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REPORT ON GEOPHYSICAL SURVEY AT CASTELPORZIANO

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Geophysical Survey at Castelporziano 2008

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1.0 Introduction

The following report is a brief summary of the geophysical survey undertaken at the Castelporziano estate as part of the project *The evolution of Rome's maritime facade: archaeology and geomorphology at Castelporziano*. The work was carried out from the 9th-18th April 2008 under the overall direction of Amanda Claridge.

The survey was split between two sub-regions of the overall Castelporziano study area:

- The area provisionally identified as the extant remains of a series of possible fish farms – referred to within the project literature as D6 and D5;
- Two discrete locales sited in the vicinity of the *Vicus Augustanus*.

2.1 Location

The present character of the survey area is of dense woodland and low-level vegetation with quantities of building debris – such as stone and fired clay – over the surface at large. These agents have severely hampered previous efforts at remote-sensing and geophysical surveys at other sites on the Castelporziano estate. However, a recent period of drought and an increase in local wildlife has significantly reduced the density of much of this low-level vegetation. Survey grids (using a standard 20x20m) were located to allow the greatest possible coverage of the areas within the constraints applied by the presence of substantial areas of dense vegetation. Grids were also sited to target apparent vegetative and topographic changes within the area along with the surviving traces of architecture indicated by clearance and prior excavation.

To this end, the survey of the D5 / D6 area was broken down into three component locales (figure 1a):

- The West bank of D6 / East bank of D5: an area circa 30mx70m (orientated South-North)
- The North Bank of D6: an area circa 90mx25m orientated East-West
- The East and South bank of D6: an L-shaped area circa 60mx20m

The geophysical survey at the *Vicus Augustanus* was focussed on two small areas (figure 1b):

- A 10x20m area located to the East of the bath building A in a conspicuously open area within the known limits of the site, surrounded by dense vegetation. Evidence of recent human activity (charcoal, debris etc) was present.
- A 20x30m area situated to the West of buildings Y and Z. The objective was to determine whether these buildings could represent the western limit of the site, as yet undefined.

2.2 Methodology

In the 2006 season, a series of small-scale resistivity surveys' were undertaken in the Areas B and H. However results were mixed, with the technique struggling with the high resistance properties of the background geology (Evans 2006). In 2008 a magnetometer survey was employed - features that can be detected through this process include ferrous materials, fired materials such as kilns and hearths, tiles, bricks, and concentrations of ceramics (Clark 1996) - and it was hoped that this technique would be more conducive to the singular archaeological and geological conditions of Castelporziano.

The survey was carried out using a single Geoscan FM36 Fluxgate Gradiometer with integral data logger. Data was collected with a sampling interval of 0.25 m along transects spaced at

1.0m apart. Traverses were collected in a parallel configuration at a resolution of 0.1 nT combined with a gain setting of x1.

A full record of the technical details of the survey is available within the Digital Archives Record Sheets which comprise Appendix A of this report, produced to the standards recommended by the Archaeological Data Service (ADS).

2.3 Processing

Data processing was performed using Geoscan Research Geoplot v.3 for the production of raw data composites, and processing and display of the initial data. Greyscale plots were produced of the raw composite data from all areas. The following processing was then applied to the raw data:

1. Zero Mean Grid: (sets the background mean of each grid to zero and is useful for removing grid edge discontinuities). *Geoplot parameters:* Threshold = 0.25 std. dev.
2. Clip to three Standard Deviations off the median average;
3. De-spike; (useful for display and allows further processing functions to be carried out more effectively by removing extreme data values).

Geoplot parameters:

X radius = 1, y radius = 1, threshold = 3 std. dev.

Spike replacement = mean

Finally, data was pixel interpolated within Golden Software Surfer 8, to create a smoother appearance to facilitate interpretation. Surfer 8 was then used to convert the data to other formats and to allow the production of wireframe, 3D surface and colour transform plots of the processed data.

3. Results from D5 / D6

The survey in this area benefited from being run alongside several small-scale excavation trenches as well as running over architecture identified in clearance and excavation in D5 in 2007. It is therefore, possible to compare the geophysical data with areas of known archaeology and to confidently equate a strong signal with a surviving feature. Results were successfully obtained from all areas of the survey at a resolution adequate for the definition of a wide series of potentially interesting anomalies. Results are divided by area below for detailed discussion.

3.1 West Bank of D6 / East Bank of D5

Results

The survey identified a large number of coherent positive, linear magnetic anomalies (Figure 2). The strongest individual anomalies – and discrete concentrations of anomalies – have been labelled numerically in Figure 5 and are discussed below.

The strongest response is given by a roughly East-West orientated linear anomaly (Feature 1), positively identified as a wall by small-scale excavation. These excavations demonstrated that the architecture was surviving at a shallow depth; often 10-15cm below ground level. When taken into account this would explain the strength of the magnetic signal that can be seen in the dataset.

Another strong linear anomaly (Feature 2) runs parallel c. 7m to the south of Feature 1. Taken together these seem to form a coherent architectural unit traversing the flat area between D5 and D6. The “inside” of this unit contains some very strong magnetic readings –

these align with small spoil heaps produced by the 2008 excavations and should be discounted. The Western extent of Feature 1/2 is unclear – both seem to develop a roughly “S-shaped” kink upon reaching an interrupted North-South line (Feature 3).

Approximately 5m parallel to the West of Feature 3 is Feature 4 – positively identified in the 2007 as a sizeable wall, probably indicating a retaining wall of the East bank of D5. In the data Feature 4 can be seen to turn to the West at its Northern extent. However, the southern extent is slightly less clear; although two interrupted positive anomalies on the same alignment can be identified there is nothing equivalent to the strong coherent signal of Features 1-3. Possible reasons for this are:

1. The wall has been heavily damaged by erosion of the bank, resulting in a fragmented response in the dataset.
2. Collection error - such as not maintaining a straight traverse - while over the feature has resulted in the wall being surveyed partially, and thus not being picked up in its entirety.

Of interest are three high-confidence strong linear anomalies to the South of the southern end of Feature 4, coinciding with the southeast corner of D5. These lie at a 45 degree angle to the main feature and could be associated with further constructions in this area.

Feature 5 is represented by two lower confidence positive magnetic linear anomalies running parallel c. 35m to the South of Features 2 and 3. Viewed in plan with conjunction with the higher confidence Feature 3 it could be speculated that these anomalies form a distinct corridor running through the survey area. Of interest are two “s-shaped” anomalies identical to – if slightly weaker than – those identified with Features 1 and 2 to the North. Furthermore the four features – if taken as a group – are staggered at apparently regular intervals of c.8.5m

To the South of Feature 5 is a strong positive East-West anomaly (Feature 6) continuing outside the extent of survey area to the East. The extent to which it continues to the West is unclear, although several strong anomalies exist in this area. An East-West linear anomaly – albeit with a weaker signal – can be suggested c.4-5m to the South of 6. To the North of this survey area is feature 7: which appears to be four sides – perhaps segmented – of a rectangular structure measuring c.9x7m. Associated with this structure are a range of high confidence linear anomalies, apparently laid out on the same alignment and perhaps directly associated with Features 1 and 3 to the South and West respectively.

3.2 North Bank of D6

Results

The survey identified a large number of coherent positive, linear magnetic anomalies (Figure 3). The strongest individual anomalies – and discrete concentrations of anomalies – have been labelled numerically in Figure 6 and are discussed below.

The survey area is dominated by a very strong East-West anomaly (Feature 1) running for over 50m. A single test-pit located over this feature has revealed it to be a surviving wall. At its western extent the wall appears to be contiguous with a three sided structure (Feature 3) with a strong dipole reading possibly indicating the presence of a dense mass of buried building material (a platform?). The wall then continues on its previous alignment for circa 7m before terminating short of Feature 8 (discussed below). At its eastern extent the wall appears to turn to the South, with a concentrated mass of high magnetic readings on the right angle, possibly indicating a heavily reinforced corner (Feature 2).

Running parallel c.7m South to Feature 1 is another high strength linear anomaly (Feature 4) identified as a wall. Topographically this feature is situated further down the slope of the North Bank. In contrast to the easily defined Feature 1, this secondary wall appears truncated and slightly harder to pin down as a single feature. However, we can confidently identify distinct architectural features (5 and 6) interrupting the wall. The small-scale clearance and excavation in these locales revealed these anomalies to be suspected alcoves with vaulted ceilings.

Of interest is another potential wall – Feature 7 – parallel with walls 1 and 4 coming off the western extent of Feature 6. We are therefore presented with a series of 3 walls converging on the roughly rectangular anomaly - Feature 8- at the western extent of the survey area. The exact shape of this anomaly is difficult to ascertain due to the strength of the magnetic signal – but it would appear to be a not inconsiderable structure.

