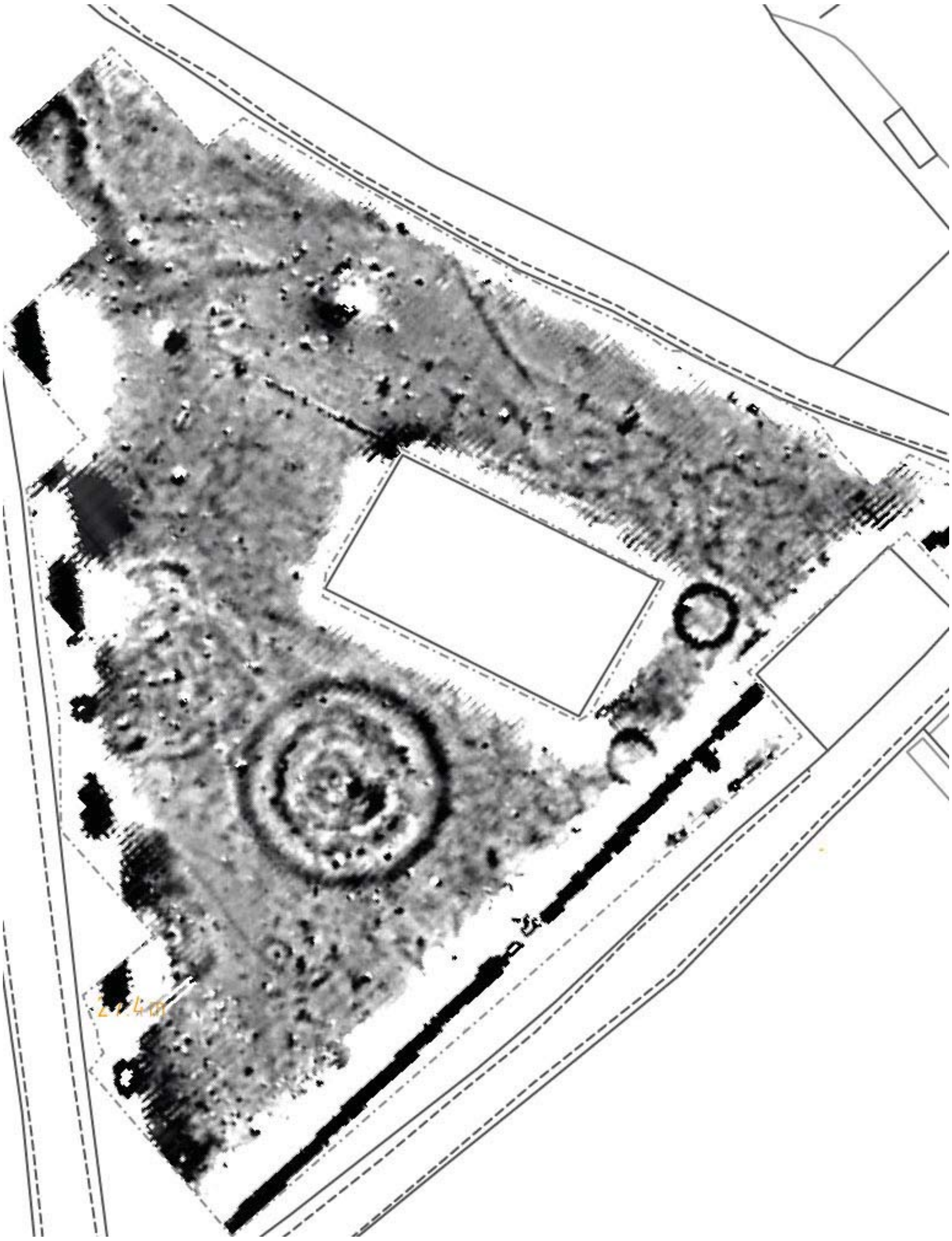
PLAS GOGERDDAN

Geophysical survey



Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

Plas Gogerddan

Geophysical Survey

Project No. 2484

Prepared for: Ceredigion Historical Society/RCAHMW

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GEOPHYSICAL SURVEY AT PLAS GOGERDDAN (G2484)

1. Introduction

Gwynedd Archaeological Trust was asked to carry out a high resolution fluxgate gradiometer survey at Plas Gogerddan by the Ceredigion Histoical Society and the Royal Commission on the Ancient and Historical Monuments of Wales. The survey area, centred on SN62658350, comprised a triangular area of 1.4ha bounded on all three sides by modern roads.

