GeoArch

Report 2012/17

Geophysical survey at Llandow Airfield, Vale of Glamorgan [SS 957717]

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13th July 2012

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Abstract

Magnetic gradiometry was undertaken over approximately two hectares corresponding to the intended location of the Pafiliwn and adjacent tents of the 2012 National Eisteddfod.

The magnetic survey was moderately 'noisy' and the ground surface showed brick and clinker fragments amongst other magnetic debris. It is not clear whether this debris represents material reworked during modern agricultural improvement or whether it dates to the construction of the airfield and demolition of the buildings at Six Wells in the 1930s.Other probably modern features imaged by the survey include ploughing both parallel and perpendicular to the adjacent runway.

A slight magnetic NW-SE anomaly across the northern part of the area is likely to mark a former fence-line. A strong magnetic anomaly just clipping the SE edge of the survey is suggestive of services running parallel to the margin of the runway.

The major anomalies of the survey are associated with the pre-1930s field boundaries. These correspond to the boundaries between parcels 75, 92 and 94 of the 1st Edition OS and are suggestive of field banks bordered by shallow scoops. Some broad, slight, featuring is aligned with the field boundaries in the western part of the survey and is tentatively suggested to be possible medieval ridge and furrow ploughing.

The survey also shows some subtle lineations which do not respect the field boundaries and which are not aligned with the airfield features. These are similar to anomalies seen in surveys at Llanmaes and are interpreted as features (jointing?) within the Jurassic bedrock.

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Methods

Surveying

The surveys were laid-out using a Trimble 4700 survey grade RTK GPS system. An *ad-hoc* arbitrary location was chosen for the Trimble 4700 base station. Surveys were laid out from pre-planned "round-number" 20m intervals of National Grid, uploaded to the GPS system, with the stakeout undertaken using a Trimble 4700 RTK rover unit. The survey was planned and processed within Trimble *Geomatics Office*. The base-station coordinates were established subsequently by post-processing using RINEX corrections from the closest five Ordnance Survey active stations. Because TGO has a software bug which will not allow it to process GPS baseline surveys conducted after September 2011, a modified workflow has been adopted: the raw GPS base-station data file was converted to RINEX format using Trimble's '*Convert to RINEX*' utility v2.1.2 and then, together with all the OS active station RINEX files, date-adjusted using the '*RinexDates*' utility (v.13), before baseline processing in TGO. The grid peg locations were then post-processed to final coordinates.

The 20m grids were marked by survey paint and temporary canes, to avoid leaving a trip hazard. The marked grids are illustrated in Figure 1.

In practice, the difference between the initial setup and the post-processed coordinates is very small – allowing the survey plan to be followed closely without the need to establish a base-station in advance of the commencement of survey. In this instance the as-staked locations were 0.84m east of the designed location and 2.59m south. This means that the southwest corner of the surveyed area was [295680.84, 171597.41].

The grid pegs were positioned to within 30mm of the correct location reported by the GPS, which should mean they have a final accuracy to within approximately 50mm of National Grid.

Magnetic gradiometry

The data were collected with a *Bartington Grad 601 Dual* fluxgate gradiometer. Data were collected at 0.125m intervals on traverses 1.0m apart. Data were downloaded from the instrument, assembled and cleaned using DW Consulting's '*Archeosurveyor 2*' software. The grids were assembled, the data clipped and the destriping function employed for data in which there was an imbalance between the two gradiometers. The data were exported from *Archeosurveyor* and interpolated using Golden Software's *Surfer* package to reduce pixilation. Surfer produced a surface-fitted grid using kriging to a node spacing of 0.125m x 0.125m. For the regularly-spaced data the kriging ensured conservation of all measured points. No data have been filtered or otherwise 'enhanced'.

Data presentation

All geophysical data are presented following imaging in Golden Software's *Surfer* software, unless otherwise stated. The standard resolution of fitted surfaces was 0.125m x 0.125m. Site plans have prepared in *CorelDraw*

The surveys were conducted between 13th and 14th June 2012, under warm, dry conditions, with the field as short grass. This project was conducted on behalf of GGAT and was managed by Rowena Hart.

