# The use of geotechnical applications to assess remote archaeological deposits

The requirement for archaeological investigation to inform planning applications, whether EIA or non-EIA developments was established in 1991, with the publication of Planning Policy Guidance Note 16. It has now become the norm for planning authorities to request a phased approach to archaeological assessment of development proposals, starting at desk-based assessment followed by non-intrusive survey through to the excavation of trial trenches to reveal and record buried archaeological remains and to establish their significance.

In the majority of instances, the conventional approach to archaeological evaluation involving the excavation of an agreed number of trenches on a site where there are no constraints and the depths of excavations are within normal working parameters is proven. There are instances however, where either the nature of the development or the inaccessibility of the archaeological remains preclude the conventional trenching approach and more innovative techniques need to be applied if the base evidence within an ES is to be sufficiently robust.

The utilisation of geotechnical data, or ideally an archaeologically monitored geotechnical investigation have the considerable benefit of providing a degree of clarity when assessing impacts upon archaeological assets.

This approach is by no means new; the discipline of archaeology has a long tradition of borrowing from geology and geomorphology however the technological advances, particularly in computer modelling has presented significant opportunities for the visualisation of complex and difficult to access archaeological remains and sequences.

To illustrate that, a number of case studies are presented. These vary from projects which contained deep and complex archaeological sequences within a confined urban environment in Bristol; the quantification of the degree of loss and the significance of the loss of internationally important archaeological Roman remains within Chester and deep stratified palaeoenvironmental remains from Worcester which traditional evaluation was unable to characterise.

## Bristol
A development project in Bristol involved the demolition of an existing 16 storey tower constructed in the 1960s with the replacement of an 18 storey tower. The tower was situated on the edge of a former medieval river course, itself canalised through extensive areas of reclaimed medieval land and palaeoenvironmentally-rich estuarine silts. The area had been identified as being of high archaeological potential within a regional archaeological research framework and any application had to address particular research questions and demonstrate opportunities to further the understanding of the development of this area.

A combined archaeological and geotechnical borehole programme was undertaken within the bottom level of a basement carpark to inform upon the extent of impact that previous development had upon archaeological deposits, the potential for medieval land reclamation, the identification and modelling of a complex sequence of marine inundation and the recovery and assessment of palaeoenvironmental remains at approximately 15m below the basement floor. Following the borehole programme, deposit modelling enabled the identification of areas previously impacted and truncated by development and areas of archaeological and palaeoenvironmental potential which in turn informed the design of the demolition programme and the subsequent foundation design.

Indeed, the information provided was of sufficient detail to constitute both evaluation and mitigation in its own right, with a buried terrain contour model produced effectively mapping the geomorphological sequence, which was refined through scientific dating recovered from the boreholes.

The benefit of this approach over traditional trenching techniques was obviously that a considerable amount of information was gathered and its use was maximised through the combined studies. Accessibility issues were avoided, as conventional trenching in this instances would have required both the demolition of the tower block above the car park and the excavation of exceptionally deep trenches, requiring shoring, to obtain the same quality of data.
The information presented permitted considerable confidence in the identification of the nature, scale and significance of impacts and significantly reduced the planning and construction risk to the development through archaeological issues.

**Chester**

A development within the Roman city walls of Chester had the potential to impact upon archaeological remains, which if present were considered to be of at least national significance. As such the requirement, developed with the City Archaeologist and Historic England was to demonstrate that the development was not to result in the loss of more than 3% of the archaeological remains within the site.

Conventional archaeological trenching was deployed, alongside a programme of geotechnical boreholes, which were subject to archaeological monitoring. The spatial distribution of both the trenches and the boreholes permitted the identification of individual horizons of various archaeological date across the site, with modern, post-medieval, medieval, Roman and natural substrate depths all identified. By inputting the data into Keynetix Holebase Si which is then exported to AutoCAD Civil 3D, 3D fence diagrams and isocontour plans were created which permitted the production of a complex quantitative assessment of the survival of nationally significant deposits across the site in comparison to sites in the immediate vicinity.

The incorporation of the evolving foundation design allowed the volumetric calculation of the loss of significant (in this case Roman) archaeological deposits through the development proposals. This proved to be an iterative process, where a variety of piling arrays and modifications to stair wells, lift pits and attenuation tanks effectively provided embedded mitigation within the design process and resulted in the scheme meeting the requirements of the HE and the local authority.

The production of the model and its presentation enabled a high level of confidence in the extent of loss of archaeological deposits. Whilst using conventional trenching techniques, without recourse to geotechnical modelling, this would not have been possible.

**Worcester**

An evaluation associated with a previous, unsuccessful application had encountered post-medieval deposits and had tentatively identified deep alluvial deposits which were considered to have medium - high potential for the presence of prehistoric and Roman archaeological and palaeoenvironmental remains.

As a result, the area had been identified as being of significance within the City’s archaeological research framework and any application had to address particular research questions and demonstrate opportunities to further the understanding of the development of the city and its environs.

Unfortunately, due to the depth of these deposits, and the limitations of deep archaeological trial trenching in urban contexts such as safety, cost and the presence of sub-surface obstructions, the Local Planning Authority still had concerns which could not be assuaged via traditional archaeological means.

In close consultation with the City Archaeologist and the Client, and through the study of existing geotechnical datasets from previous investigations, a scheme involving the sinking of windowless sample boreholes to recover and characterise the alluvial deposits, was designed and successful implemented to address the archaeological condition and research requirements.

These boreholes were effective in being the sole requirement for fieldwork for the scheme with post-site assessment and analysis of the cores being recognised as suitable mitigation. The scheme produced the first stratified archaeological remains of Neolithic date from within the city and, through palaeoenvironmental study and deposit modelling of the landscape, greatly enhancing the understanding of the development of the River Severn and its wider landscape throughout prehistory into the Roman period.

These results would not have been possible through traditional trial trenching or excavation, which would have been prohibitive and disproportionate due to the expenditure required to access these deposits which lay approximately 4.50 metres below ground surface.

It has been demonstrated that the inability to undertake conventional archaeological evaluation need not preclude the collection of valuable archaeological data to inform an EIA. Through collaborative working and by being aware of the opportunities available from geotechnical site investigations and the application of digital 3D mapping and contouring techniques, a comprehensive and robust dataset can be assembled to inform and determine an Environmental Statement and to influence and shape effective mitigation measures.

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