2. Archaeological background

The survey area was situated on a low ridge in the Afon Clarach valley comprising glacial deposits of sand and gravel over a solid geology of Silurian grits. The survey contained a standing stone and a ploughed-down round barrow. An excavation was carried out on the site in response to the construction of a gas pipeline along the eastern edge of the site in 1986. The main excavated features are shown on Fig.1. (Murphy et al 1992). The findings were summarised as follows:

> At Plas Gogerddan, evidence was discovered for human presence from the middle of the fourth millennium B. C. up to the present day. Numerous pits and post-holes were excavated around a standing stone; one of these pits was dated to the tenth-fifteenth centuries B. C. To the west of the standing stone, three ring-ditches were constructed and used in the first millennium B. C.; in association with these ring-ditches were three Iron Age crouched burials. In the vicinity of the standing stone lay twenty-two east-west aligned, extended inhumation graves, three of which were surrounded by rectangular timber structures. A coffin stain from one of these graves was dated to the third-seventh centuries A. D. (Murphy et al, 1)

It was also noted that a racecourse ran along the north-eastern side of the site in the early part of the 19th century.

3. Survey

3.1 Technical Detail

The survey was carried out in a series of 20m grids, which were tied into the Ordnance Survey grid using a Trimble GPS system. The survey was conducted using a Bartington Grad 601-2 dual fluxgate gradiometer. The surveys were carried out at high resolution (0.5m traverse interval by 0.25m sample interval). The survey was carried out by David Hopewell with assistance from Richard Suggett on the 19th and 20th October 2016. The central part of the field was fenced off and contained a former agricultural field trail and was not available for survey.

3.2 Instrumentation

The Bartington Grad 601-2 dual fluxgate gradiometer uses a pair of Grad-01-100 sensors. These are high stability fluxgate gradient sensors with a 1.0m separation between the sensing elements, giving a strong response to deeper anomalies. The instrument detects variations in the earth's magnetic field caused by the presence of iron in the soil. This is usually in the form of weakly magnetized iron oxides which tend to be concentrated in the topsoil. Features cut into the subsoil and backfilled or silted with topsoil, therefore contain greater amounts of iron and can therefore be detected with the gradiometer. This is a simplified description as there are other processes and materials which