Results

Magnetic gradiometry was undertaken over approximately two hectares corresponding to the intended location of the Pafiliwn and adjacent tents of the 2012 National Eisteddfod.

The magnetic survey was moderately 'noisy' and the ground surface showed brick and clinker fragments amongst other magnetic debris. It is not clear whether this debris represents material reworked during modern agricultural improvement or whether it dates to the construction of the airfield and demolition of the buildings at Six Wells in the 1930s.Other probably modern features imaged by the survey include multiple vehicle tracks in the northern part of the survey (dashed lines on Figure 4).

Much of the survey area shows multiple sets of lineations. These pervasive lineations probably include sets of both geological and agricultural origin.

Geological lineations:
The bedrock on the site is the Porthkerry Member of the Blue Lias Formation (Early Jurassic), which comprises thinly-interbedded mudstones and limestone. Similar bedrock geology at Llanmaes, 3km SE of Llandow airfield, produced strong lineations on magnetic gradiometer surveys (Young 2008, Figure 2; Young 2010, Figure 4). At Llanmaes these lineations were dominantly NW-SE or NNW-SSE in orientation. In the northern part of the Llanmaes survey, they took the form of narrow positive anomalies of up to about 1nT amplitude, with a spacing of approximately 4m. On the present site there are several sets of lineations of probable geological origin, all shown schematically by thin dashed lines on Figure 4.

The set most similar to those at Llanmaes is a NNW-SSE lineation (schematically illustrated by orange dashed lines on Figure 4), which is of lower amplitude and more diffuse than in some areas at Llanmaes but nevertheless broadly similar.

A somewhat similar diffuse lineation, but with a WNW-ESE orientation, is also seen in the southern part of

field 94; this may also be geological in origin (blue dashed lines on Figure 4).

Two further sets of poorly-marked and mutually perpendicular lineations (lilac dashed lines on Figure 4) also show long lengths of anomaly, cross cutting historic field boundaries and showing no clear orientational relationship to other features. These may also be geological.

Agricultural lineations:

Two sets of approximately perpendicular lineations can be related to ploughing on axes associated with the alignment of the runways (black lines with arrowheads on Figure 4). The SW part of the survey is marked by moderately strong lineations both parallel (strong, abundant) and perpendicular (weak, infrequent) to the runway. Similar, but slightly less well-marked lineations are also seen in the northern part of the survey, but in this area the NW-SE set are dominant. These lineations will have been produced by post-1930s ploughing.

With the western part of the survey there are narrow lineations perpendicular to the 75-90 field boundary. These are quite discrete and may therefore either reflect ploughing, or just possibly, land drains. The most prominent is indicated in mid-green on Figure 4.

There are also subtle broader anomalies, partly expressed by variations in 'noise', parallel to the field 75-92 boundary (pale brown wide zones on Figure 4). Such diffuse anomalies may be the product of geological structures but, given their orientation parallel to the SE field boundary, are more likely to be agricultural and may possibly be indicators of former ridge and furrow cultivation. This interpretation would also be favoured by the curvilinear of the field boundaries SE of Six Wells as depicted on the pre-1930s OS mapping.

Discrete features:

A slight magnetic NW-SE anomaly across the northern part of the area incorporates discrete dipolar anomalies and is likely to mark a former fence-line (bold dotted line on Figure 4). The orientation is approximately perpendicular to the runway – so a post-WWII origin for this anomaly is likely (there is a slight possibility that it might be associated with some dominantly non-ferrous services rather than a fence).

A strong magnetic anomaly just clipping the SE edge of the survey is suggestive of services running parallel to the margin of the runway, although it is also possible that this anomaly has been produced by the margin of the substructure of the runway itself (thick black line on Figure 4). At other points to the SW of the survey a substantial soakaway/French drain lies in a similar position with respect to the runway.

