CHANTER'S ORCHARD
ST DAVID'S
PEMBROKESHIRE

GEOPHYSICAL SURVEY

REPORT No 2008/111

Prepared by Dyfed Archaeological Trust
For Cadw

ymddiriedolaeth archaeolegol
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RHIF YR ADRODDIAD / REPORT NO. 2008/111
RHIF Y PROSIECT / PROJECT RECORD NO.65073

Rhagfyr 2008
December 2008

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Gan / By

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Paratowyd yr adroddiad hwn gan / This report has been prepared by Pete Crane

Swydd / Position: Senior Archaeologist

Llofnod / Signature ..... Dyddiad / Date

Mae'r adroddiad hwn wedi ei gael yn gywir a derbyn sêl bendith
This report has been checked and approved by Richard Ramsey

ar ran Ymddiriedolaeth Archaeolegol Dyfed Cyf.
on behalf of Dyfed Archaeological Trust Ltd.

Swydd / Position: Project Manager

Llofnod / Signature ..... Dyddiad / Date

Yn unol â'n nôd i roddi gwasanaeth o ansawdd uchel, croesawn unrhyw sylwadau sydd gennych ar gynnwys neu strwythur yr adroddiad hwn

As part of our desire to provide a quality service we would welcome any comments you may have on the content or presentation of this report

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Cover Photo: General View. View NE

SUMMARY

A geophysical survey was undertaken on the field called Chanter's Orchard, adjacent to the Cathedral and Bishops Palace, St David's, Pembrokeshire. Buildings were observed at either end of the area. However, in the central area, where there is known to be a building complex, nothing was visible other than disturbance or detritus. Part of this project was undertaken during an archaeological demonstration day for the public, with over one hundred visitors and two school groups taking part. This activity was also recorded for the Welsh Television news.

INTRODUCTION

Project commission

Dr Kate Roberts of Cadw contracted Dyfed Archaeological Trust to undertake a geophysical survey on the field called Chanter's Orchard in St David's (centred on NGR SM 7502525370) (Figs 1 and 3) and also to take part in an open day.

Scope of the project

The project was designed to establish whether there were significant archaeological features in the area of the survey.

Report outline

Because of the limited nature of this project, and the considerable archaeological evidence and historic documents relating to St David's, this report is restricted solely to the results of the Chanter's Orchard geophysical survey.

Abbreviations

Sites recorded on the Regional Historic Environment Record (HER) are identified by their Primary Record Number (PRN) and located by their National Grid Reference (NGR). The Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) hold a collection of aerial photographs of the region.

THE SITE

Archaeological potential and location

Activity at St David's is documented from the post-Roman period and it is probable that there was some settlement pre-dating this, although no evidence for this earlier activity has yet been found. There is considerable archaeological potential.

The site is situated within the Walls of the Cathedral Close, in the bottom of the valley in which the Cathedral is located. It is on the northwest side of the road running from the southwest gate in the Close Wall to the Cathedral (Figs 1 and 3). The field slopes gently down from the base of a retaining wall by the road to wooded banks of the River Alun, which is, at this point, a large stream rather than a river.

The field is under roughish pasture, and within it there are a number of undulations, with one notable linear depression running from southeast to northwest. Currently the field is used for livestock grazing. Just prior to the survey the bramble had been cleared from the area adjacent to the road. In the southwest corner of the field there is a silted up fishpond.

History

The detailed plan of the Cathedral Close is taken from Archdeacon Yardley's *Menevia Sacra*, 1720, which indicates that the ruins of the Archdeacon of Carmarthen's House lie in the middle of the field towards the road (Fig 2, L).

The only archaeological work to have been undertaken was in 1970 when a trench was dug across the fishpond (PRN 2651). This trench found that the pond has a wall around its edge and that this appeared to be post-medieval (pers. comm. Wyn Evans, Dean of St David's).

METHODOLOGY

Geophysical Survey Instrumentation

A fluxgate gradiometer survey provides a relatively swift and completely non-invasive method of surveying large areas.

The survey was carried out using a Bartington Grad601-2 dual Fluxgate Gradiometer, which 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 magnetised 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. There are, however, other processes and materials that 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. Archaeological features such as hearths or kilns also produce strong readings because fired clay acquires a permanent thermo-remnant magnetic field upon cooling. This material can also get spread into the

surrounding soil leading to a more generalised magnetic enhancement around settlement sites.