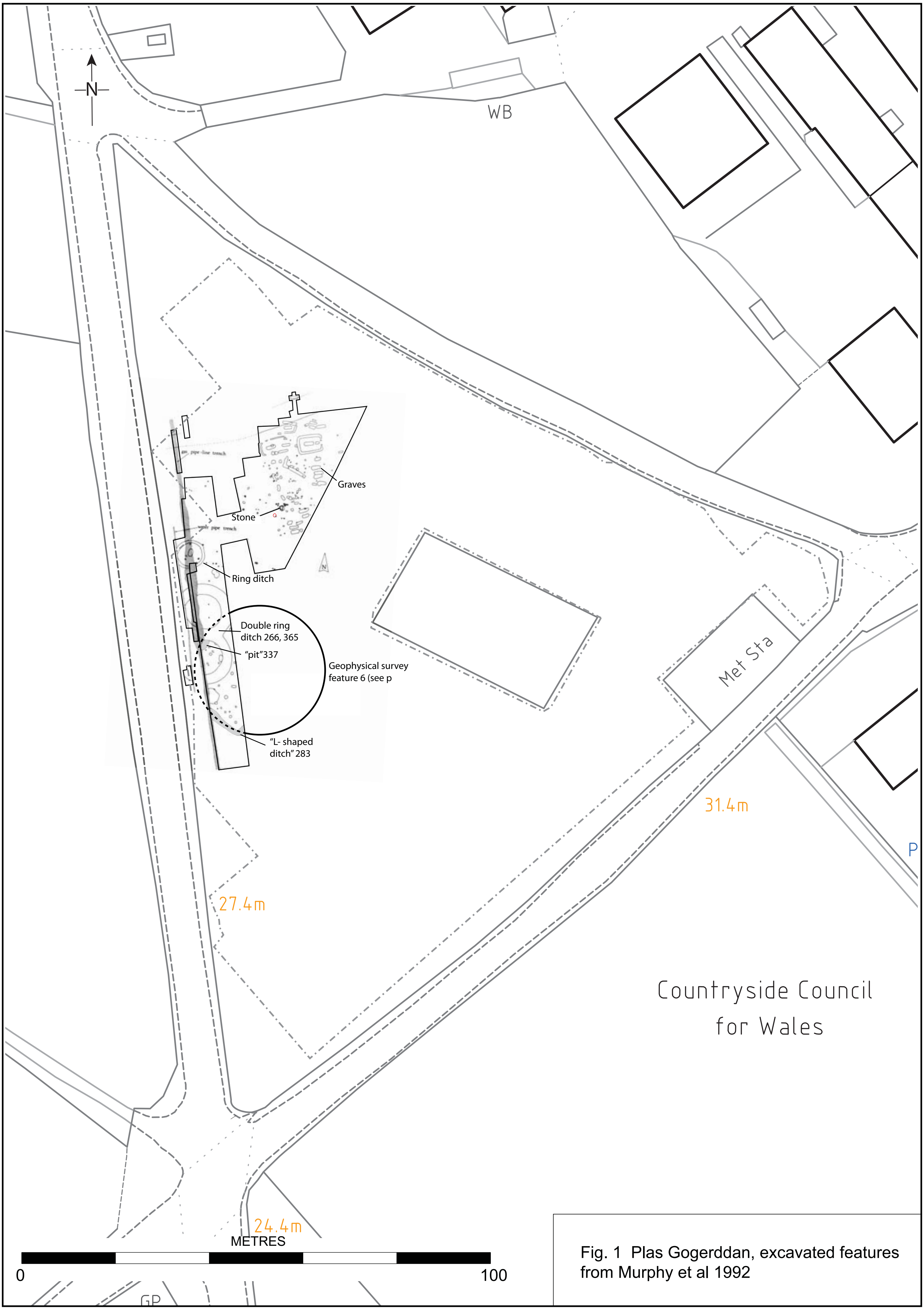

Fig. 1 Plas Gogerddan, excavated features from Murphy et al 1992

can produce detectable anomalies. The most obvious is the presence of pieces of iron in the soil or immediate environs which usually produce very high readings and can mask the relatively weak readings produced by variations in the soil. Strong readings are also produced by archaeological features such as hearths or kilns as fired clay acquires a permanent thermo-remnant magnetic field upon cooling. This material can also get spread into the soil leading to a more generalized magnetic enhancement around settlement sites. Not all surveys can produce good results as results can be masked by large magnetic variations in the bedrock or soil or high levels of natural background "noise" (interference consisting of random signals produced by material with in the soil). In some cases, there may be little variation between the topsoil and subsoil resulting in undetectable features. The Bartington Grad 601 is a hand held instrument and readings can be taken automatically as the operator walks at a constant speed along a series of fixed length traverses. The sensor consists of two vertically aligned fluxgates set 500mm apart. Their cores are driven in and out of magnetic saturation by a 1,000Hz alternating current passing through two opposing driver coils. As the cores come out of saturation, the external magnetic field can enter them producing an electrical pulse proportional to the field strength in a sensor coil. The high frequency of the detection cycle produces what is in effect a continuous output. The gradiometer can detect anomalies down to a depth of approximately one meter. The magnetic variations are measured in nanoTeslas (nT). The earth's magnetic field strength is about 48,000 nT; typical archaeological features produce readings of below 15nT although burnt features and iron objects can result in changes of several hundred nT. The machine is capable of detecting changes as low as 0.1nT.

