PUTTING LiDAR TO THE TEST IN THE BRÚ NA BÓINNE WHS, IRELAND:

Site discovery, definition and investigation using LiDAR, geophysics and coring.

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INTRODUCTION

Historically aerial photography, and latterly LiDAR, have been used to identify and map new sites in the Brú na Bóinne World Heritage Site (WHS), an internationally significant archaeological landscape known for its Neolithic passage tombs, other monuments and megalithic art (Figure 1, below).

Recent analysis of LiDAR data from the Brú na Bóinne WHS undertaken as part of the INSTAR (Irish National Strategic Archaeological Research) Boyne Valley Landscapes Project (Davis et al. 2010), which directly addresses a number of the knowledge gaps identified in the Brú na Bóinne WHS Research Framework (Smyth *et al.* 2009), has revealed a host of new monuments in this important archaeological landscape. This poster presents some of the results of a programme of ground truthing of a small sample of sites: Site W in Monknewtown, a previously recorded monument and two low profile topographic sites, LP1 in Newgrange and LP2 in Dowth interpreted from the LiDAR. Ground-truthing involves a combination geophysical survey (magnetic gradiometry (MG), earth resistance (ER) and electrical resistivity tomography (ERT)) and coring to obtain material for sedimentological and geochemical analysis and for radiocarbon dating.

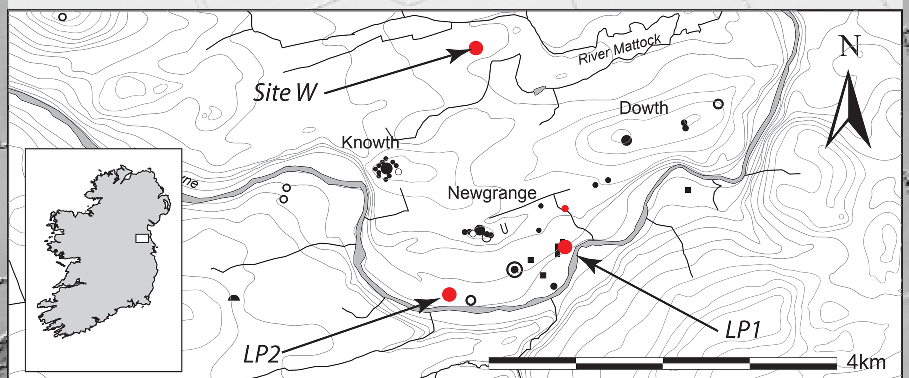

Figure 1: Map of Brú na Bóinne showing site locations


Figure 4: Google Earth image of site LP2 (top) and 3D model, view from SW (below).

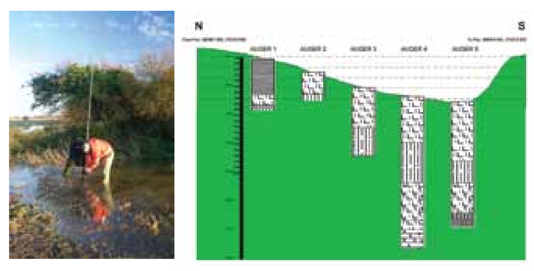
Figure 7: Sampling using a narrow (2.5cm) gouge auger (left); stratigraphy recorded at each auger point (right).

Monknewtown Site W

The availability of the LiDAR data greatly facilitated the investigation of Site W, the Monknewtown 'ritual pond' - a monument not previously investigated with a suggested Late Bronze Age parallel . The monument is a pond with an enclosing bank of overall diameter *c.*65m and height *c.*3.5m. Outside the line of the bank is a ditch c. 15-20m wide. It appears to sit in a natural depression , possibly a late glacial kettle-hole. The site is heavily overgrown but the LiDAR has 'seen' through to allow the 3-D model to be made (Figure 4). The 'gap' in the bank in the S is caused by dense vegetation preventing LiDAR returns.