Not all surveys produce good results as anomalies can also 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 within the soil). In some cases, there may be little variation between the topsoil and subsoil resulting in features being un-detectable. It must therefore be stressed that a lack of detectable anomalies cannot be taken to mean that that there are no below ground archaeological features.

The Bartington Grad601 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 1.0m apart. Their Mumetal cores are driven in and out of magnetic saturation by an 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 (Clark 1996).

The gradiometer can detect anomalies down to a depth of approximately one metre. 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 instrument is capable of detecting changes as low as 0.1nT.

Geophysical Survey Data Collection

The gradiometer includes an on-board data-logger. Readings in the surveys were taken along parallel traverses of one axis of a grid made up of 20m x 20m squares. The traverse interval was 0.5m. Readings were logged at intervals of 0.25m along each traverse giving 3200 readings per grid square (medium resolution).

Geophysical Survey Data presentation

The data was transferred from the data-logger to a computer where it was compiled and processed using ArchaeoSurveyor 2 software. The data is presented as grey-scale plots (Figs 3 to 5) 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 features of the survey with reference numbers linking the anomalies to descriptions in the written report (Fig 6). 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 for 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.

Geophysical Survey 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 pixellated 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 and a small amount of low pass filtering can be applied. 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.

Interpretation and reliability

An interpretation diagram is produced for each data set. It should be emphasised that this cannot be seen as a definitive model of what lies below the ground surface. The survey results indicate the general shape of features and the intensity of the magnetic response. The shape of the feature is the principle diagnostic tool. This can produce definite results in some cases (e.g. a Roman fort is readily identifiable) but often produces a range of possible interpretations. A simple linear anomaly could be interpreted as, amongst other things: a ditch, a drain, a plastic water pipe, a ploughed out bank, or a buried trackway. The intensity of the magnetic response gives further information, a strong response indicates burning, iron or thermoremnancy in geology. Comparison with known features from other surveys is always useful; the general appearance of an anomaly can give additional information to an experienced geophysicist. When all factors are taken into account the interpretation of major features such as defensive ditches and buildings is usually reasonably secure. Interpretation becomes less definite as anomalies become weaker and begin to blend into the background noise. The human brain attempts to identify known objects within relatively random patterns and this can tend to lead to less than reliable interpretations.

Geophysical survey is an immensely useful tool but it should be realised that while a survey will detect a wide range of features, it may not detect *all* buried features. A gradiometer survey detects changes in magnetic flux density and relies on there being a detectable difference between the archaeology and the substrate. This may not occur for many reasons (e.g. a cut feature being backfilled with subsoil). It must therefore be stressed that a lack of archaeological responses from a geophysical survey does not prove that there is no archaeology present.

Grid locations

The survey grids were located by measurements to fixed points such as field boundaries.

RESULTS

Limitations

The survey was undertaken on the 8th and 9th July 2008. The first day the weather was very good but on the second day it was atrocious. The open day was on the 16th July 2008. The survey area was approximately 0.5ha. with the majority under longish grass. There were also undulations, and a steep rise just by the roadside wall hampered smooth data collection. On the southwest side of the site there was the fishpond and alongside the River Alun there were trees with overhanging branches plus some fallen timber, rendering this edge of the site impossible to survey.

The underlying geology is Pre-Cambrian, Pebidian Volcanic Series which did not appear to cause any geological survey problems. There was a little background magnetic noise from recent detritus and/or disturbances over all of the survey area, plus considerable disturbance from a metal pipe and manhole cover. All of these gave considerable problems finding a zero point, to calibrate the instrument, in either this field or to the west of the Bishops Palace, hence there is some striping in the results. Consequently, the results have been presented in both clipped data and also de-striped, as de-striping filters out some of the results especially around areas of high responses.

Because of the time available the majority of the area where results were indicated was re-surveyed with traverses at 90° to the initial survey. During the open day the northern part of this second survey was completed at very high resolution (0.25m by 0.25m interval readings totalling 6400 readings per 20m by 20m grid), to see if this would notably improve results and how much additional time this would take.