3.3 Data Collection

The gradiometer includes an on-board data-logger. Readings are taken along parallel traverses of one axis of a 20m x 20m grid. The traverse interval was 0.5m. Readings were logged at intervals of 0.25m along each traverse

3.4 Data presentation

The data is transferred from the data-logger to a computer where it is compiled and processed using TerraSurveyor software. The data is presented as a grey-scale plot where data values are represented by modulation of the intensity of a grey scale within a rectangular area corresponding to the data collection point within the grid. This produces a plan view of the survey and allows subtle changes in the data to be displayed. This is supplemented by an interpretation diagram showing the main feature of the survey with reference numbers linking the anomalies to descriptions in the written report. It should be noted that the interpretation is based on the examination of the shape, scale and intensity of the anomaly and comparison to features found in previous surveys and excavations etc. In some cases the shape of an anomaly is sufficient to allow a definite interpretation e.g. a Roman fort. In other cases all that can be provided is the most likely interpretation. The survey will often detect several overlying phases of archaeological remains and it is not usually possible to distinguish between them. Weak and poorly defined anomalies are most susceptible to misinterpretation due to the propensity of the human brain to define shapes and patterns in random background "noise". An assessment of the confidence of the interpretation is given in the text.

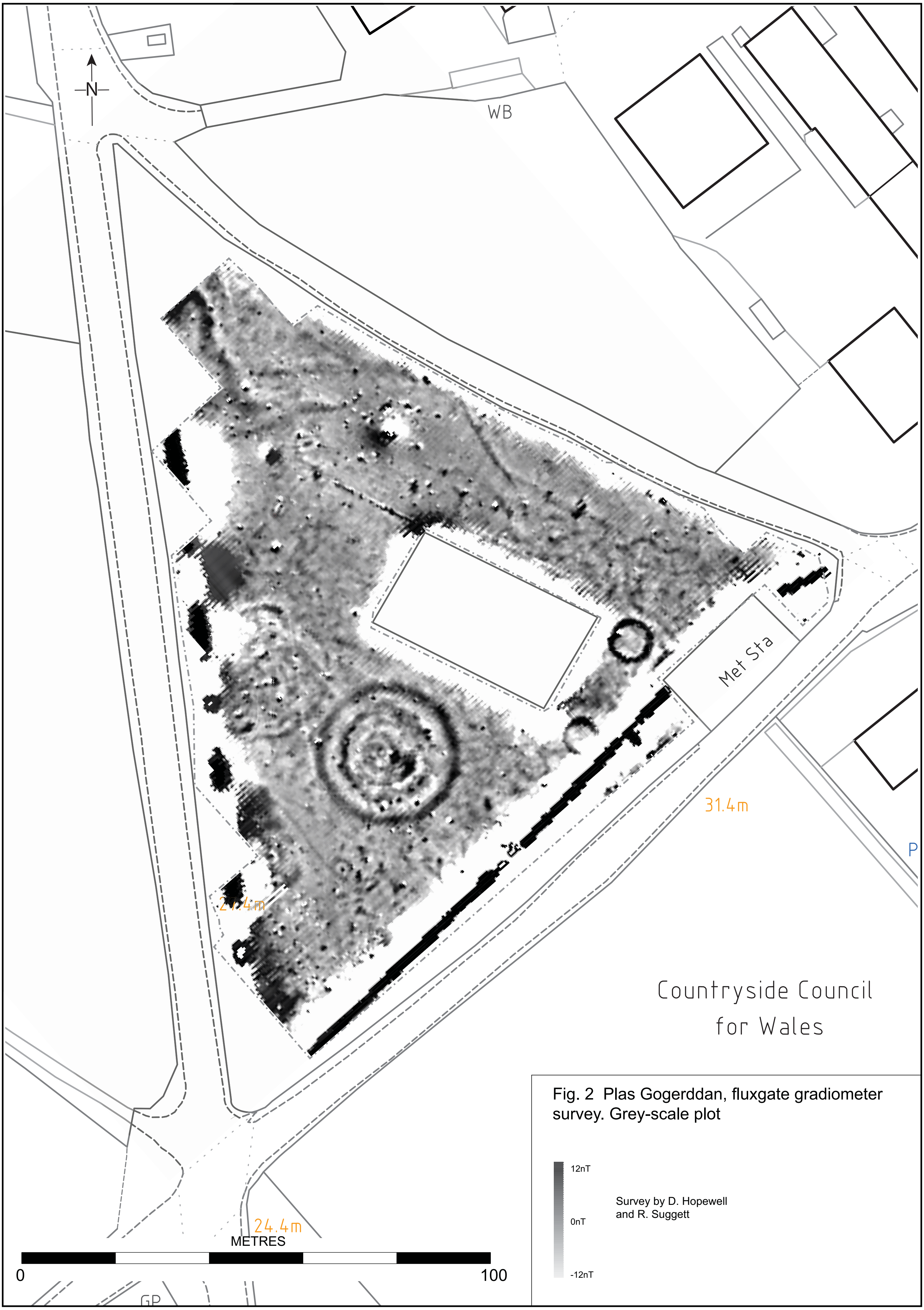

Fig. 2 Plas Gogerddan, fluxgate gradiometer survey. Grey-scale plot

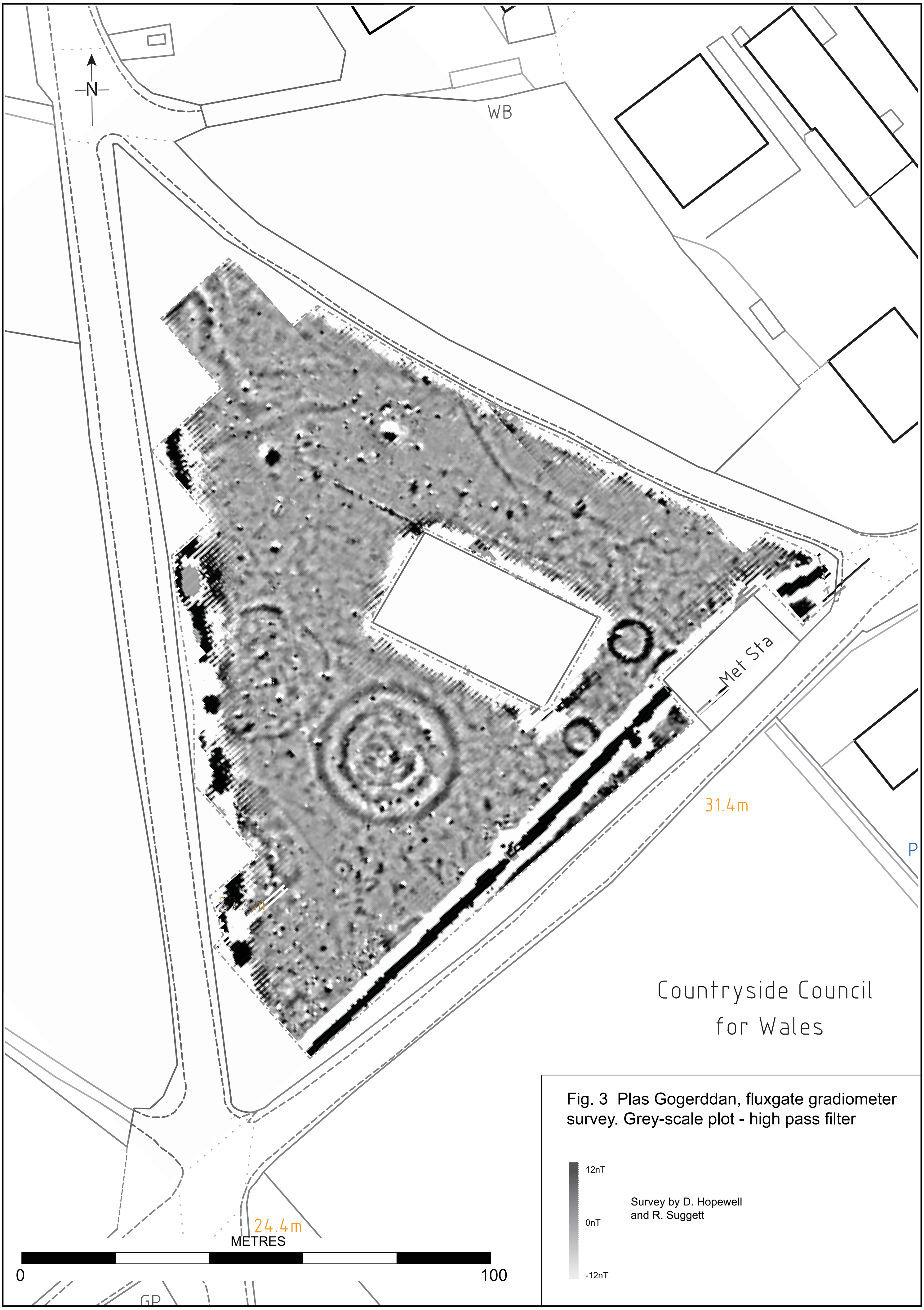

Fig. 3 Plas Gogerddan, fluxgate gradiometer survey. Grey-scale plot - high pass filter