The MG survey identified a range of features including the area of the surrounding ditch (Figure 5, below left). An outer ditch was identified on the N side of the monument. Several weak linear anomalies radiate out from the monument ditch and there is a small rectangular ditched enclosure c. 17m x 6.5m on the SW side. A large rectilinear feature (c. 37m x 33m) is located on the S side of the monument.

The ERT pseudosection revealed the original morphology and structure of the ditch and bank surrounding the monument as well as indicating the nature of the sediments in the surrounding area (Figure 6, below right). E2 and E6 are zones of low resistivity sediment filling the enclosing ditch. E3 and E5 are the banks which have a high resistivity core. The pond bottom E4 has a low resistivity base between 1.5 and 2m thick, perhaps a deliberate clay seal. Below this again there is a discrete higher resistivity 'core'.

A line of cores was taken with a narrow-chamber (2.5cm) gouge at 5m intervals along the line of the ERT pseudosection on the N side of the monument (Figure 7). Stratigraphy was recorded for each core retrieved. Core 4, taken from the surrounding ditch, was particularly rich extending to a length of 2.56m and contained significant organic material. Samples from this layer were submitted for radiocarbon dating and the lowest sample at 1.90m returned a date of 4050±40 BP in the Late Neolithic.

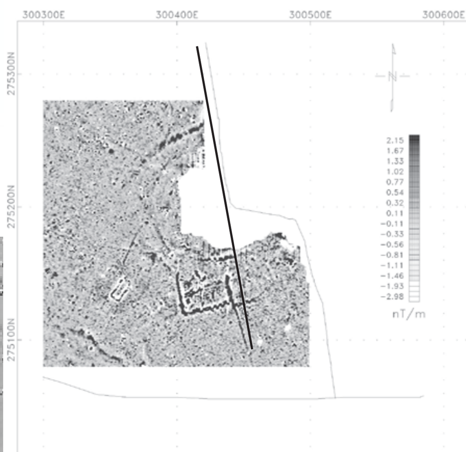
Figure 5 (left): Magnetic gradiometry eith ERT line indicated.

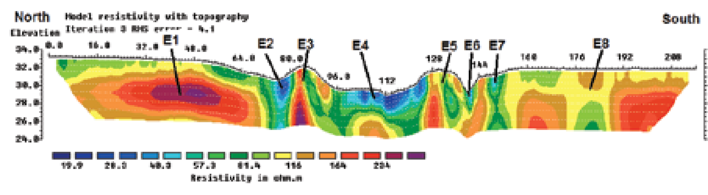

Figure 6 (above): Interpreted ERT pseudosection, Site W. Vertical exaggeration x3, electrode spacing 2m, modelled depth 6m. Topo profile from LiDAR.

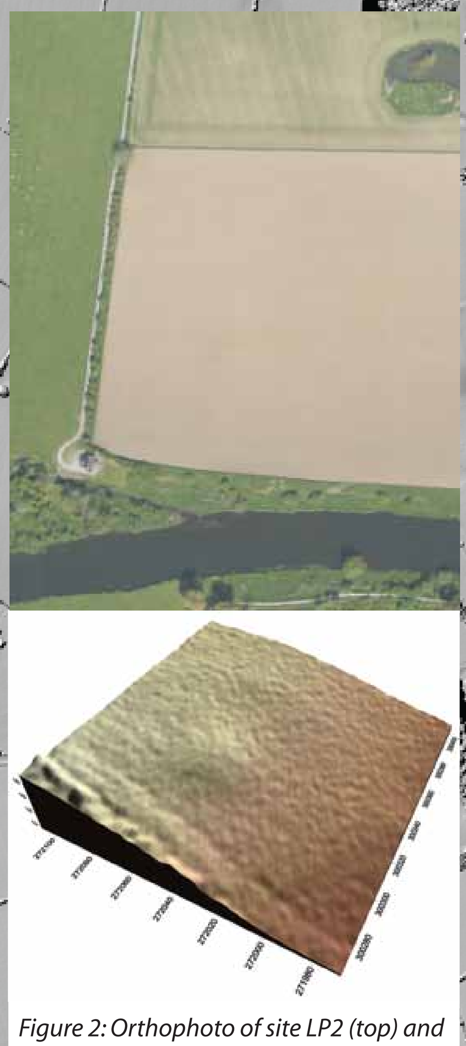
Figure 2: Orthophoto of site LP2 (top) and 3D model, view from SW (below). Ground under crop at time of survey.