Geophysical interpretation

The results of the survey clearly indicate two separate negative anomalies (lighter) at either end of the field (1) and (2)(Fig 6). These probably represent the footings of buildings, possibly where the wall material has been robbed. The northern building (2) may be the structure indicated on Archdeacon Yardley's *Menevia Sacra*, 1720, to the north (right) of the ruins of the Archdeacon of Carmarthen's House (Fig 2, L). At the southeast end of this building (2) there may be a hearth or oven (3). To the northwest there was another area with a higher response (4) which could also be a thermo-remnant (heat affected) response but is more likely to derive from ferrous material and is probably modern. There may also be another possible small building (5), but his could just be adjoining linear anomalies and was only seen in the second survey.

In the middle of the site, where Yardley's Map of 1720 places the location of the Archdeacon of Carmarthen's House, there was no definitive indication of any buildings (Fig 2, L). However, there are a large number of small, dipolar responses (6)(adjacent black and white) which are likely to represent small ferrous debris or spread thermoremnant material such as ash, brick or tile. This may be evidence of the demolished buildings at this location. There are also linear anomalies (7and 8) on either side of this spread that would be consistent with two of the boundaries on Archdeacon Yardley's *Menevia Sacra*, 1720. A modern pipe trench possibly obscured the boundary to northeast.

There are a number of linear negative responses. Although these could be the remains of banks, they are more likely to be ditches. It is also possible that those

to the southwest may be modern drains (pers. comm. Wyn Evans, Dean of St David's).

There are a number of other obvious and fainter anomalies. These may represent: hearths, pits, large postholes or bits of masonry, along with ferrous detritus. Many of these features may be modern.

Open Day

During the open day there were over 100 visitors and two school parties. Archaeological geo-surveying, using the gradiometer, was demonstrated and explained, including its limitations. Also mentioned were the other main methods of geo-survey, earth resistance and ground penetrating radar, and how these methods can overcome some of the gradiometers limitations whilst having limitations of their own. While undertaking the initial survey there were about 20 to 30 enquires from visitors each day to whom the basics of the project were explained.

The opportunity was also taken to resurvey part of the site at very high resolution (0.25m by 0.25m interval readings totalling 6400 readings per 20m by 20m grid). This was found not to give significantly better results while taking over twice as long to complete.

RECOMMENDATIONS

There are a number of undulations on the site, some of which are linear. Where there are "humps and bumps" it is advisable to undertake a topographical survey onto which the geophysical survey results can be placed, as this often aids interpretation

Although this site has a lot of activity on it two probable buildings can be seen (Fig 6 1 and 2), and one possible building (5). These are not necessarily dwellings and are more likely to be outbuildings. Small test pits could be dug to evaluate these possible buildings.

The area of the Archdeacon of Carmarthen's House is hidden by ferrous debris and other disturbance, possibly a result of the demolition of the buildings. Using an earth resistance survey may circumvent this debris and give a clearer plan of the remains of any buildings.

There are also other areas on the north side of the Cathedral that would also benefit from geophysical survey. It is recommended that a gradiometer survey is undertaken in the first instance, probably in conjunction with a topographical survey. This may identify more limited areas where alternative geophysical survey methods may be desirable.

There is clearly a lot of public interest in archaeology and a lot of misconceptions about geophysics, further open days would be of obvious benefit, but also where the sites are close to passing visitors or the general public more effort should be made to inform them, possibly with temporary information panels.

CONCLUSION

This project has confirmed that there are major archaeological features within the site that can still be recorded despite the modern presence of pipe trenches, manholes and wire tree cages totally obscuring some areas. The demonstration of this work in conjunction with the open day proved to be a great success

ACKNOWLEDGEMENTS

Thanks are due to Andrew Shobbook, DAT, for assistance with the survey and open day and Ciaran Crane, for help with surveying during the open day.

ARCHIVE DEPOSITION

The archive will initially be held by DAT, before passing it onto the National Monument Record, Aberystwyth.