Survey by D. Hopewell
and R. Suggett

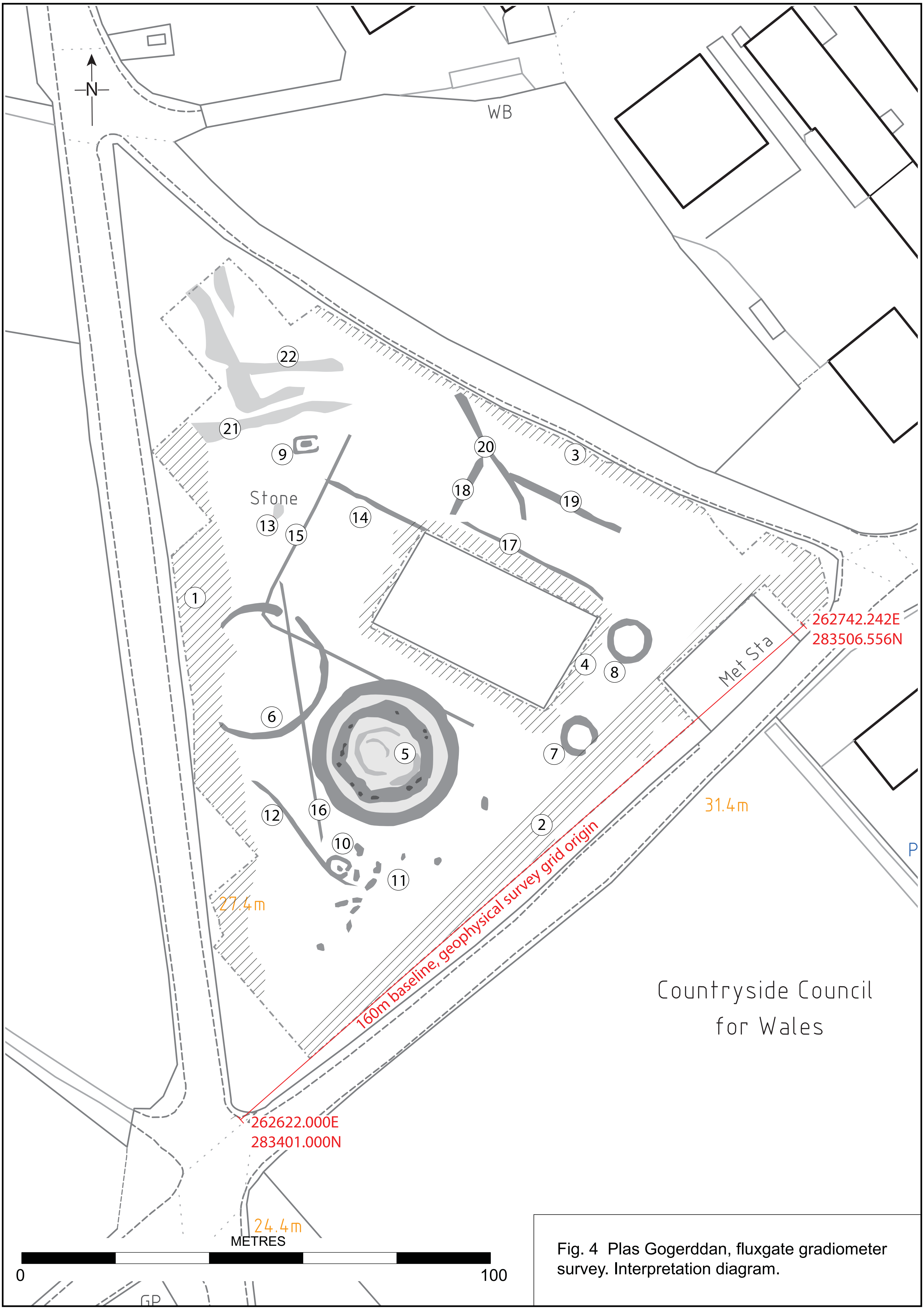

Fig. 4 Plas Gogerddan, fluxgate gradiometer survey. Interpretation diagram.

3.5 Data Processing

The data is presented with a minimum of processing although corrections are made to compensate for instrument drift and other data collection inconsistencies. High readings caused by stray pieces of iron, fences, etc. are usually modified on the grey scale plot as they have a tendency to compress the rest of the data. The data is however carefully examined before this procedure is carried out as kilns and other burnt features can produce similar readings. The data on some 'noisy' or very complex sites can benefit from 'smoothing'. Grey-scale plots are always somewhat pixelated due to the resolution of the survey. This at times makes it difficult to see less obvious anomalies. The readings in the plots can therefore be interpolated thus producing more but smaller pixels. The smoothed data is a default display option in the software (graduated shade). This reduces the perceived effects of background noise thus making anomalies easier to see. Any further processing is noted in relation to the individual plot.

4. Results

The area produced moderate to low levels of background noise as a result of natural variations in the subsoil. This is most marked at the east and south-east sides of the survey where low intensity patterns of interlocking polygonal anomalies were detected. These are best interpreted as being the result of periglacial ice-wedges. The existence of these features was also recorded in the 1986 excavations (ibid, 1). These anomalies were not transcribed on the interpretation diagram. A scatter of anomalies of more recent origin in the