At the northern extent of the area the survey has located traces of a high confidence linear feature(s) – Feature 9 - on a roughly East-West alignment corresponding to the known location of the *Via Severiana*.

Approximately 6m to the North of wall 1 is another possible linear feature, although identification as a wall is less confident. To the North of Feature 3 are further high confidence traces of possible buildings and walls, although the restricted survey area does not allow any definitive patterns to be recognised.

3.3 East Bank of D6

Results

The survey identified a small number of coherent positive, linear magnetic anomalies (Figure 4). The strongest individual anomalies have been labelled numerically in Figure 7 and are discussed below.

Feature 1 is an extremely high North-South strength perhaps corresponding with the suspected North-East corner of D6. However, the extent to which this linear continues to the South is unclear. However, a rough North-South linear (Feature 2) can be identified on a different alignment. The linear appears to be interrupted in places and possibly associated with features directly to the East – although no distinct patterns can be identified. At the southern extent of the survey area this linear possibly turns to the West (Feature 4), although again no definite patterns can be identified.

3.4 D5/D6 Overall interpretation

The survey at D5 / D6 has provided some particularly clear results that benefit from being viewed as a single composite image for interpretation (Figure 8).

On the West bank we can confidently identify three sides of a larger structure c. 40m in width with a clear central area with very little geophysical activity within. Viewed in plan the Western side is reminiscent of a portico-like structure extending South towards the contemporary coastline. Of interest are the regular ‘kinks’ detected along the length of this structure, possibly representing internal features such as steps. The most southerly wall (forming the South edge of the area) is perhaps associated with another less clear feature to its South. Also ambiguous is the extent to which this Southern wall extends across the South

bank. When viewed in plan with the project GIS (Figure 8) it does seem to align with a short stretch of architecture identified in a trial trench. There appears to be no firm trace of an equivalent wall in the survey of the East / South bank, although there are possible signs of a return – associated with a Southeast corner – at the very limit of the survey area. A possible answer for a lack of clear high-strength features akin to those so already identified could lie in the relative depth of subsoil along the South bank. Excavations and geomorphological investigations here indicated a substantial accumulation of wind-blown sand, with anything over 1m likely to mask any surviving archaeology to the FM36.

To the North of the West bank of D6 is a dense concentration of walls - including one clear rectangular structure - laid out on the same alignment as those to the South. This concentration of features possible continues onto the North bank, although a lack of coverage in key areas prevents any firm conclusions being reached.

The truncated wall (Feature 4) towards the top of the East slope of D5 undoubtedly forms part of the external retaining wall of this larger feature, with traces of a turn to the West evident at its Northern extent. A clear return to the South is less clear, although a concentration of high-strength linear anomalies seem to indicate substantial sub-surface structures – possibly interpreted as re-enforcement for the corner of D5?

Of interest is the relationship between the Eastern wall of D5 and the features on the higher bank to the East. There is an obvious East-West wall between 4 and 3. Thus it would be tempting to equate this part of 4 with the westwards continuation of 1. However, the former appears to be set out on a slightly different alignment, thereby suggesting that the space in-between (occupied by one of the 'kinks') is a potential junction between the areas and an area of some importance.

The North Bank arguably offers the best results for any of the 3 areas at this site. We can confidently identify a sequence of 2-3 parallel East-West walls running from the top of the bank, down-slope towards the base of D6. The wall furthest down-slope contains two definite architectural features – tentatively identified here as alcoves with a third possibly situated in the small area not surveyed to the East of Feature 6. Towards the West of the area we can identify 3-walls of a rectangular structure directly adjacent to one of these alcoves. Traces of equivalent structures further to the East are less obvious, although some ambiguous features are perhaps evident. Of interest is the apparent way all the East-West walls appear to converge towards an extremely high-strength structure located at the western limit of the survey area. The magnetic signal suggests a compact well-built structure roughly rectangular in shape.

At North-East corner of D6 we are presented with a major wall (overlapping the North / East bank survey areas) laid out at a 45 degree angle to the main East-West walls located on the North bank. Associated with this unusual feature are dense, ill-defined high-magnetic signals possibly signifying concentrations of building material? This could therefore be identified as a heavily reinforced bracing wall similar to those tentatively identified at the South-eastern corner of D5.

The strongest candidate for a wall on this East bank is a heavily truncated linear feature lower down the slope. This is perhaps equivalent to the lower wall on the North bank and there is strong evidence (again at the Northeast corner) for these to be contiguous. A parallel can also be drawn to the East bank of D5 (discussed above) which appeared heavily truncated in plan albeit with certain segments giving off a strong magnetic signal.

4.0 Results from Vicus Augustanus

4.1 Area 1

Results

Results from this area have produced very little in the way of coherent high magnetic features (Figure 9), the strongest individual anomalies have been highlighted in Figure 11. Only one feature, an East-West linear with a medium-strong signal seems to bear up to scrutiny. A large section of the survey area has been covered by a substantial dipole, probably the result of modern activity (such as burning) within the area.

Interpretation

The East-West linear identified here could be associated with a possible continuation of architecture towards the East of bath building A.

4.2 Area 2

Results

In comparison with the smaller Area 1, there is a marked increase in potential features in this area. At the eastern extent of the area the survey has picked up traces of buildings Y and Z, although there are no obvious features adjacent to either of these areas. The most obvious feature is a North-South linear in the centre of the area, c. 15 m. west of Y, with a strong positive signal. Another linear – but lower in confidence – lies at right angles to this. Both these features appear to be cut by an irregular anomaly traversing the area roughly Northwest – Southeast.

Interpretation

The outline plans of the western extent of Y and Z can be clearly made out as strong signals. Thus, if there were further structures in this immediate area we would expect them to show up on a similar strength. A lack of anomalies seems to suggest that there is something of a ‘blank area’ in this locale. However, there is a strong case for a potential feature in the centre of the area, on the same alignment as the Vicus, although definite limits are hard to define. The buildings Y and Z could constitute the western limit of the Vicus and the line further to the west could represent the eastern limit of the adjacent site (B3D). Alternatively the gap between building Y and the line to the west is another wide avenue, similar to the wide space ‘D’ which separates blocks C and F on the main site. The irregular NW-SE anomaly is likely to represent a modern pathway or cart-track. .

5. Overall Conclusions and Discussion

The 2008 survey season has proved that in the right conditions –and especially when run in tandem with ground clearance and small-scale targeted excavation – a magnetometer survey can be an effective sub-surface mapping technique at Castelporziano. The survey at the fish farms has provided good evidence for surviving walls and definite structures on the West and North bank of D6. This is in no small part due to the relative shallowness of features in this area as well as the substantial size of remains (walls c.0.9m thick), but also to the strong magnetic signal of the building materials (tufa block, stone, brick, re-used tile) that emit a high magnetic signal. In some cases this has actually led to the magnetic response being so strong that the resulting dipole within the data actually masks any clear definition of linear features.

The only problems in the survey appear to be when surveying on a slope, with collection errors perhaps resulting in a staggered mode of collection with inherent errors. However, while it is tempting to attribute a lack of “clear picture” on the slopes solely to human error

we must also consider the possibility that features may be severely damaged by taphonomic processes such as vegetation growth and earthquakes. Small-scale excavation on the West slope of D6 highlighted just such damage received by an equivalent mid-slope wall.

The results from the *Vicus Augustanus* are at first sight less impressive than the fish-farms. There is a distinct lack of high-confidence features, with the most obvious belonging to buildings already excavated. However, this being said, it has been proved that a magnetometer survey will work, and when used in collaboration with conventional archaeological excavation can help add to existing plans and prove/disprove the existence of features in supposed blank areas. A major factor to consider in analysing data from the *Vicus* is the higher level of modern activity in the area that can eclipse surviving archaeology.

6. Bibliography

Clarke, A.J. 1996. *Seeing Beneath the Soil: Prospecting Methods in Archaeology* (New Edition). B.T. Batsford Ltd. London.

Evans, T. 2006: A report on Geophysical Survey work at Castelporziano. Non-published report.