The major anomalies of the survey are associated with the pre-1930s field boundaries (Figure 4 - pale green lines are positive anomalies and dark green lines are positive anomalies). This correspond the boundaries between parcels 75, 92 and 94 of the 1st Edition OS. The SSW-NNE boundary between 75 and 92 is marked by a moderately strong, narrow (2m), positive magnetic anomaly, locally bordered by broader (up to 5m)lesser positive anomalies. This is suggestive a field bank bordered by shallow scoops. The WNW-ESE boundary between 75 /92 and 94 is rather more variable – to the east being dominated by a broad positive anomaly and to the west by multiple anomalies of alternating sense. To what extent these differences reflect differences in the original boundary and to what extent they indicate differences in the way the boundaries were grubbed-out in the 1930s, is unclear.

The area around and just to the west of the intersection of these former boundaries is marked by a large number of very strong magnetic anomalies, indicative of ferrous debris. This area was mapped as woodland on the pre-1930s OS mapping – and may have accumulated metallic detritus (not indicated on Figure 4).

Two short lengths of positive linear anomaly occur in the northern part of the survey (red lines on Figure 4). These are very slight, and although they need to be flagged as of potential archaeological significance are most likely to just slightly stronger elements of the anomalies produced by the agricultural activities and/or site levelling n the 1930s.

Interpretation

The evidence described above strongly suggests that the featuring in the survey mainly reflects post-medieval agricultural activity, with some very tentative evidence for medieval agriculture.

The survey contained no evidence for features of pre-medieval age and only indications on the very margins of the survey for features directly associated with the airfield structures.

References

YOUNG, T.P. 2008. *Geophysical Survey at Llanmaes, 2008 Season*. GeoArch Report 2008/16. 5pp.

YOUNG, T.P. 2010. *Geophysical Survey at Llanmaes, Vale of Glamorgan, December 2009 [SS 982 692]*, GeoArch Report 2010/02, 7 pp.

Figure Captions

Figure 1. Grid layout and relationship to National Grid.

Figure 2 Bitmapped greyscale plots of magnetic gradiometer (data collated and tidied only). For location see figure 1. Images from *Archeosurveyor*.

a) Greyscale -2nT (black) to +2nT (white).
b) Greyscale -6nT (black) to +6nT (white).

Figure 3. Magnetic gradiometer survey results. Greyscale image of data kriged to 0.125m node spacing in *Surfer*.
Greyscale -6nT (black) to +6 nT (white).

Figure 4. Summary interpretation.

Geological:
Thin dashed lines in orange, blue and lilac depict the orientation of probable geological features (jointing?). These are mostly represented by spaced, low amplitude positive magnetic anomalies.

Agricultural:
Modern and post-1930s ploughing is shown schematically by thin black lines with arrow heads.

Apple green feature may be ploughing or possibly a drain parallel to the S margin of pre-1930s field 75.

Pale brown broad lines indicate possible medieval cultivation.

Broad dotted black line represents possible metal fence-line.

Pre-1930s field boundaries:
Pale green tone – positive anomalies
Dark green tone – negative anomalies

Airfield:
A strong magnetic anomaly (broad black line) runs parallel to the margin of the runway.

Uncertain:
Minor magnetic anomalies of uncertain origin are indicated by solid red lines.

Background linework:
Modern plan redrawn after Figure 1 with historic linework sketched based on the 1878 OS 1st Edition. Field numbers after the 1st Edition OS mapping.

