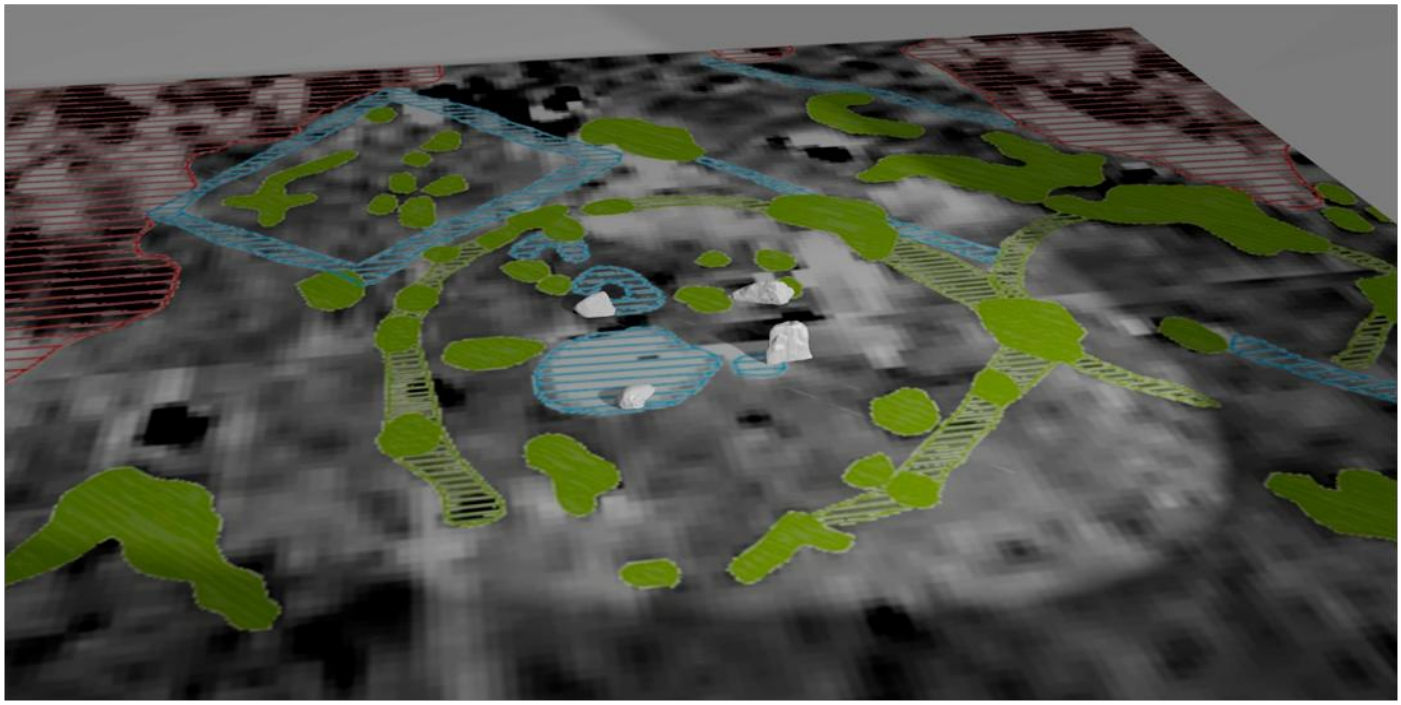

Figure 20: Simulated 3D view of the integrated laser scan survey and the interpreted magnetometry results, from the SW.

