PREDICTIVE MODELLING OF MULTI-PERIOD GEOARCHAEOLOGICAL RESOURCES AT A RIVER CONFLUENCE

Phase 1 Report (PNUM 3357)

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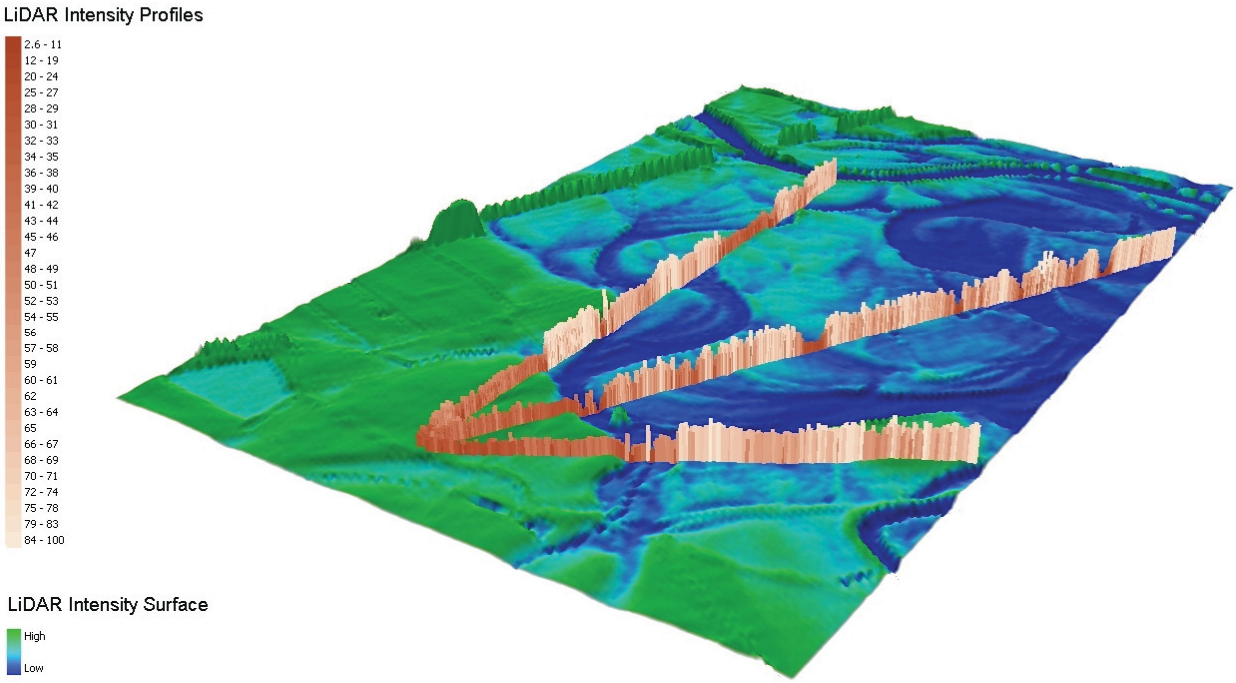

I. Executive Summary

This report describes a multi-method to characterise the archaeological resource of a complex confluence zone between to rivers in the East Midlands, UK (Trent and Soar). The aims of the project centred upon the evaluation of LiDAR, IFSAR and GPR for the semi-automated production of a chronostratigraphic model that could be related to traditional techniques of data collection such as geomorphological survey and plotting of the archaeological resource. The results showed that LiDAR last pulse return produced an accurate DTM, which defines the topographical complexity of the area. The results were found to be very comparable to geomorphological mapping. IFSAR data was found to reveal less of the subtle within terrace/unit variation identified by LiDAR but still identified the terrace sequence.

GPR transects provided technical experience in the survey of such complex alluvial terrain. GPR survey performed well on the gravel bodies including the terraces and agreed well with gouge auger surveys. GPR could resolve the edge of terraces and palaeochannels but not the internal stratigraphy or depth of the deeper and lowest palaeochannels due to a combination of radar absorbent silt and clay and a high water table. GPR survey revealed that the LiDAR intensity of return data appeared to reflect the sub-surface stratigraphy probably through variations in soil moisture. Archaeological resource evaluation showed that the pattern of finds was a result of differential erosion and deposition, visibility and intensity of survey. The high archaeological resource of the area is probably due to it being a transport node but this resource is buried in zones of the valley floor of different ages and modes of deposition.