SOURCES

Clark A J 1996 *Seeing Beneath the Soil* (2nd edition). Batsford. London

Photo 1: Chanter's Orchard field to St David's Cathedral. View NE

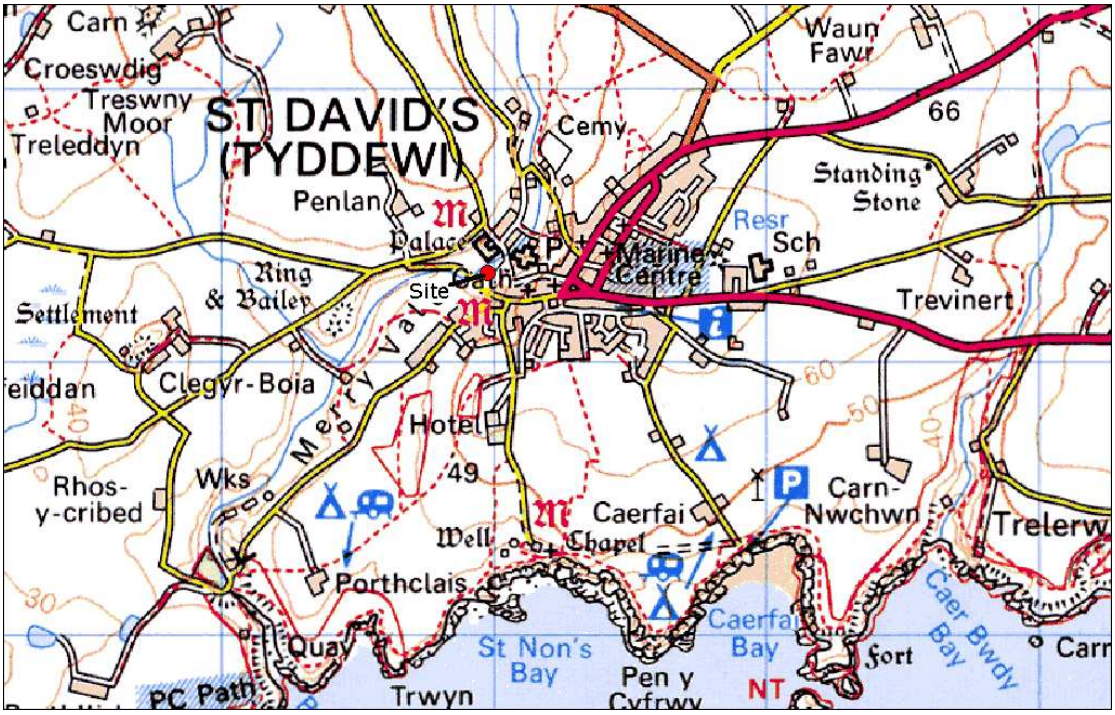
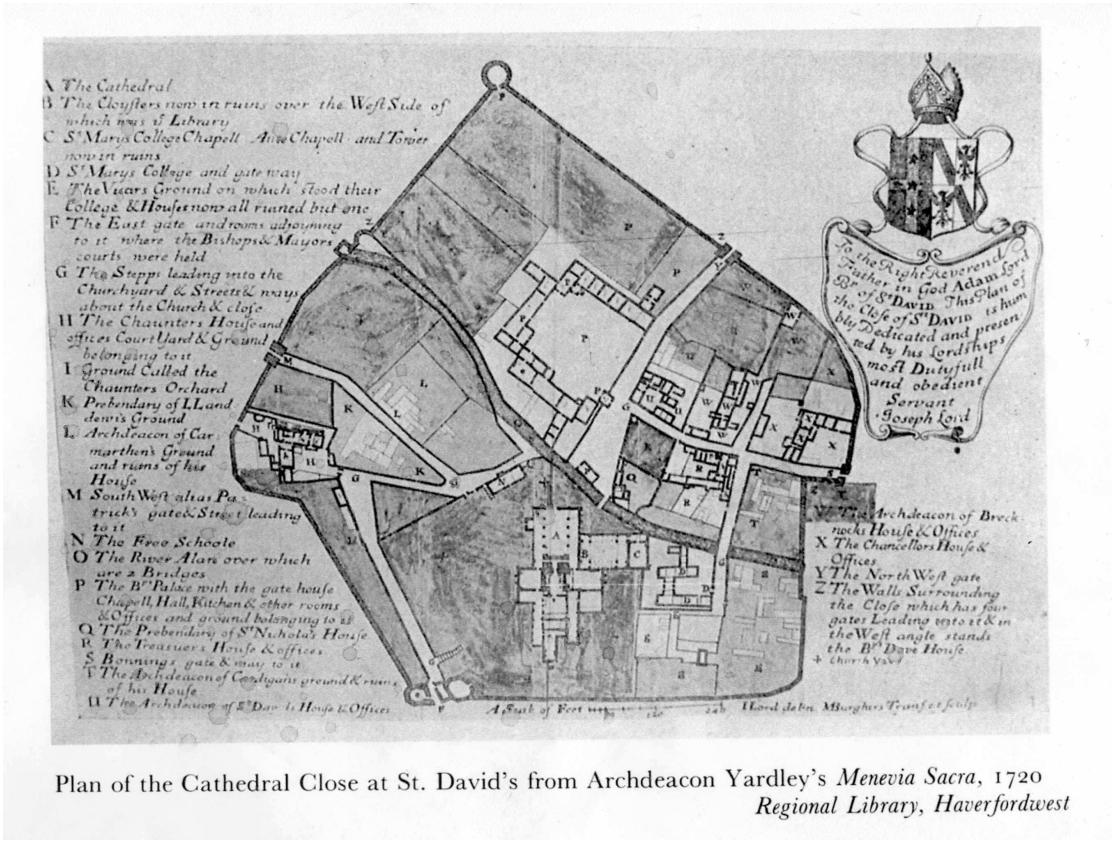