form of discrete magnetic dipoles indicating pieces of iron in the topsoil were detected across the whole survey. These are visible on the grey-scale plot as small half black and half white dots and are usually found to be the result of litter such as ring-pulls, nails etc. . These anomalies were also not transcribed.

Fig. 2 is a grey-scale plot with a minimum of processing. Fig. 3 shows the data after application of a high pass filter that removes some of the large-scale background variations in the data. Fig. 4 shows the interpretation plot with numbered anomalies which are referred to in the text below in bold.

The most dominant anomalies were of recent origin in the form of buried pipelines (**1** and **2**) and steel-wire fences (**3** and **4**). These masked any nearby archaeological anomalies the responses being one or two orders of magnitude stronger.

The most obvious anomaly (**5**) of archaeological origin corresponds to a poorly defined earthwork in the field that has been interpreted as a Bronze Age barrow. The geophysical anomaly, in contrast, is very well-defined comprising a 30m-diameter circular outer anomaly that is best interpreted as a ditch with a corresponding upcast bank on the inside. A second inner concentric circular anomaly is 18.5 in diameter and is less well defined. This appears to include discrete smaller anomalies that could be interpreted as a ring of post –holes quarry –pits or other cut features. This shows that the barrow is a complex and possibly multiphase structure, the possible post holes could be tentatively interpreted as a hengiform monument dating from an earlier phase. Further roughly circular anomalies in the centre of the barrow indicate additional structural elements.