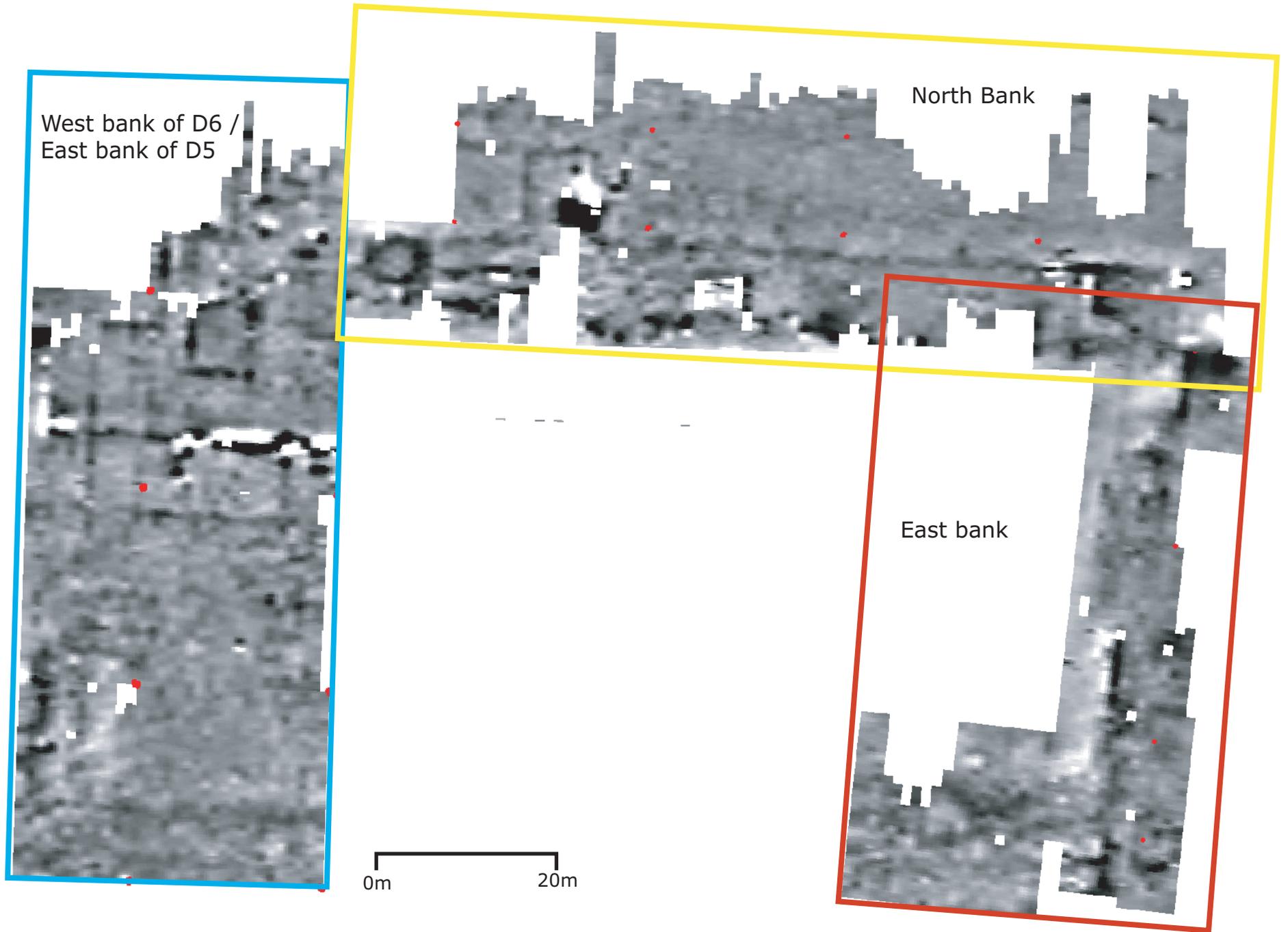


Figure 1a: Location of Survey areas at D5 / D6



Figure 1b: Location of Survey areas at the Vicus Augustana

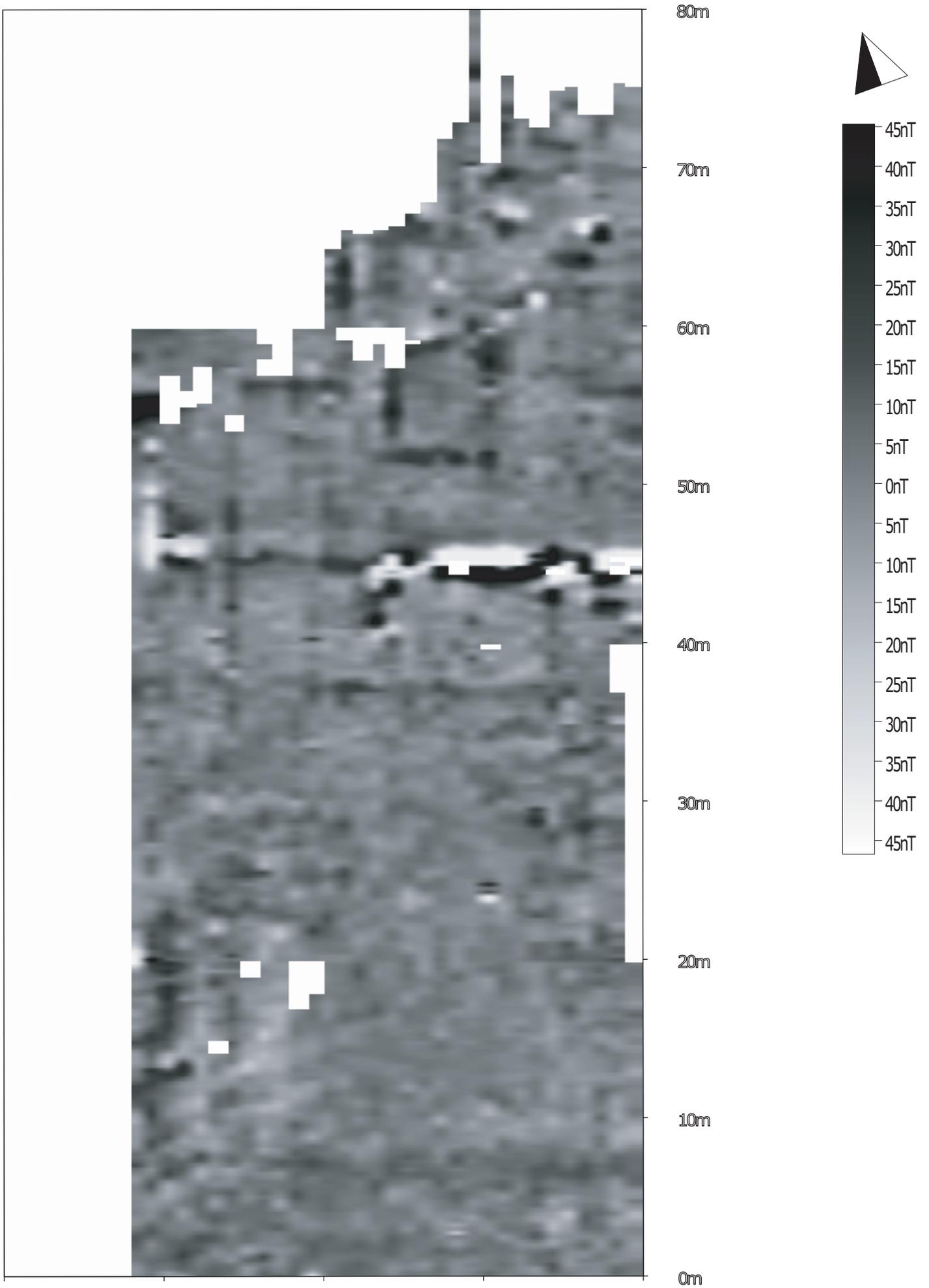


Figure 2: West bank of D6 / East bank of D6 - processed results