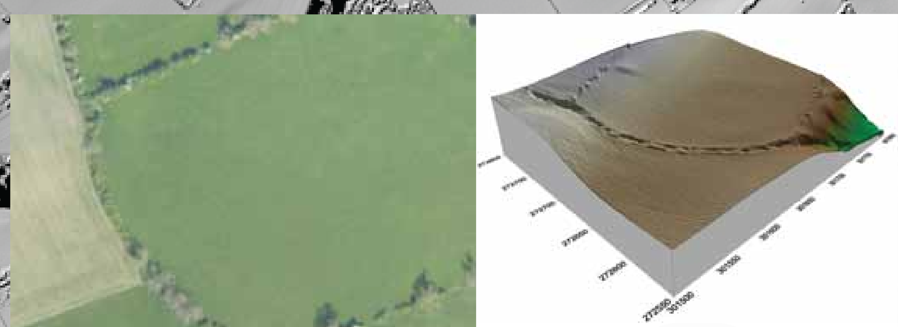
Figure 8: Orthophoto of site LP1 (left) and 3D model, view from SW (above).

LP1 Dowth

LP1, in the vicinity of a Neolithic standing stone (Site D), appeared in the LiDAR data as a large circular enclosure *c.*120m in diameter with a vertical expression of *c.* 0.20m with a low mound in the centre (Figure 8, above). It is located on a terrace overlooking the River Boyne 1km to the SE of the major passage tomb at Newgrange.

The MG results partially map the northern part of LP1 where there appear to be two parallel curving ditches (Figure 9, below left). The S ditch has a topographic expression in the LiDAR. The rest of the enclosure does not have a strong magnetic expression. There are two previously unrecognised features at the S and E of the survey area. The S feature is a sinuous ditch and the E feature is a circular ditch *c.*15m in diameter possibly enclosed by a ring of pits giving an overall diameter of *c.*30m. A topographic feature at the N of the survey area, also a recorded monument, had no clear geophysical signature.

A N-S ERT transect was also carried out with 2m electrode spacing (Figure 10, below right). The modelled pseudosection is given in Figure x. This shows a higher resistivity lens on the lower ground to the S and lower resistivity material to the N. The line of the double ditch feature identified in the gradiometry is visible at G1 and G2.

LP2 Newgrange

LP2 appears on the LiDAR data as a low enclosure *c.*110m in diameter with a low mound in the centre, all with a vertical expression of *c.* 0.25m (Figure 2, above). It is located on the lowest fluvioglacial terrace, 1km SSW of Newgrange and 100m north of the River Boyne, on the same terrace as Site P, a large ploughed-out hengiform earthen enclosure.

MG survey (Figure 3a, below left) revealed a positive gradient anomaly, i.e., a cut feature, 16m long and 2m wide with splayed 'terminals' each 7m long. Surrounding this is a circular cut feature *c.*110m in diameter. ER survey focused on the central feature and identified the same feature as in the gradiometry (Figure 3b, below right). Low resistance correlates with the MG positive gradient indicating a cut feature with low resistance fill such as clay. The outer ER footprint' of the possible mound is due to slightly higher resistance possibly due to more compacted ground.