Figure 1. General Location
Reproduced from the 1997 Ordnance Survey 1:50,000 scale Landranger Map with the permission of The Controller of Her Majesty's Stationery Office, © Crown Copyright Cambria Archaeology, The Shire Hall, Carmarthen Street, Llandeilo, Carmarthenshire SA19 6AF. Licence No AL51842A.



Plan of the Cathedral Close at St. David's from Archdeacon Yardley's *Menevia Sacra*, 1720
Regional Library, Haverfordwest

Figure 2: Archdeacons Yardley's *Menevia Sacra, 1720*

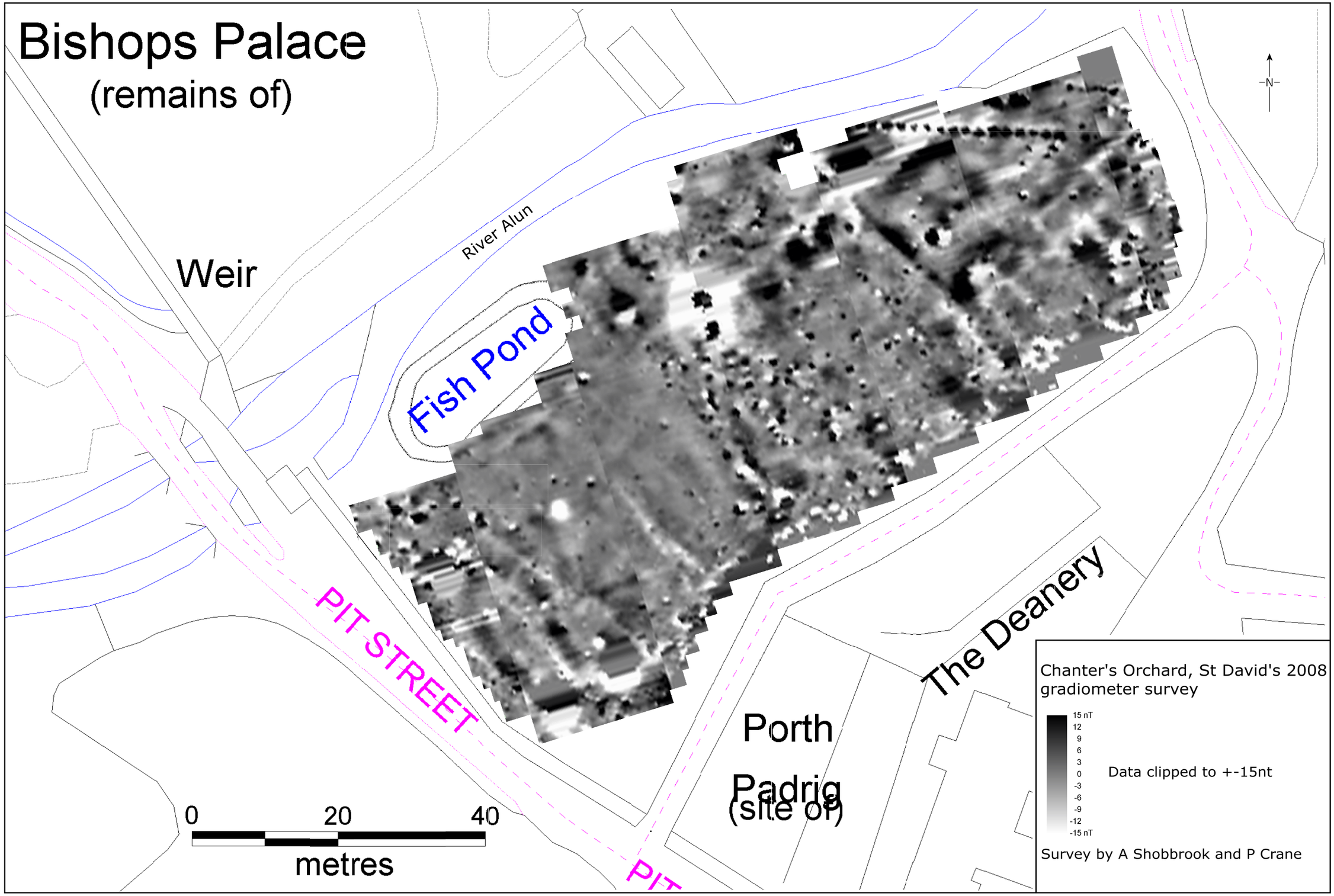


Figure 3: Gradiometer survey, east west traverses, grey-scale plot destriped.