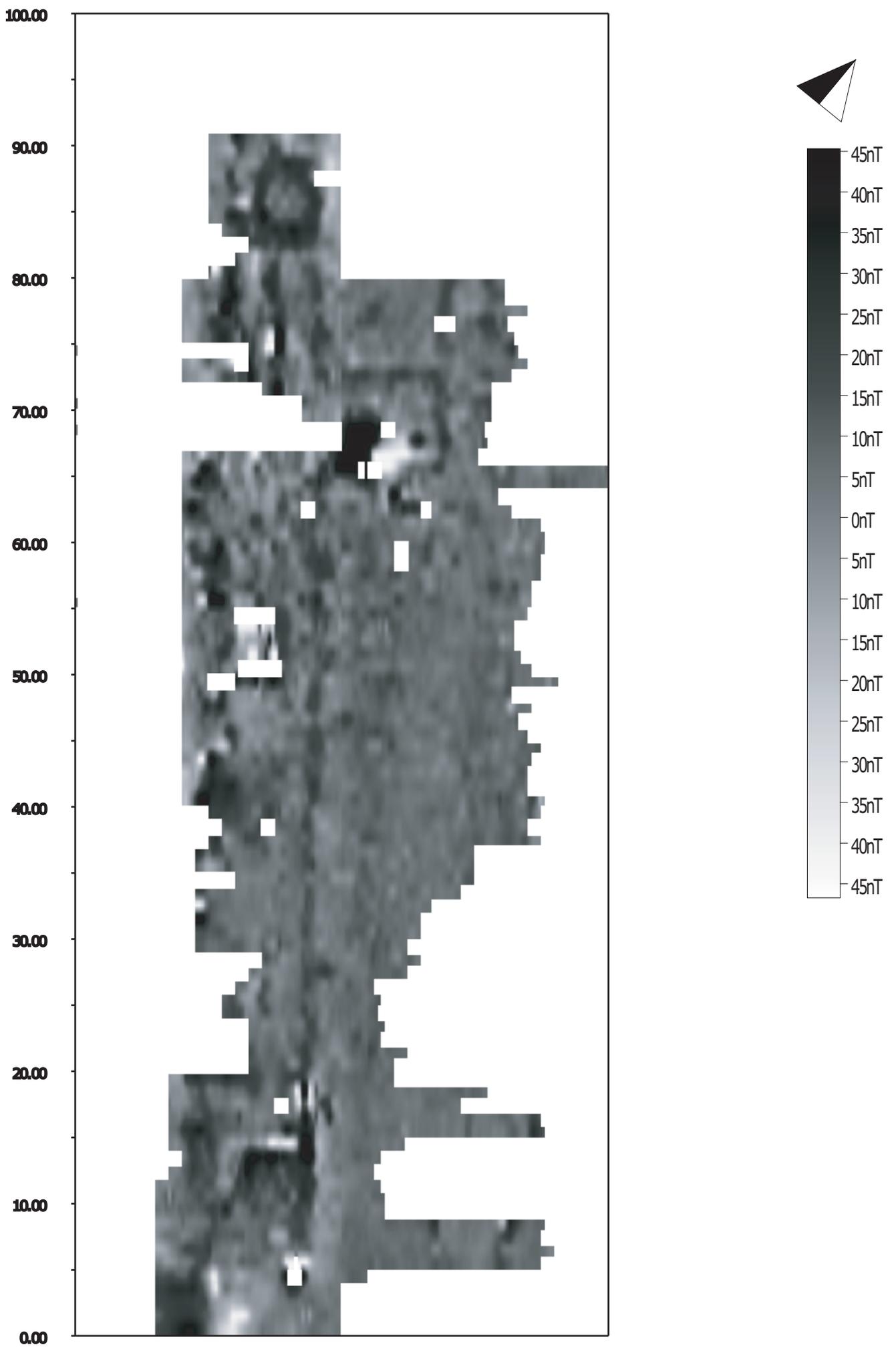


Figure 3: North bank of D6 processed results

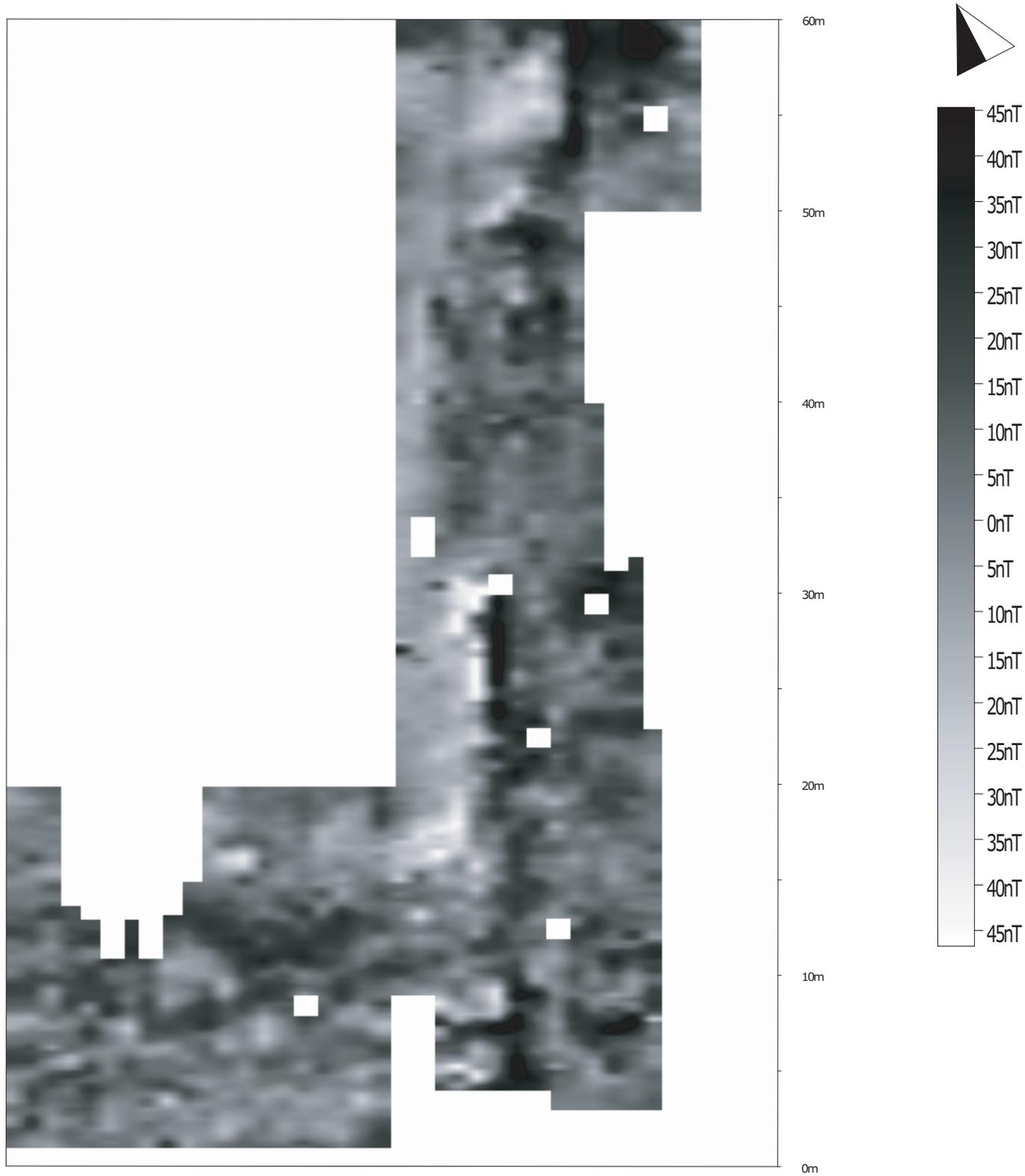


Figure 4: East bank of D6 processed results

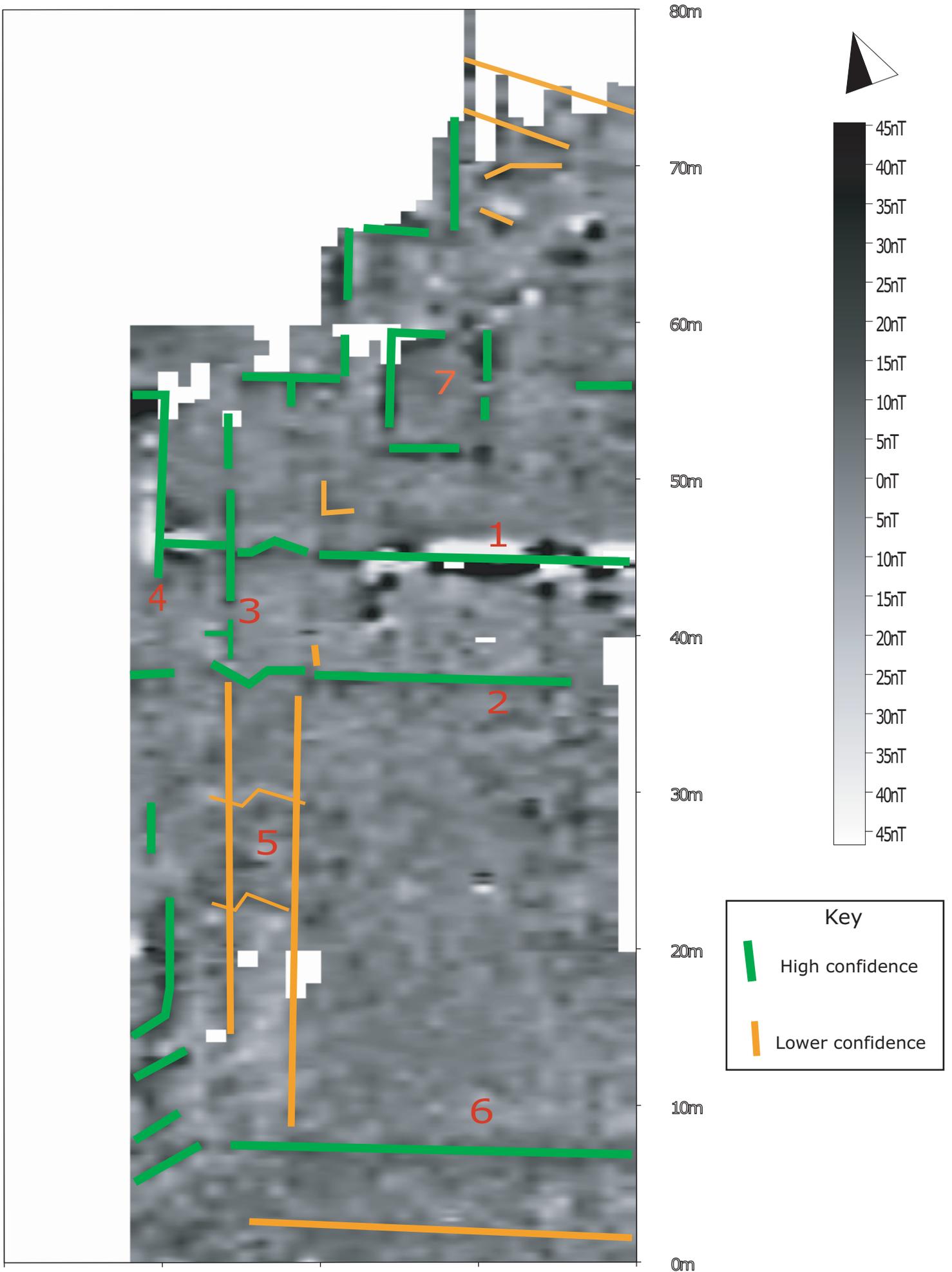


