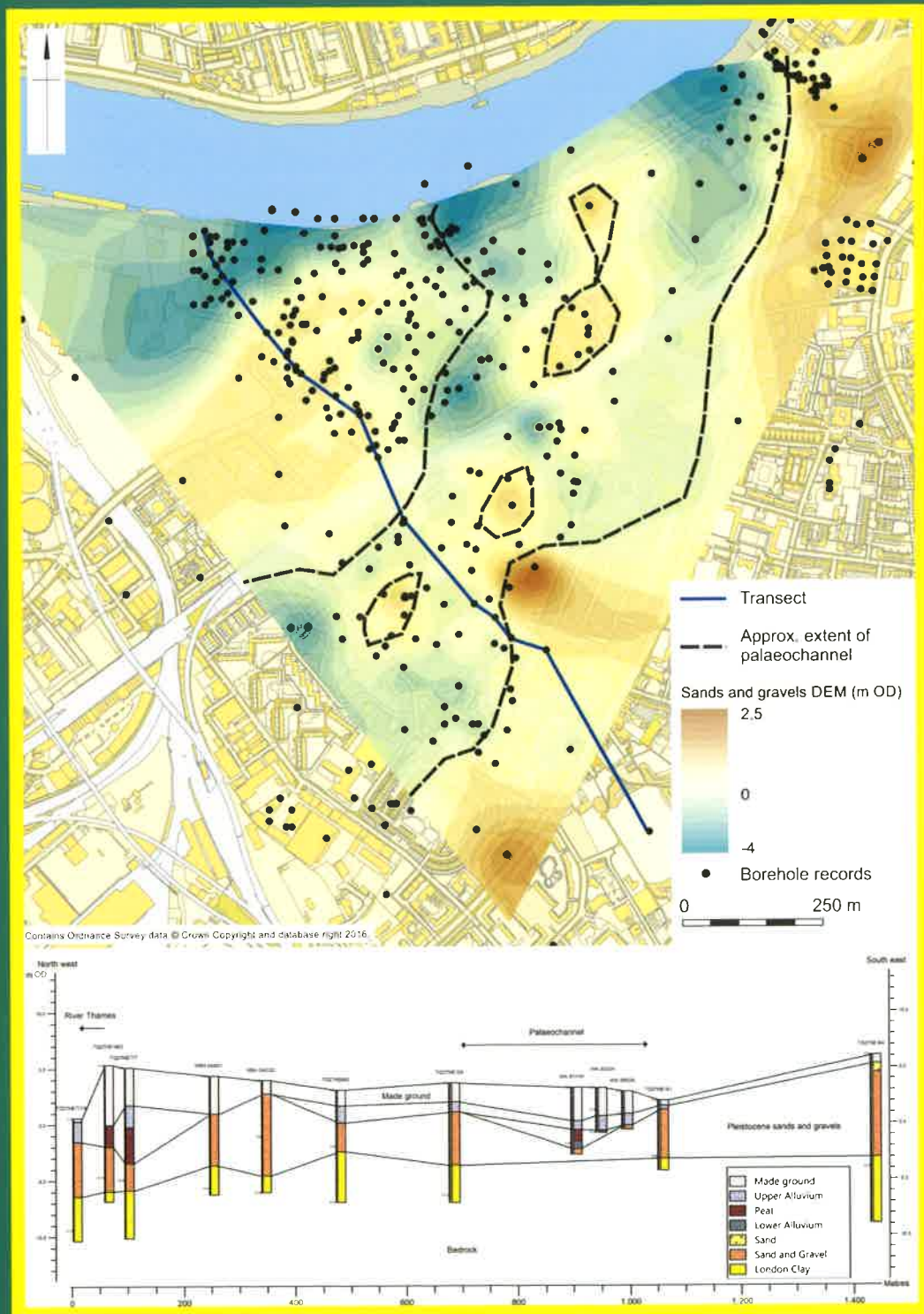


Deposit Modelling and Archaeology



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2. 35 years at the trench-face: a personal deposit modelling narrative

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Abstract

Deposit modelling, as practiced within archaeology, has been increasingly used in the UK during the last 35 years to predict the location of buried archaeological remains. This has been particularly useful in developer-funded archaeology, where accurate prediction of buried archaeological remains can significantly save expenditure on unexpected discoveries. This contribution takes a personal view of the uptake in deposit modelling in south-east England over the last 35 years and its impact on developer-funded archaeological works. The contribution begins with a short review of the subject before focusing on south-east England and a case study based on Dover (Kent). The review ends by articulating some important questions that need to be addressed in the next 35 years.