A second slightly irregular circular anomaly (**6**), 29m in diameter, immediately to the north-west appears to be a simple ditch, which may have a break or entrance on the north-eastern side. This is noticeably different to the barrow (**5**) and appears to be a relatively slight feature comprising a single ditch. Its relationship to the excavated features immediately to the west is problematic. It must have been cut by the double ring ditch. Two fragments of features in this area one of which was mostly removed by the double ring ditches could be reinterpreted as parts of the circular feature. The first was a small part of a feature interpreted as a shallow pit (feature 337) and the second a length of L-shaped ditch (feature 283). Both had similar shallow u-shaped profiles and could possibly be interpreted as being part of the circular geophysical feature, particularly as the survey feature seems to be somewhat irregular. If this interpretation is correct feature **15** dates from the first millennium BC (Radiocarbon date 2770+-60BP (CAR 1073), ibid 12). It could be interpreted either as a simple ring ditch or as a small enclosure. It is very shallow suggesting that it was unlikely to have had a defensive function.

Two further circular anomalies (**7** and **8**) immediately to the west of the Meteorological Station are best interpreted as small ring ditches, 8.0 and 9.2m in diameter, similar to the smallest example found in the excavation (Murphy feature 237.

The excavation revealed an inhumation cemetery of probable early medieval date. The rectangular cut (**9**) around one grave (Murphy feature 237) was detected by the survey. The excavation plan was overlaid onto the greyscale plot and it appears that some excavated graves produced weak anomalies. These were, however, not distinguishable from the background magnetic variation without reference to the plan. These graves did not contain their original fill. No graves were distinguishable beyond the excavated area. Experience has shown that early-medieval graves often do not produce distinguishable magnetic anomalies; the fill usually contains a large percentage of the natural substrate and in the absence of stone-linings, a body and wood may not produce detectable magnetic enhancement. The features are also very small in relation to the data collection intervals. In contrast, the rectangular slots around graves or groups of graves commonly produce clear anomalies and often provide the only geophysical evidence for this site-type.

A cluster of possible anomalies (**10** and **11**) were detected at the south of the survey. Anomaly **10** appears to comprise a circular or subrectangular feature, 5m across, with a central pit. This could be another funerary feature but is poorly defined and could alternatively, and equally convincingly, be interpreted as a result of the periglacial patterning in the subsoil. The same caveat applies to a series of small randomly orientated features in this area (**11**). These could be tentatively interpreted as inhumations although their random orientation suggests that they would not be Christian. Further investigation would be required in order to demonstrate that these anomalies are archaeological.

The standing stone produced a weak anomaly (**12**)

A series of linear anomalies were detected (**13-19**). Anomaly **12** is a curvilinear narrow anomaly perhaps a drain. Anomalies **14** and **15** are modern boundaries and were visible in the 1986 (Murphy, 3). Narrow negative anomalies **16** and **17** are probably modern, perhaps small cable trenches. Linear 17 is aligned with the modern enclosures and is also likely to be a modern boundary. Linear 19 appears to mark the edge of the former racecourse (ibid). Linear **20** runs at an angle to the modern boundaries and is best interpreted as an element of a former field system.

A group of wide and diffuse anomalies at the north of the site (**21** and **22**) could be interpreted as former boundaries, landscaping, or natural variations in the subsoil.

5. Conclusions

The area survey produced clear results for most classes of monuments although early medieval graves were not detected with any reliability. The ploughed-down large round barrow was shown to retain a considerable amount of structure. The discovery of two further ring ditches when viewed with the 1986 excavation results show that this area was clearly a focus for ritual activity across several millennia inviting comparisons with other multiperiod ritual areas such as Llandygai (Kenney 2008). The ditch of the simple circular ditched feature is

6. References

Kenney, J, 2008 ‘Recent excavations at Parc Bryn Cegin Llandygai near Bangor, North Wales’, *Archaeologia Cambrensis* 157, 9–142.

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