Figure 5: West bank of D6 / East bank of D6 processed results

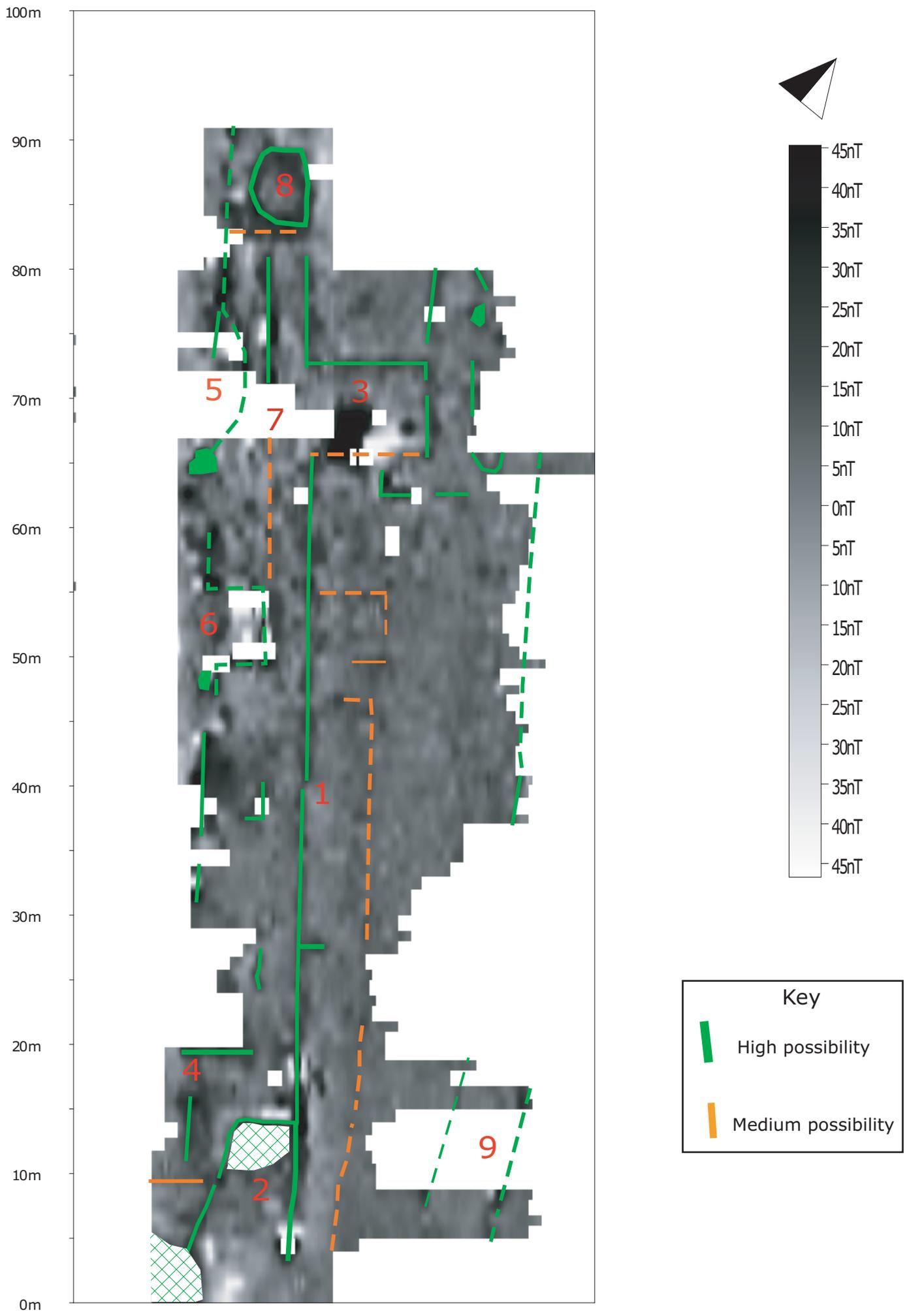


Figure 6: North bank: interpretation

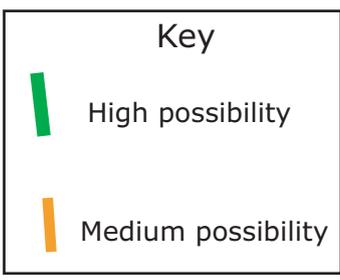
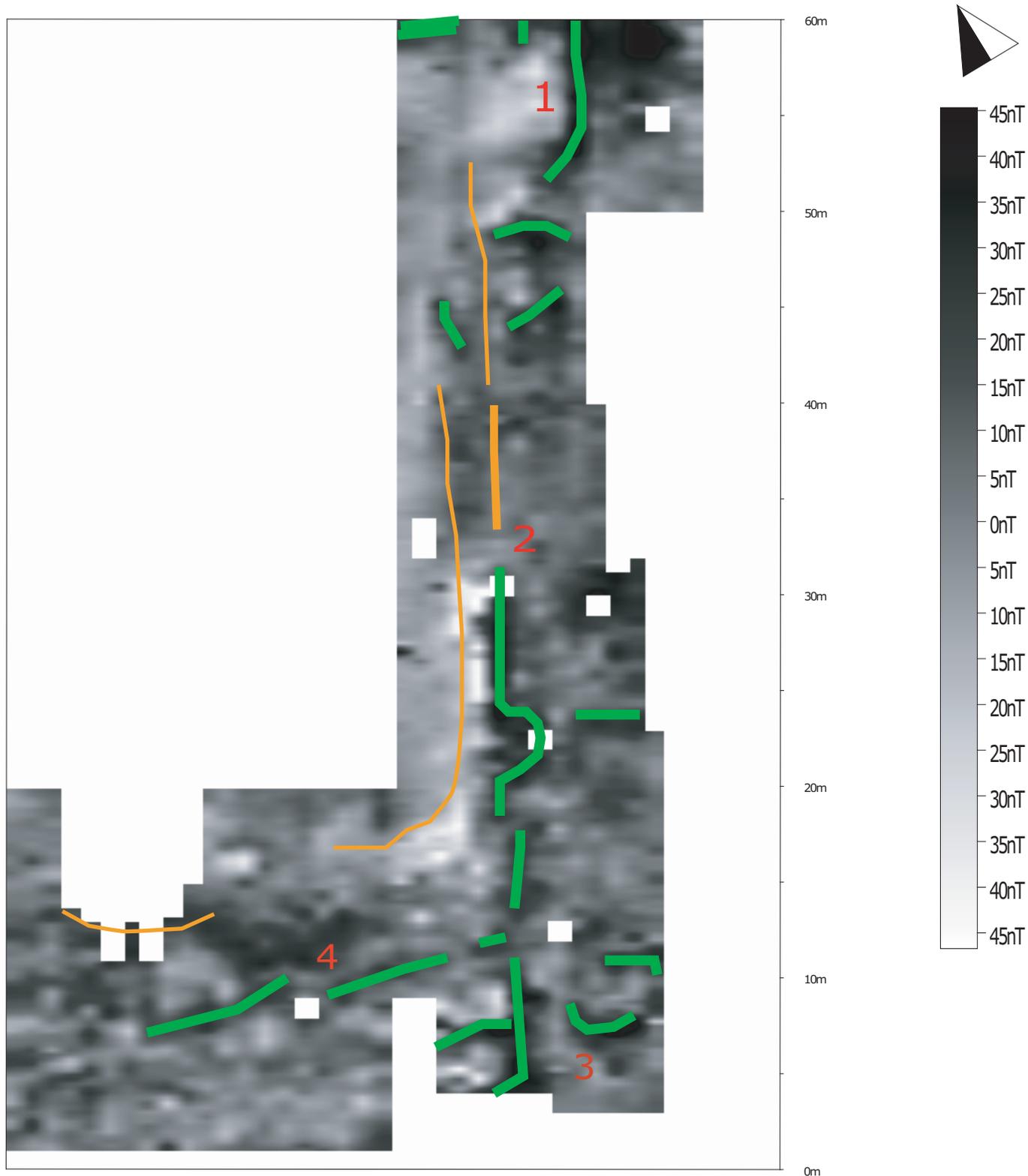