2.1. Introduction

Deposit modelling, as practiced within archaeology, has been increasingly used in the UK during the last 30 years to predict the location of buried archaeological remains (as well as contextualising sites and findspot information). This has been particularly useful in developer-funded archaeology, where accurate prediction of buried archaeological remains can significantly save expenditure on unexpected discoveries. The approaches to deposit modelling vary according to numerous factors, including the background of the practitioners, the terrain being investigated and the nature of development at a particular site. Commonly, however, borehole data is used to construct lithological or stratigraphic models of buried deposits. Increasingly though other forms of subsurface data, including geological geophysics and geotechnical ground test results, are also used to model lithology and/or stratigraphy. In all cases, this information is then coupled with knowledge of the co-occurrence of archaeological remains with particular sediment types in order to predict

where artefacts and sites are more or less likely to be preserved.

This contribution takes a personal view of the uptake in deposit modelling in south-east England over the last 35 years and its impact on developer-funded archaeological works. The paper is illustrated by a case study based on Dover in Kent. This contribution does not attempt an exhaustive review, or a step-by-step guide to deposit modelling; rather, it is hoped that some of the key issues and factors that are highlighted will provide insights for the reader and provide a setting for other case studies presented in this volume.

2.2. Deposit modelling: a short review

Deposit modelling is neither a new nor a novel approach to understanding the character or distribution of sediments below the ground surface (Kessler and Mathers 2004). Within the geosciences, what archaeologists call deposit modelling is simply mapping and the creation of stratigraphic models that provide the basis for geological maps, cross-sections and the interpretation of such illustrations. For the geosciences, this process began through recording and interpreting surface exposures or drilling and recording boreholes. Links between observed points of similar character (for example, sediment size, lithology, fossil content) were then made in order to construct local and regional stratigraphic frameworks to interpret earth history. Such practices can be traced back to the early history of geology (Doyle and Bennett 1998).

The primacy of boreholes as a source of information on subsurface lithology is undoubted, and their use can be traced back to the Han Dynasty in China between 202 BC and AD 220 (Loewe 1968). They have been used extensively within the academic community to research earth history and in the geotechnical sector to provide data for construction engineering (Culshaw 2005). However, it was with the development of the new discipline of geology in the 19th century that major strides were made

to unravel the stratigraphic framework of earth history. Workers such as Charles Lyell, William Smith, Adam Sedgwick and Roderick Murchison all utilised the ideas of deposit mapping and correlation to create the basis for our understanding of the geology of the United Kingdom (Kessler and Mathers 2004). Today, geological deposit modelling is sophisticated and is used at both landscape (Ford *et al* 2010; Mathers *et al* 2014) and more local (Aldiss *et al* 2012) scales.

Following early developments in geology in the 19th century, it was recognised that the most recent period of earth history, which we now call the Pleistocene, was of particular importance to the study of human origins (O'Connor 2007). Workers such as Joseph Prestwich (1892) used geological sections recorded in different areas of the country in order to understand recent landscape history and construct stratigraphic frameworks. These frameworks were quickly adopted by archaeologists interested in the earliest period of human activity: the Palaeolithic (McNabb 2012; O'Connor 2007). These frameworks became ever more sophisticated in the 20th century, bringing Quaternary geologists and archaeologists ever closer through a shared interest in understanding past earth systems (for example, Zeuner 1946, 1959). For much of the 20th century, these collaborations strove to understand either past chronologies or palaeogeographies by mapping landscape features such as rivers, coastlines and lake edges. In this context, the work in the 1930s

of the Fenland Research Committee (Smith 1997; West 2014) highlights an early example of the multidisciplinary use of boreholes in archaeological investigations. Their work resulted in the creation of the now familiar 3-phase sequence of Fenland deposits of East Anglia (West 2014) while Godwin (1940) produced the first synthetic 'deposit model' for the area that linked the stratigraphy of the Fen basin to its archaeological record (Figure 2.1). So close was the link between geoscience and archaeology at this time that, while excavating at Plantation Farm in Cambridgeshire, Grahame Clark requested help from O.T. Jones, the Woodwardian Professor of Geology at Cambridge University, on where to place boreholes in order to complete the stratigraphic sections that he was constructing (Smith 1997).