Along with geomorphological mapping LiDAR and GPR were able to resolve the valley floor into three surfaces and a number of individual features. Using a combination of geomorphological mapping, dGPS, IFSAR, LiDAR and GPR a predictive chronostratigraphic model of the confluence zone was produced. This model will be tested in phase II by coring, sediment characterization and a dating programme.

II. Acknowledgements

This report has been written with the considerable support and help from many individuals. Technical and cartographic advice is acknowledged from S. Rouillard, H. Jones and D. Fraser. The landowners of the target area must be thanked for access and in particular Lafarge Aggregates Ltd. for both access and the provision of data.

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CHAPTER 1: INTRODUCTION

This project was framed to address the core ALSF theme of developing capacity to manage aggregate extraction landscapes in the future (English Heritage 2004). In addition it addresses several other ALSF themes, namely:

- Characterising the (archaeological) resource and developing evaluation frameworks, predictive tools and mitigation strategies.
- Development [of] remote sensing and predictive techniques and mitigation strategies.
- Training and professional development: to raise awareness of issues and to improve the quality of historic environment work undertaken in response to aggregate extraction.
- Development of advanced visualisation and immersive three-dimensional models of landscape development. Although largely part of phase 2 of the project, this has the potential to address the theme of interpretation and outreach to the community of the knowledge gained from work related to aggregate extraction.

1.1 Summary of aims and objectives

The aim of this project is to predictively model the landscape of a major river confluence over a time-scale of millennia and at a spatial scale appropriate for archaeological management. The overall purpose is:

- To establish a RIGOROUS research model for the future development of predetermination designs for site evaluation.
- To assess the effectiveness of various airborne and ground based remote sensing methods in alluvial environments.
- To derive relationships between pre-extraction site survey data and likely chronostratigraphic and environmental data as part of archaeological assessment.

This research will assist regulatory bodies (i.e. County Councils) in demanding and specifying rapid evaluations of geoarchaeological potential as part of the implementation of PPG16. The novelty of the approach lies in the integration of high-resolution topographical, archaeological and geological (three-dimensional sub-surface) data within a Geographical Information System (GIS). The technical innovation will be the combination of Inteferometric Synthetic Aperture Radar (IFSAR), Airborne Laser Altimetry (LiDAR), CW Differential GPS (DGPS), Ground Penetrating Radar (GPR) and other ground based remote sensing techniques. This research will contribute to the framework for management of the archaeological resource in the Trent Valley developed through Trent Valley GeoArchaeology (Bishop *et a*l. 2002) and provide a transferable model for the geoarchaeological investigation and management of valley floor archaeology.

1.2 The study area

The study area is a block of the Trent/Soar confluence landscape approximately 2 by 4 km (Fig. 1.1). The area abuts the main area of Trent Valley GeoArchaeology (TVG) interest and is close to but not overlapping sites of continuing research by University of Leicester Archaeological Services (ULAS). The area is not zoned for aggregate extraction although the area to the west is. Extraction of these adjacent areas will allow boundary sedimentary information to be used in modelling.