Figure 1

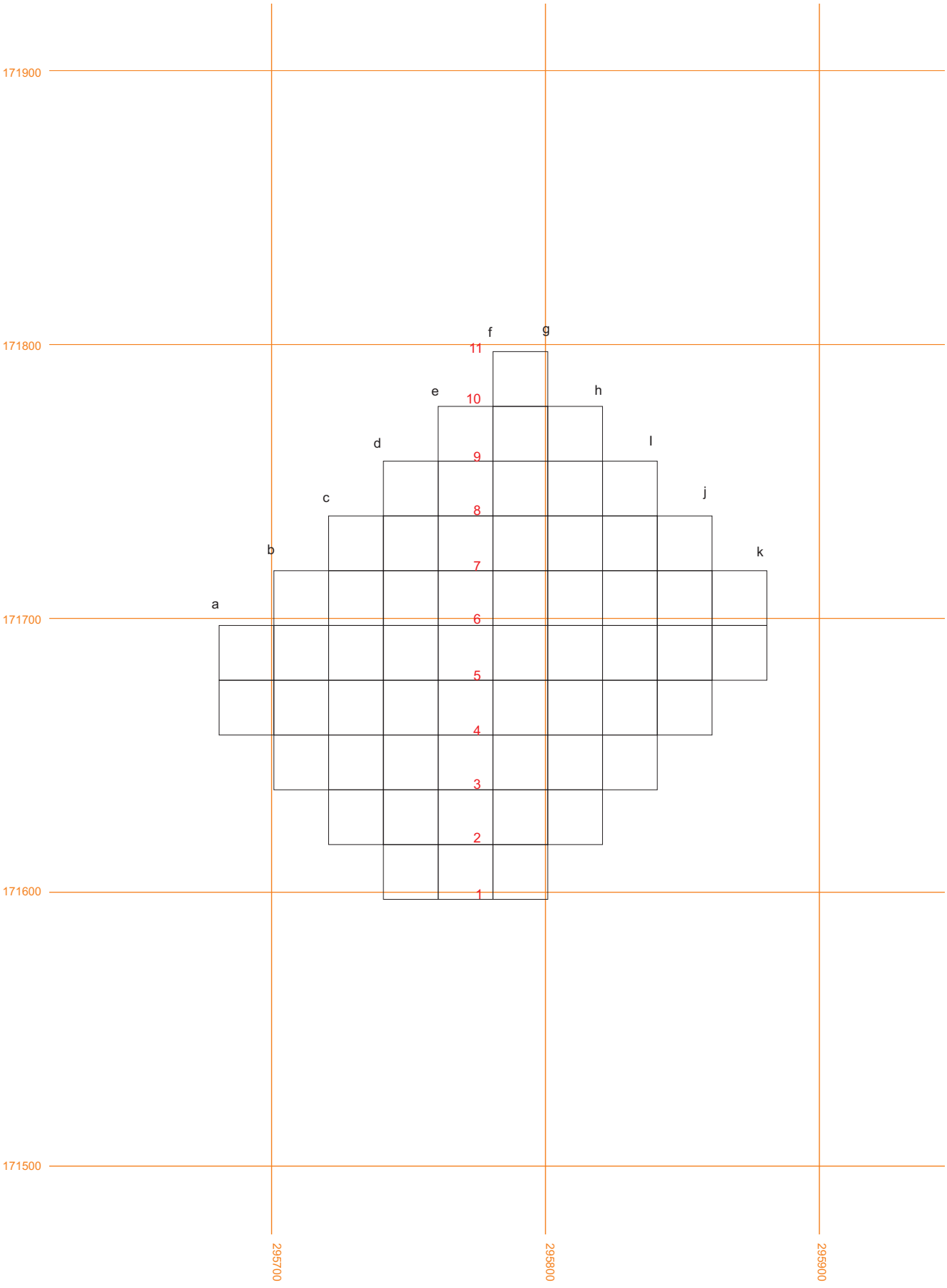
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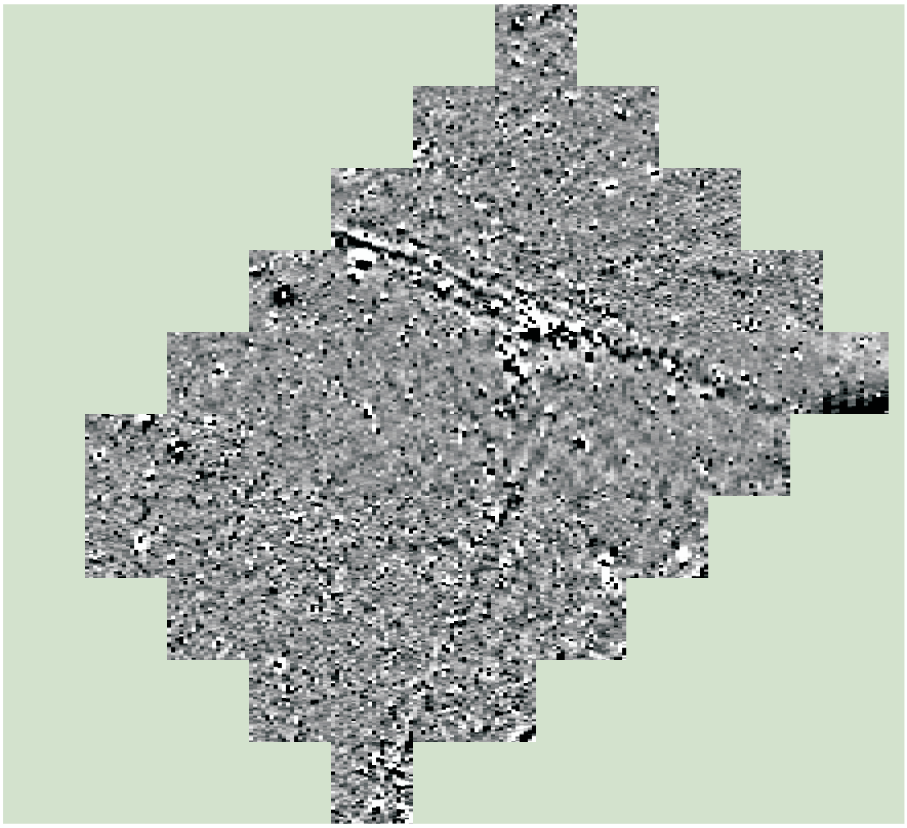
Figure 2