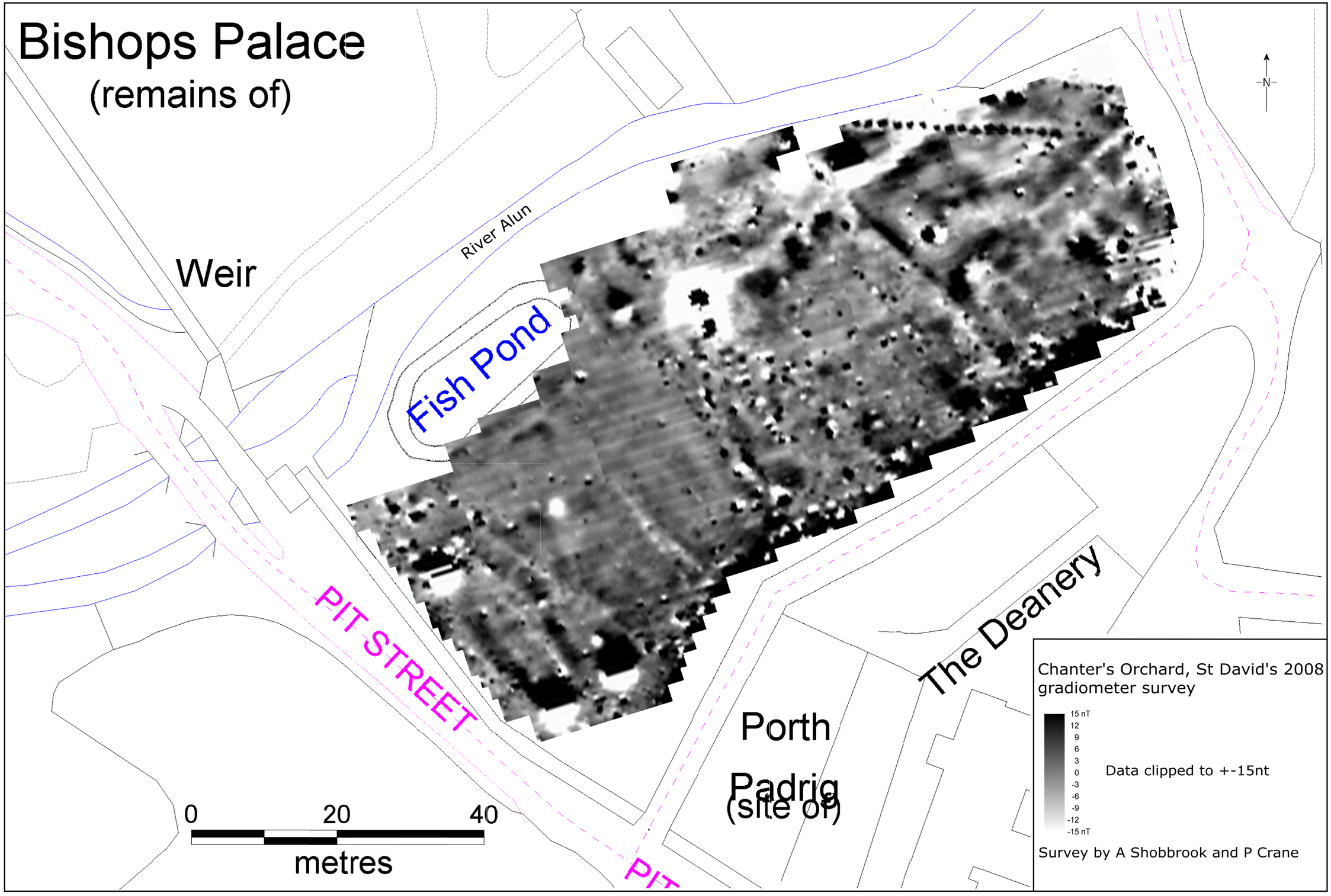


Figure 4: Gradiometer survey, east west traverses, grey-scale.