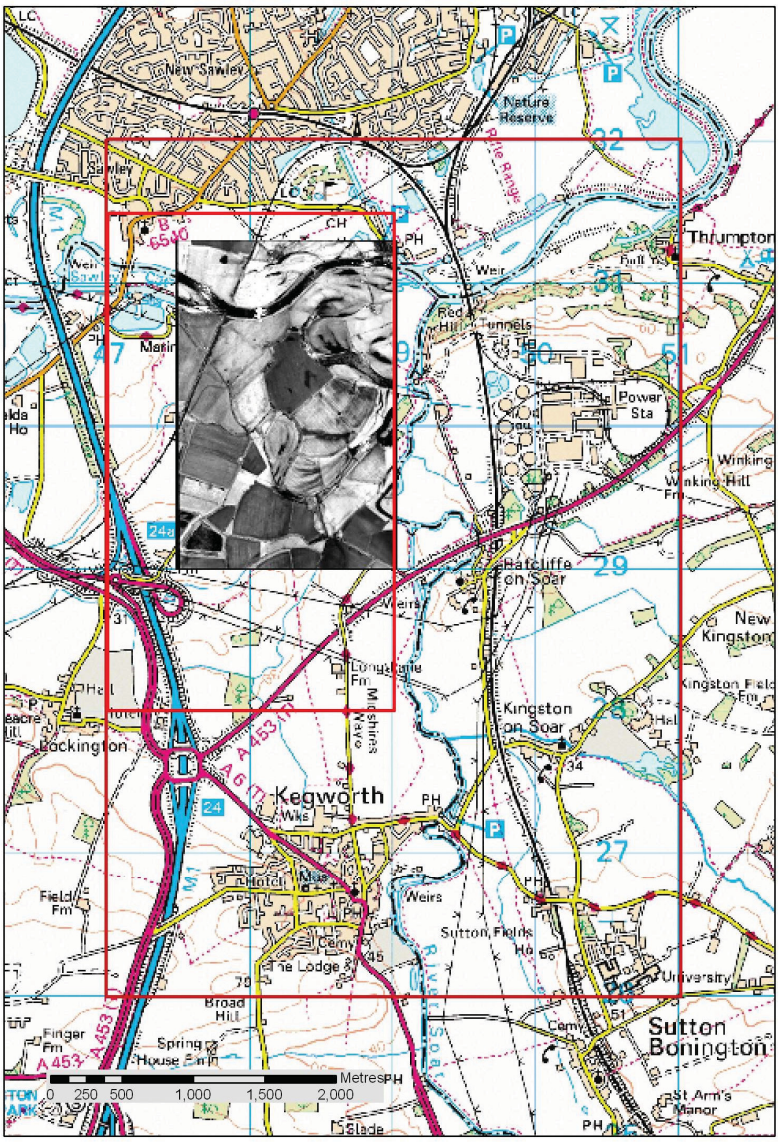

Fig 1.1: The study area over the 1:50,000 Ordnance Survey map (by permission of OS).

1.3 Project background

Recent archaeological work on the Thames and other British floodplains suggests that river confluences have been the foci of settlement and human activity since the earliest post-glacial periods. At confluences the high density of palaeochannels provides an opportunity to determine records of past environmental change. Migration of rivers channels also provides an environment with high potential for the burial and preservation *in situ* of cultural and environmental materials. Unfortunately this potential is generally only realised during the destruction of the land surface by development and subsequent 'rescue' archaeological investigation.

It is the nature of the archaeological record of floodplains that there is a direct link between the geomorphology, including the nature and distribution of channels, levees, gravel bars, terrace remnants, etc. and the distribution and nature of archaeological materials, from flint scatters to structures. Therefore there is a predictive capability in the subsurface geomorphology, stratigraphy and buried land surfaces.

1.4 Previous work

The Middle Trent is one of the archaeologically richest stretches of alluvial landscape in the UK. Finds include medieval bridges (the Hemington Bridges excavations, funded by English Heritage), a Norman milldam, fishweirs and dugout canoes (Salisbury *et al*., 1984; Cooper, 2003). The study area (a block of floodplain 8 km^2) is centred on the Lockington Marshes at the confluence of the Trent and Soar. This area is rich in cultural archaeology lying immediately east of the nationally significant prehistoric ritual landscape of the Derbyshire Trent Valley (Riley, 1987). Recent finds from a Bronze Age barrow cemetery (Hughes, 2000) strongly suggests that this prehistoric ritual landscape extends into the area. In the Romano-British period the area lies in the hinterland of a villa complex at Lockington and a small town, possibly a centre of ritual/religion at Red Hill, Ratcliffe on Soar (Elsdon, 1982). The area, although not threatened with imminent destruction, is earmarked for longer-term development. Pilot studies indicate the high buried archaeological potential of the locality (Ripper, 1997), which combined with a high density of sites suitable for palaeoenvironmental studies (Howard, 1997) provide an ideal zone for detailed modelling. Work by Trent Valley GeoArchaeology (Knight and Howard, 2004) has done much to provide a regional framework for the cultural, landscape and environmental archaeology of the Trent Valley. The present proposal provides an opportunity to build constructively on that framework through detailed consideration of a significant confluence zone, targeted fieldwork and innovative use of GIS and allied technologies.