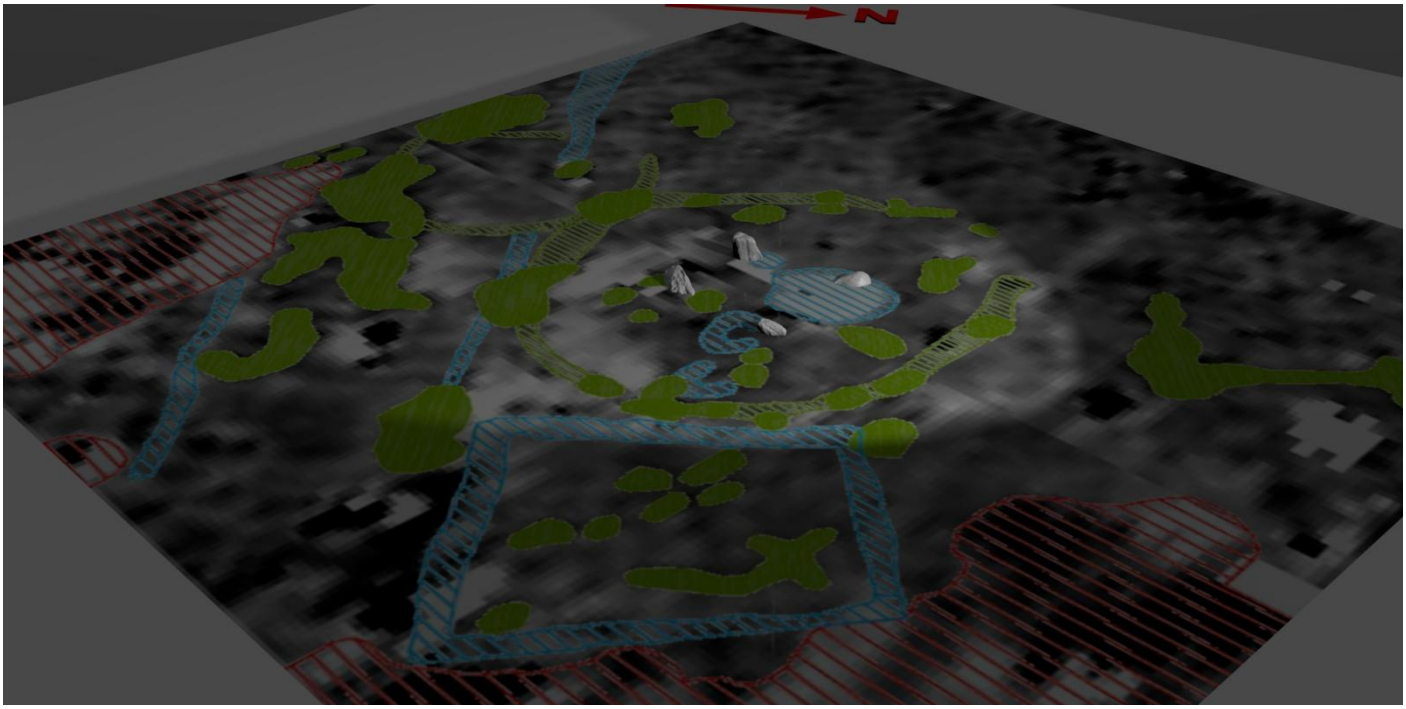

Figure 21: Simulated 3D view of the integrated laser scan survey and the interpreted magnetometry results, from the NE.

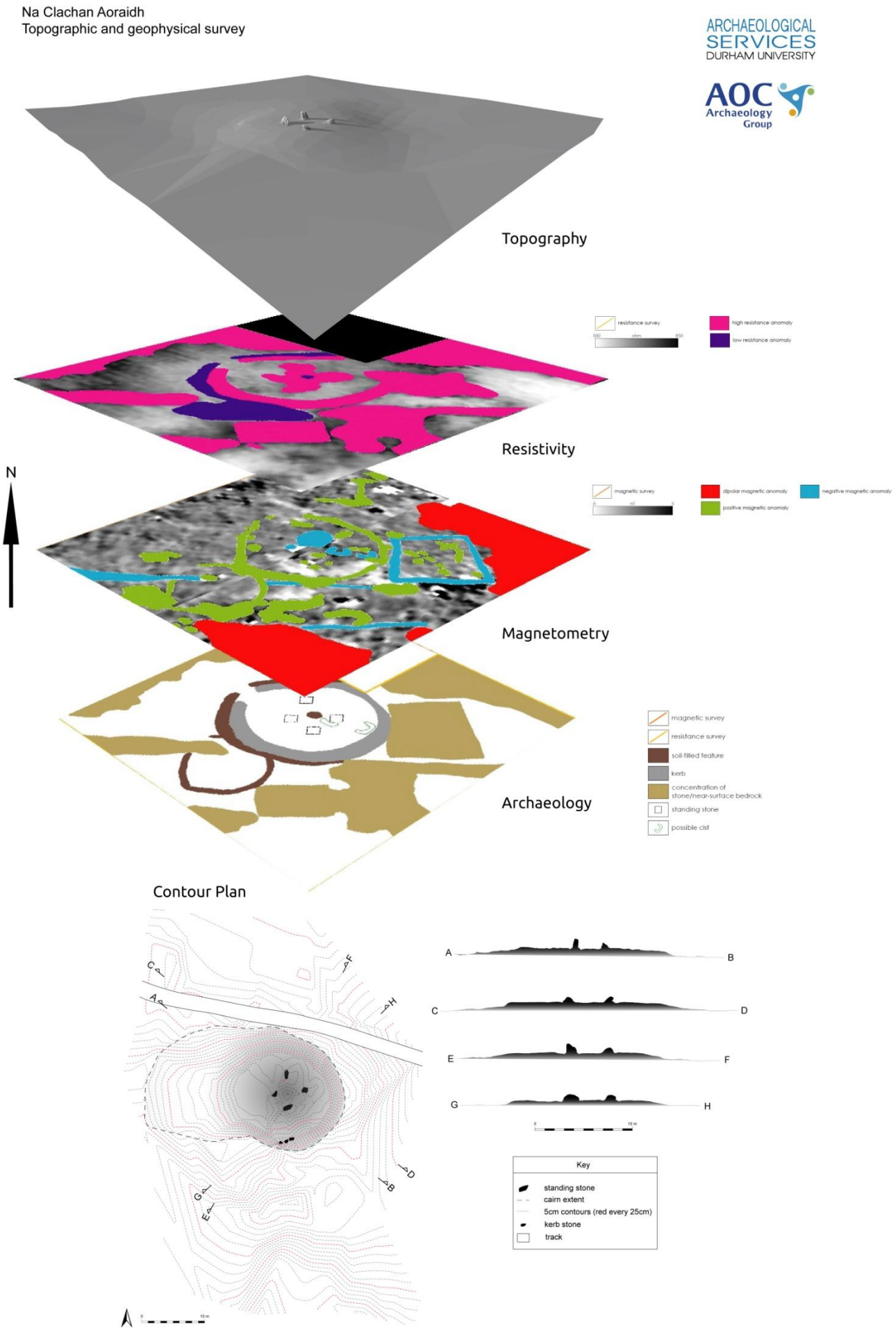

Figure 22: Integrated topographic and geophysical survey results.

Plate 1: General view of the site from the NE.

Plate 2: General view of the site from the E.

Plate 3: General view of the site from the S.

Plate 4: General view of the site from the SW.

Plate 5: General view of the site from the NW.

Plate 6: South western stone, detail, from SW.

Plate 7: North western stone, from SW.

Plate 8: South eastern stone, from E.

Plate 9: North eastern stone, from E.

Plate 10: Kerb stones on S side of the site, from the S.

Plate 11: General view of the site during the survey.

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