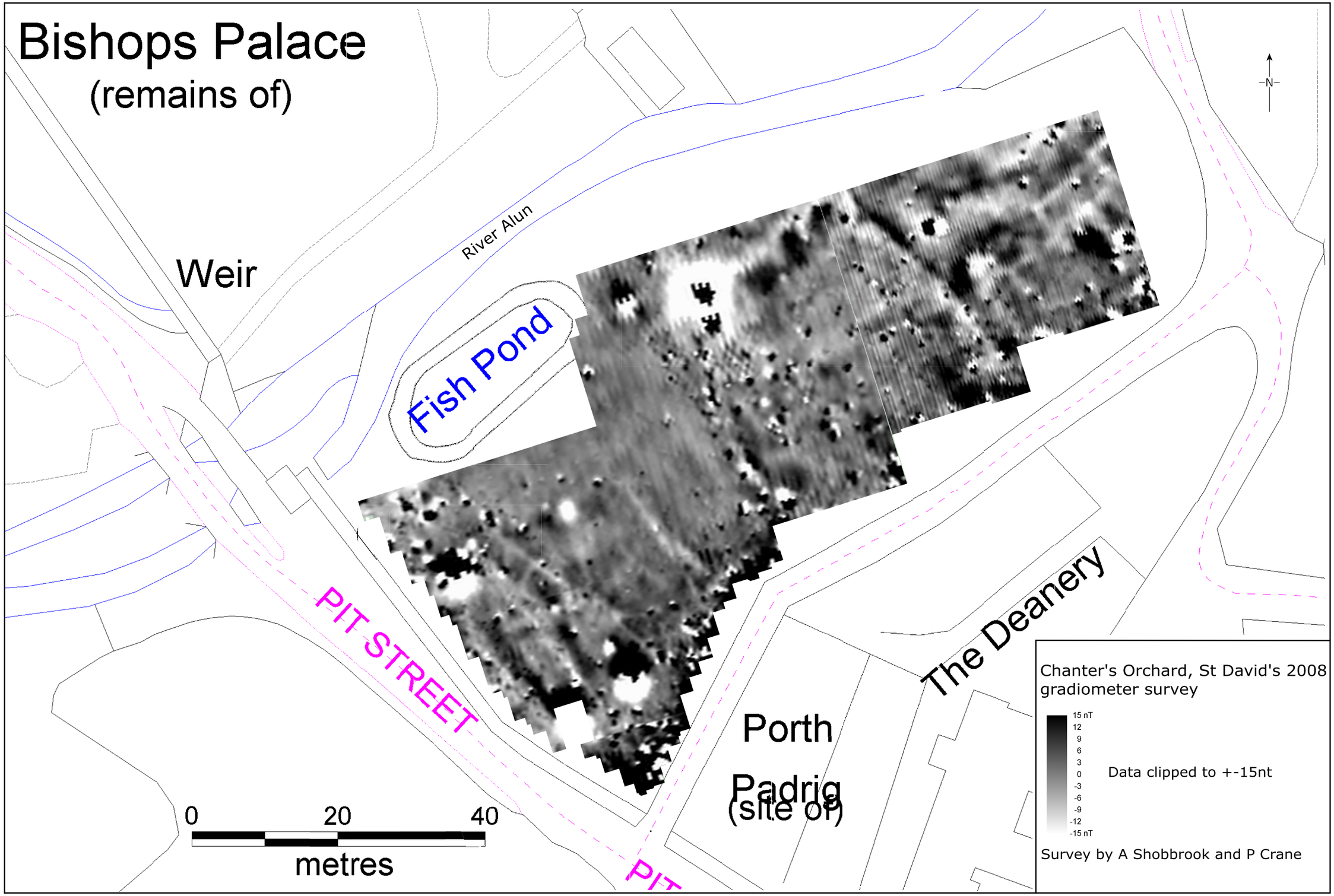


Figure 5: Gradiometer survey, north south traverses, grey-scale plot.