a



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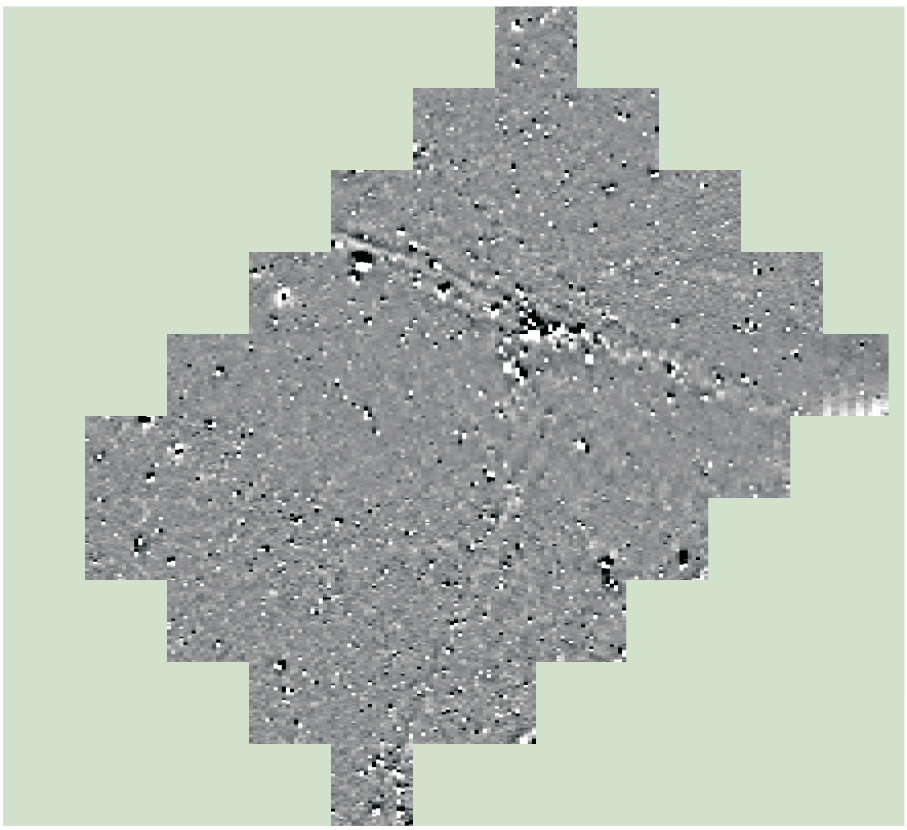