Figure 7: East bank of D6 interpretation

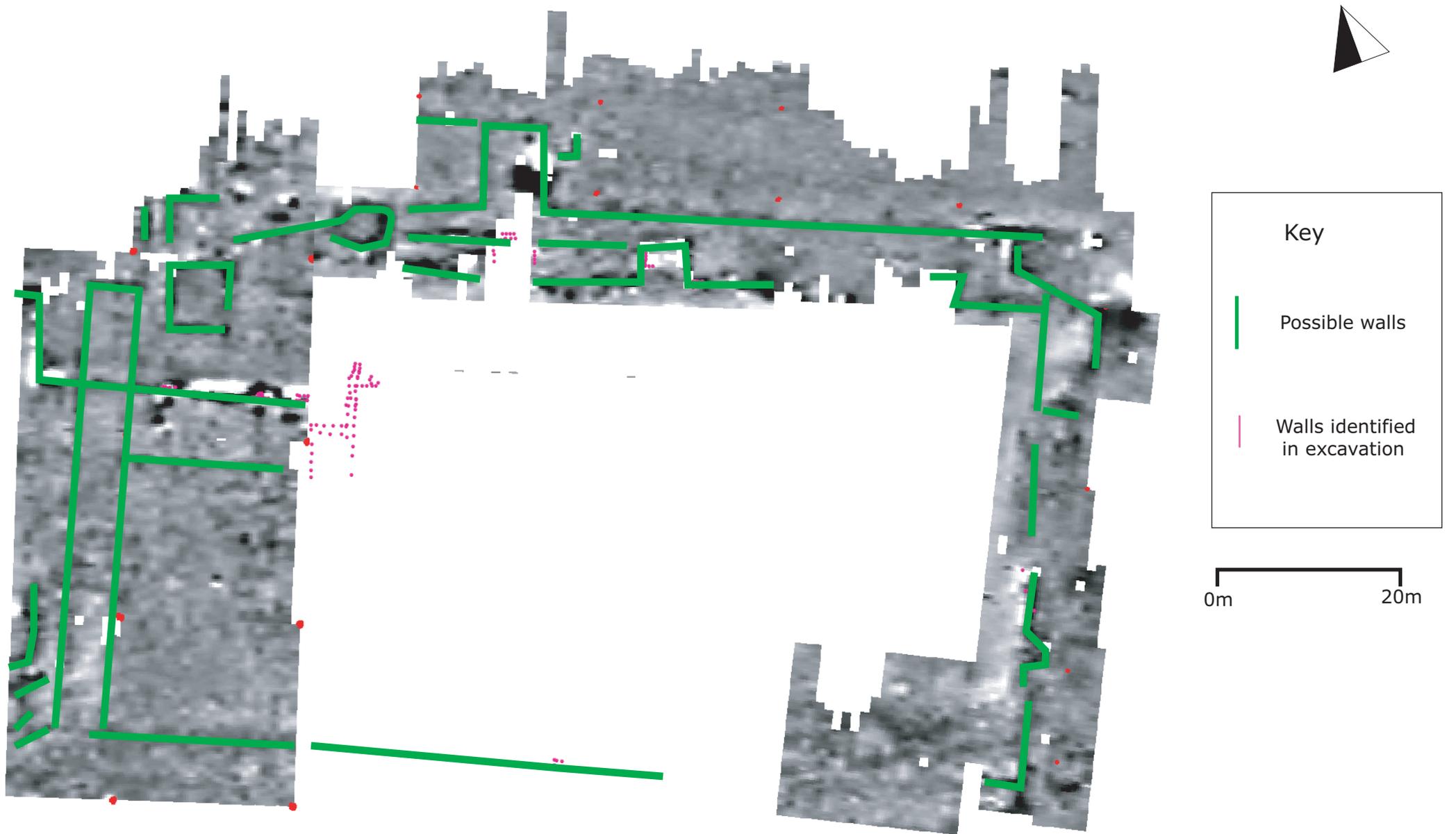


Figure 8: Simplified plan of archaeological features identified at D6 / D5

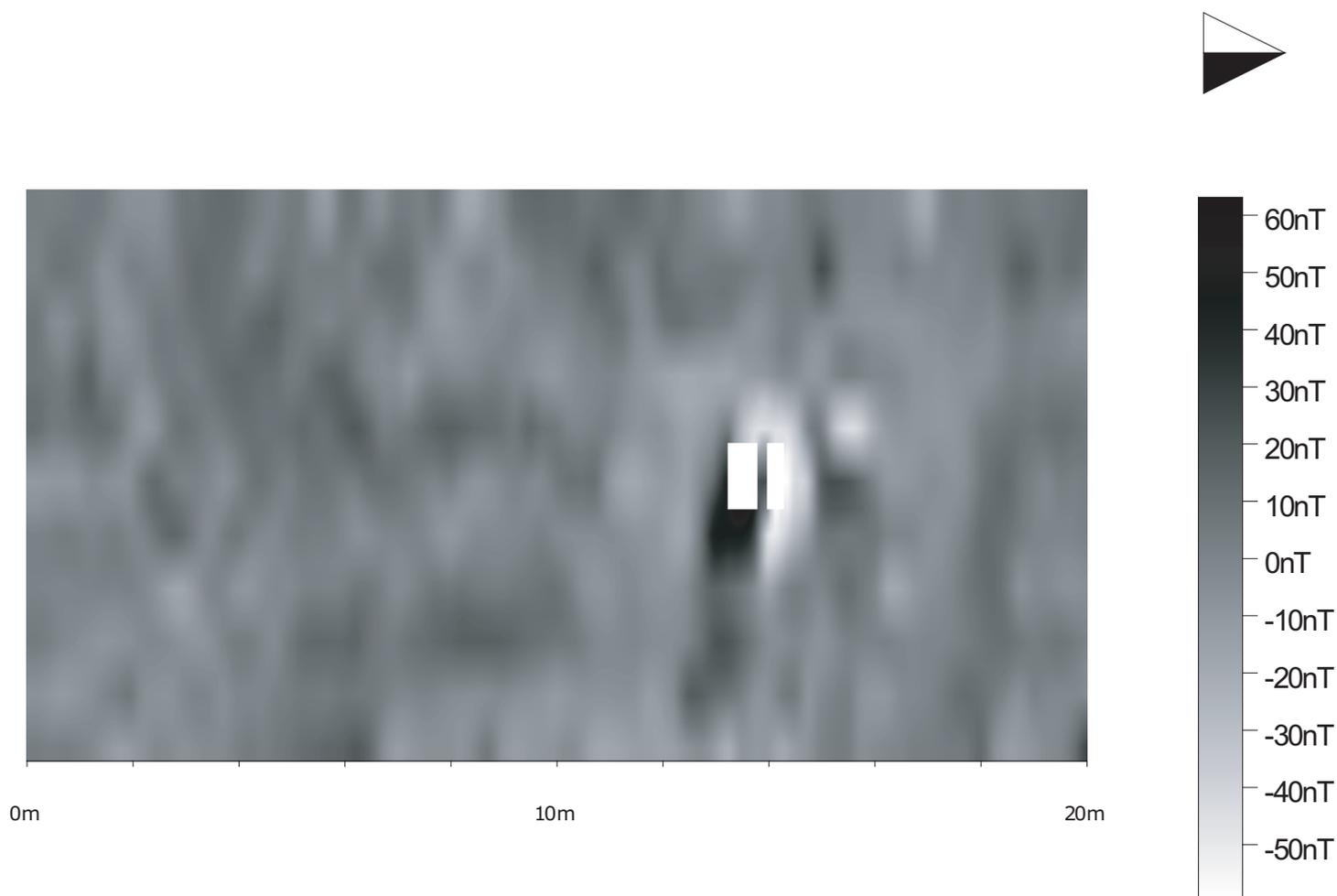


Figure 9: Vicus Augustanus - Area 1 processed results

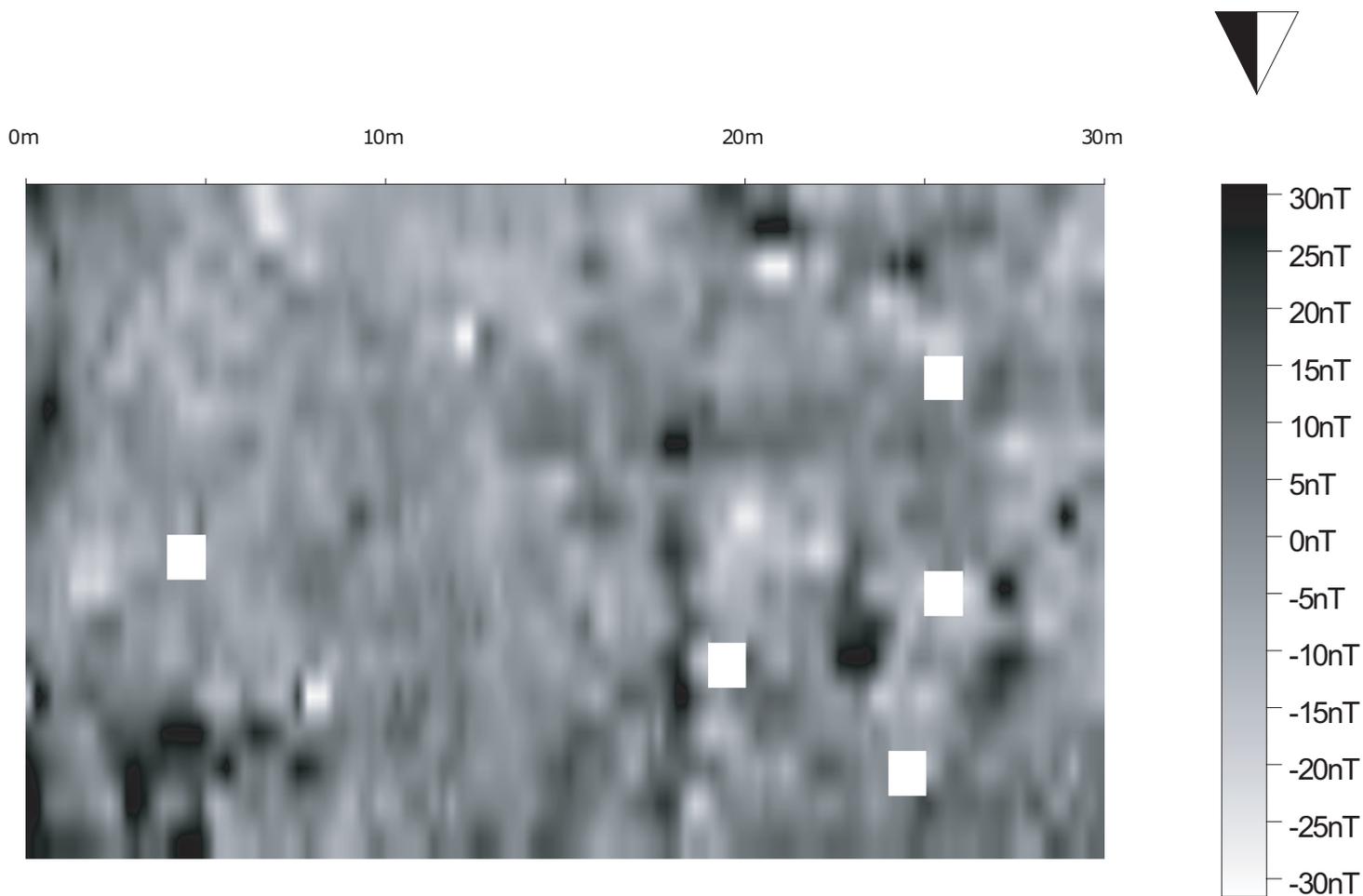


Figure 10: Vicus Augustanus - Area 2 processed results

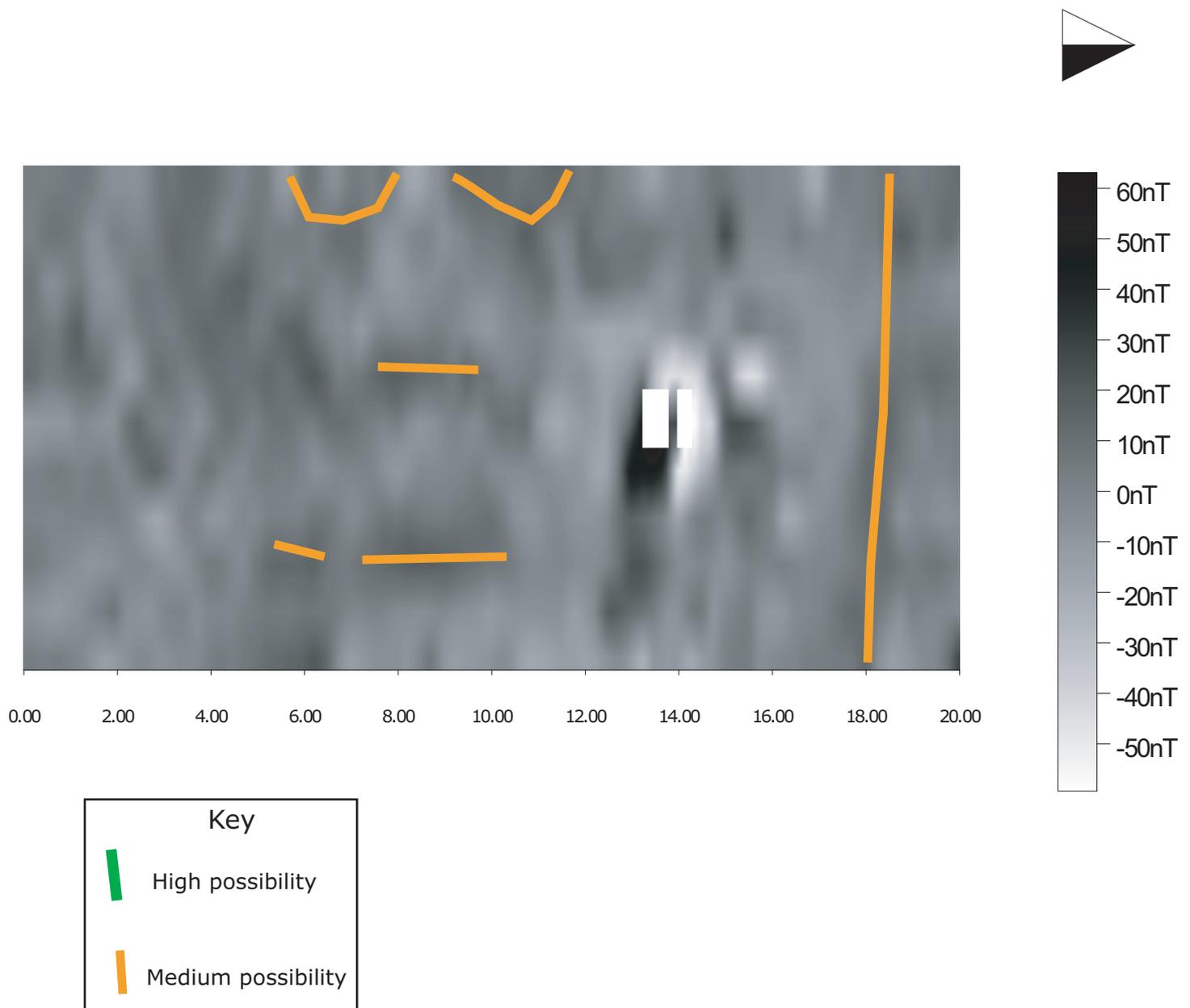


Figure 11: Vicus Augustanus - Area 1 interpretation

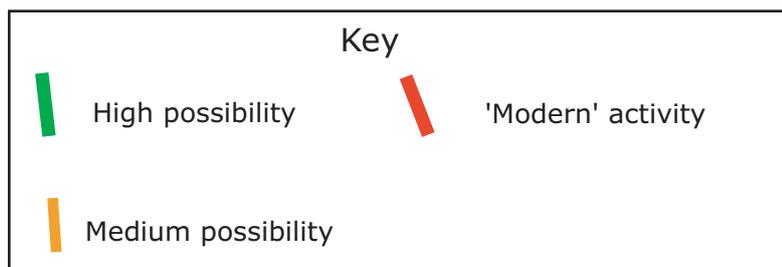
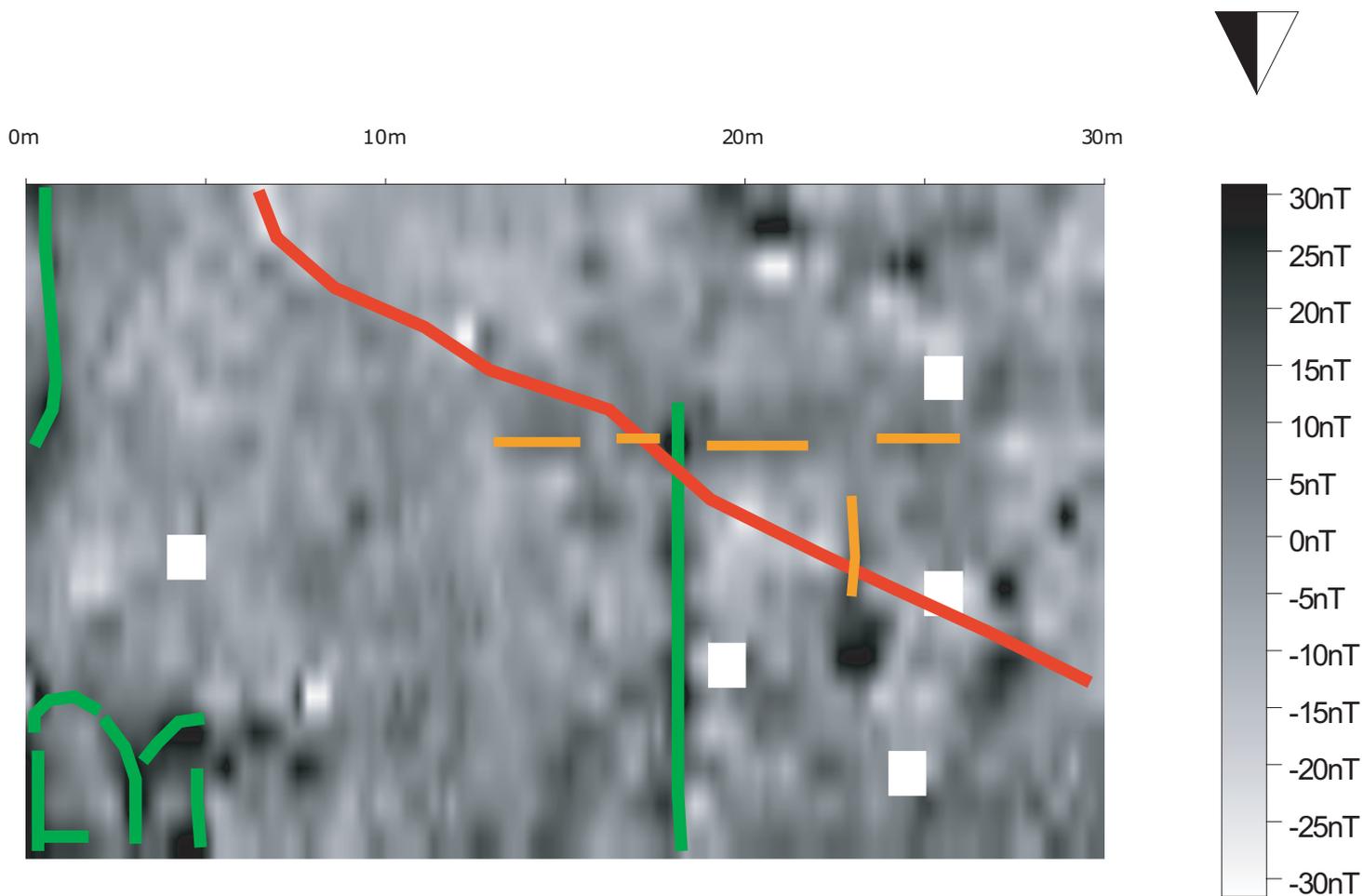


Figure 12: Vicus Augustanus - Area 2 interpretation

Appendix 1: Project Metadata (ADS standard)

<u>Field Name</u>	<u>Description</u>	<u>Relevant Types</u>	<u>Required</u>	<u>Metadata</u>
Survey Name	Name of the survey or project	All	Yes	The evolution of Rome's maritime facade: archaeology and geomorphology at Castelporziano.
Survey Purpose	A brief description of the project including its aims and objectives.	All	Yes	The survey was conducted in two parts: 1) To survey the banks of the features tentatively identified as fishfarms (D5 / D6) to provide an architectural plan of surviving features. 2) To survey open areas around the Vicus Augustanus in an attempt to evaluate the effectiveness of geophysical survey on the site
Bibliographic References	Any relevant references to the work or project.	All	No	Evans, T. 2008: Geophysical Survey at Castelporziano 2008
Survey Keywords	Keywords related to the survey or project	All	No	Magnetometry, vicus, fishfarm, roman