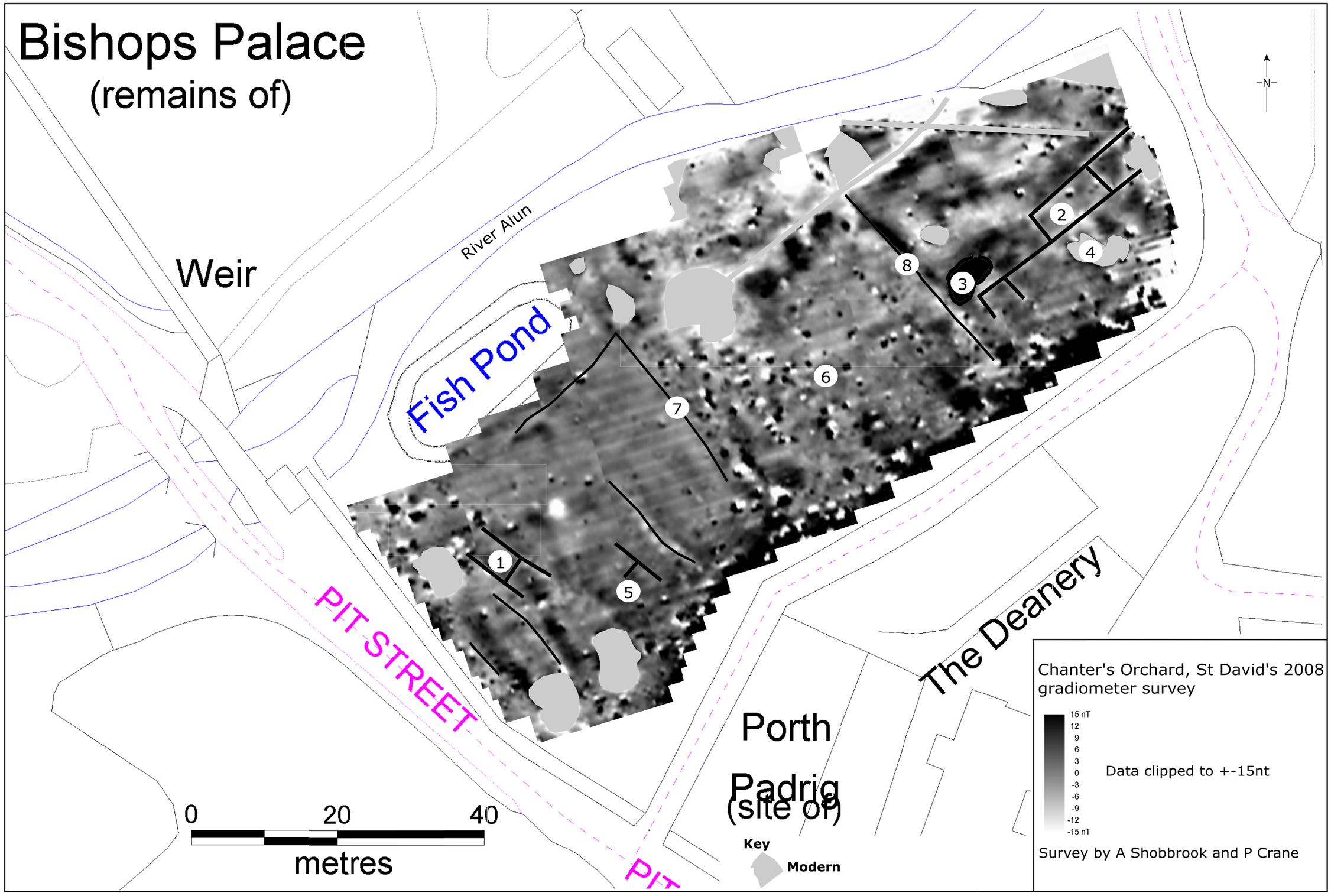


Figure 6: Gradiometer survey, east west traverses, grey-scale. Interpretation.