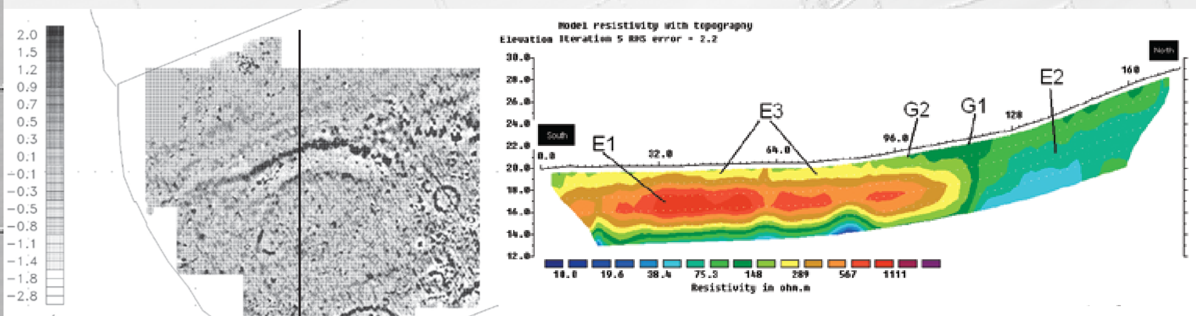

Figure 9 (above): Interpreted ERT pseudosection, LP1. Vertical exaggeration x3, electrode spacing 2m, modelled depth 6m. Topo profile from LiDAR.
Figure 10 (left): Magnetic gradiometry with ERT line indicated

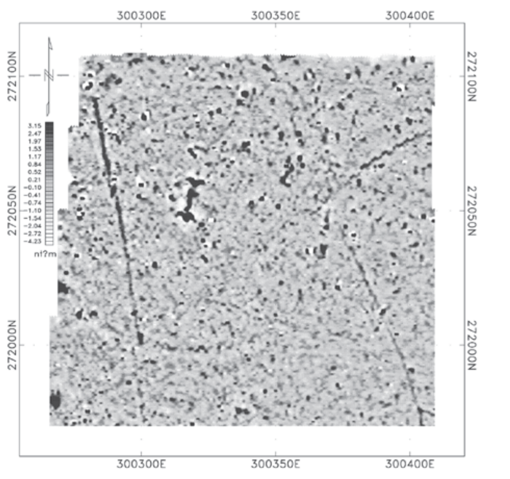
Figure 3a: LP2 magnetic gradiometry

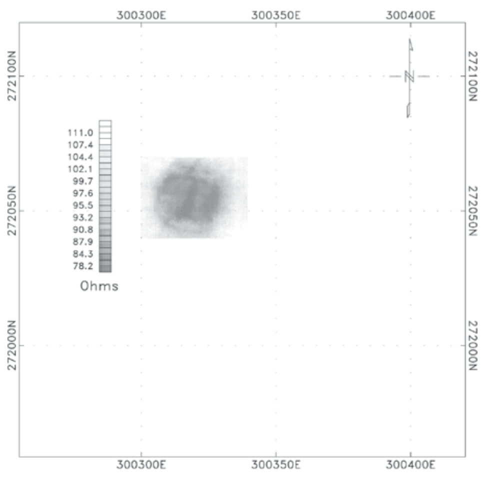
Figure 3b: LP2 earth resistance

Conclusion

The research has demonstrated the need to follow up on sites identified in LiDAR analysis. Given the very low relief character of the sites identified and investigated here, the use of an integrated multi-method approach using multiple geophysical techniques in combination (as well as other available datasets, e.g. aerial photography, multispectral imagery) is the best way to fully explore and investigate such sites identified in the Brú na Bóinne LiDAR data.

References

Davis, S., Megarry, W., Brady, C., Lewis, H., Cummins, T., Guinan, L., Turner, J., Gallagher, C., Brown, T., Meehan, R. 2010. Boyne Valley Landscapes Project. Phase III Final Report 2010. Unpublished report for the Heritage Council. (See INSTAR Webarchive at http://www.eritagecouncil.ie)

Smyth, J. Brady, C., Chadwick, J., Condit, T., Cooney, G., Doyle, I., Guinan, L., Potterton, M., Stout, G. and Tuffy, C. 2009. Brú na Bóinne World Heritage Site Research Framework. Kilkenny: The Heritage Council.

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