Spatial Coverage	Coordinates of the survey area or areas. Include coordinate system.	All	Yes	N/A
Administrative Area	Political or administrative place names where work was conducted	All	Yes	Castelporziano
Country	Country or Countries of work	All	Yes	Italy
Solid Geology	The underlying bedrock of the site	All	Yes	Not known
Drift Geology	The presence of transported rock debris or geological deposits	All	No	Wind-blown sand

Duration	The dates which the survey took place	All	Yes	9 th -18 th April 2008
Weather	Weather conditions during the survey	All	No	Generally fine with occasional showers and high winds
Land-use	A description of the land use	All	Yes	Woodland – dense ground vegetation
Monument Type	The type of site or monument, preferably based on a controlled vocabulary (such as MIDAS). If it is a Scheduled Ancient Monument type include the SAM number (UK only)	All	No	N/A
Surveyor	The individual(s) or unit which conducted the survey	All	Yes	Tim Evans
Client	The client for which the survey was conducted	All	No	N/A
Depositor	Depositor of the survey data	All	No	Amanda Claridge
Copyright	Copyright owner of the survey data	All	Yes	Amanda Claridge and Tim Evans
Survey Type	The type of survey (ie. Gradiometry, Resistivity, GPR, etc)	All	Yes	Gradiometry
Instrumentation	The model or equipment employed in survey	All	Yes	Geoscan FM36
Number of Files	The number of output or data files	All	Yes	112