Figure 3

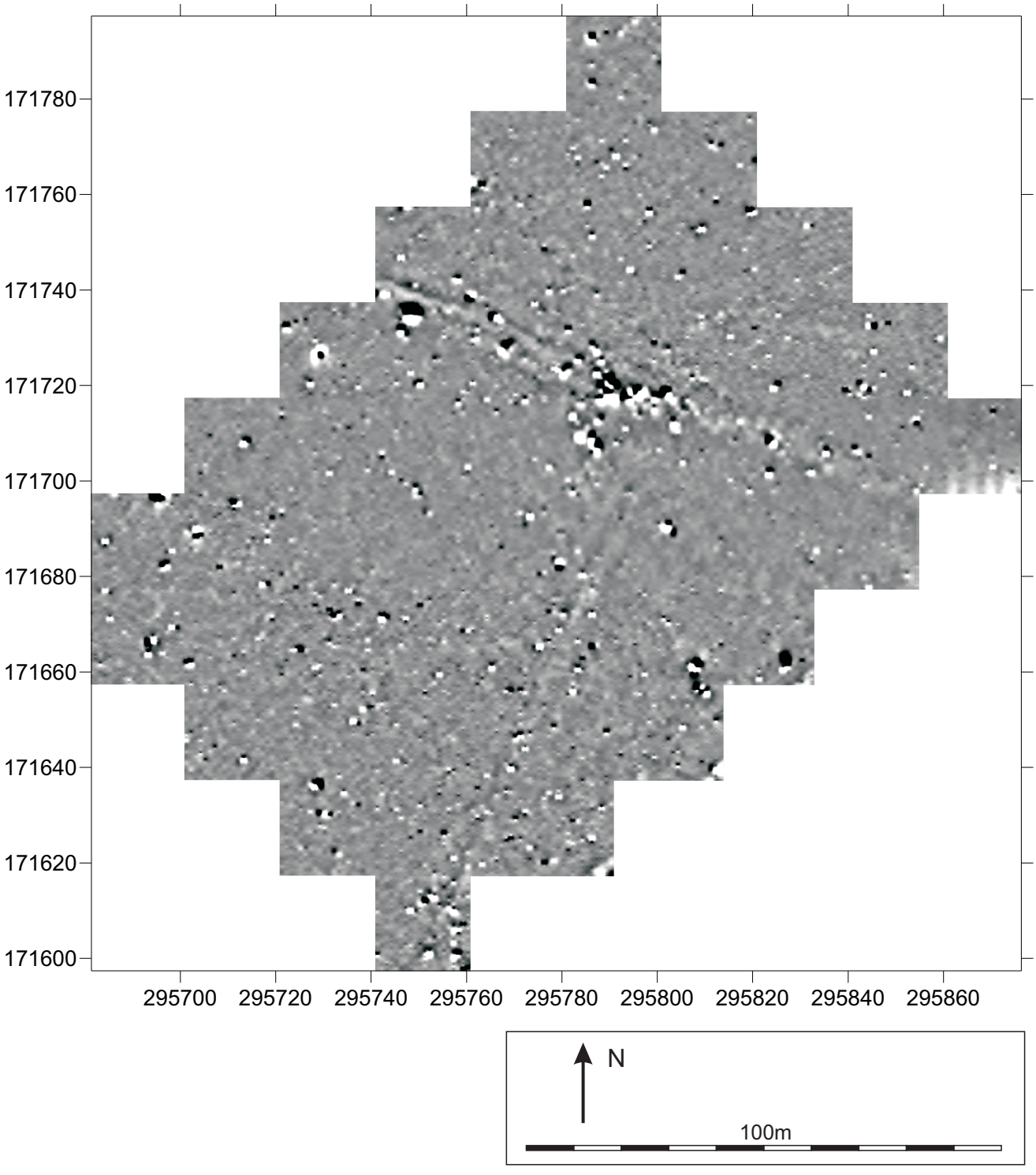
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