File Extensions	The extension types of the files and description	All	Yes	Original files collected as Geoscan Grid files comprising a .dat / .grd / .grs All files exported as ASCII text files (.txt) with composite files saved as (.tif)
Area Surveyed	The size of the area surveyed	All	Yes	6350 metre squared
Method of Coverage	The track or path taken for the survey (ie. Zigzag, Regular Grid)	All	Yes	Parallel traverse

Traverse Separation	Distance between traverses	All	Yes	1.0 metres
Sample Interval	Distance between taken readings	All	Yes	0.25 metres
Position of First Traverse	A general location of the first line of the square/survey	All	Yes	0.5m
Direction of First Traverse	A general direction of the first line of the square/survey	All	Yes	North
Probe Configuration	Configuration of instrument used during survey	Resistivity	Yes	N/A
Probe Spacing	Distance between probes	Resistivity, Gradiometry	Yes	N/A
Antenna	The antenna frequency of the survey	GPR	Yes	N/A
File Format	Type of data files	GPR	Yes	N/A
Instrument Specific	Any other information that is relevant to the data collection stage of the survey. For example GPR: Antenna separation, Pulsar voltage, Number of stacks, etc.	All	No	Zero Log drift / Averaging were NOT enabled
Additional Remarks		All	No	
Report Title	Title of related report(s)	All	No	Geophysical Survey at Castelporziano 2008
Report Author	Author of report	All	No	Evans,T
Report Holder	Holder of report. For example, could be unit or County Council.	All	No	N/A