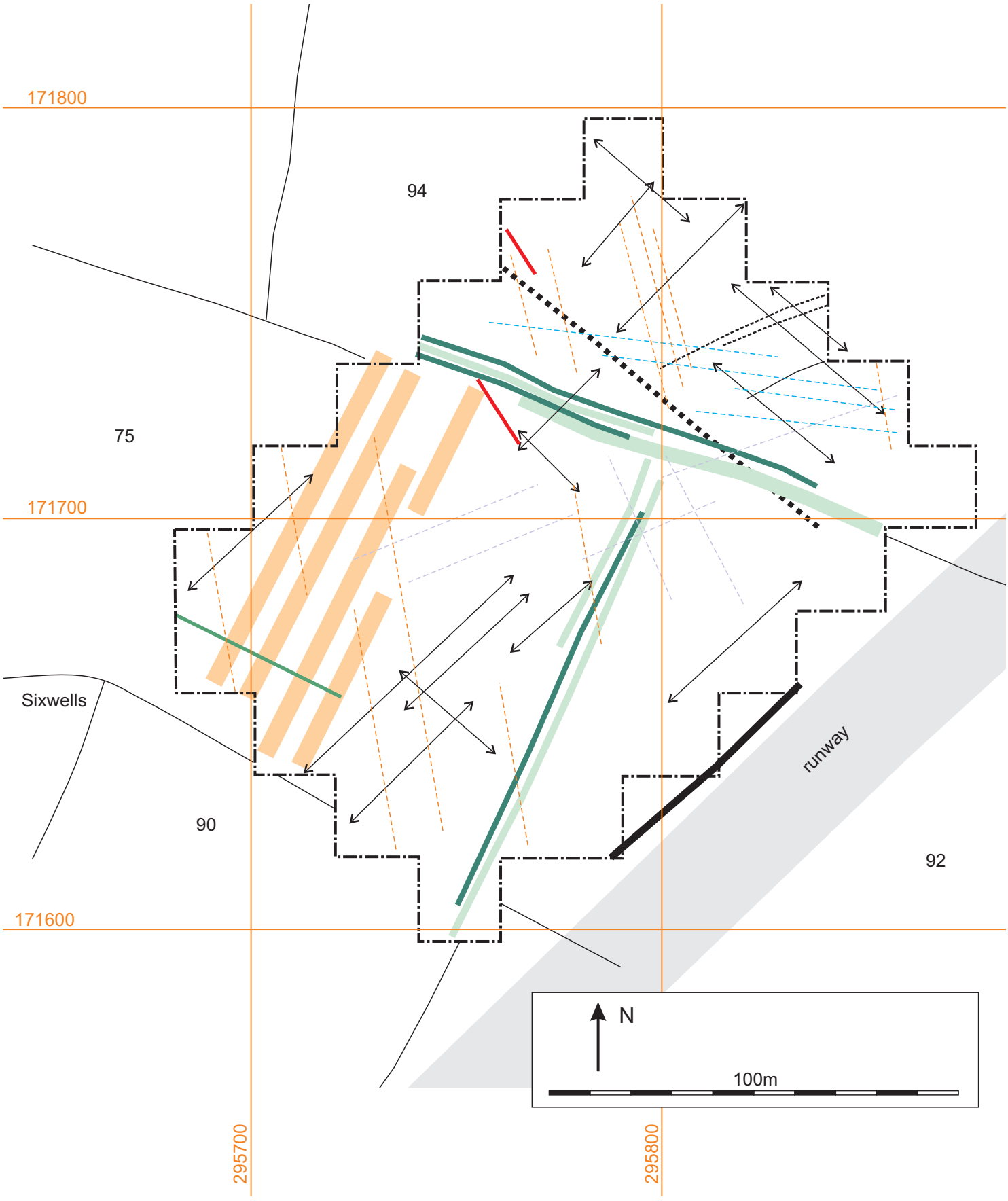
Figure 4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