Until the recent advent of archaeological and geotechnical urban deposit modelling (Moscattelli *et al* 2014; Neal 2014; Price *et al* 2010) deposit modelling was typically the domain of Quaternary geology and prehistoric archaeology. Geologists have commonly applied stratigraphic procedures to the creation of models within which the archaeological record is articulated, either to place sites within their broader and local landscape settings (for example, Bates *et al* 2016; Wenban-Smith *et al* 2013) or to allow sites and/or sequences to be correlated (Bridgland 2006; Bridgland and White 2014, 2015). An example of such a macroscale approach, albeit within an urban context, is the mapping of the

SCHEME TO SHEW ARRANGEMENT OF POST-GLACIAL DEPOSITS OF THE FENLAND

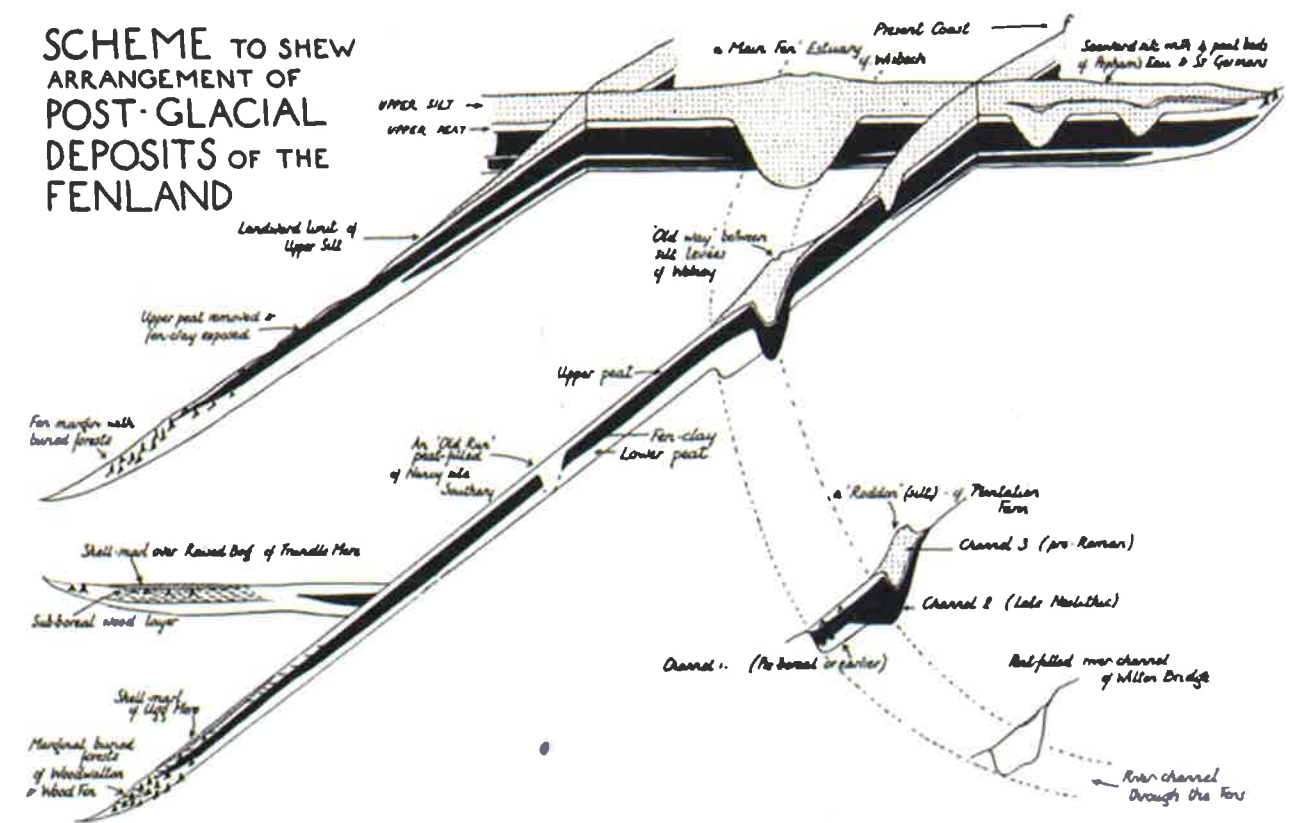


Figure 2.1: Schematic solid section to show type of variation in Fenland deposits and their relationship to features of archaeological significance (from Godwin 1940)

lower Lea Valley undertaken by the Museum of London Archaeology (Corcoran *et al* 2011). More recently, the Aggregates Levy Sustainability Fund (ALSF) provided a number of opportunities for large-scale deposit modelling of Pleistocene sediments in England (Bates and Pope 2016). Beyond the UK, large-scale palaeogeographies spanning both the Pleistocene and Holocene periods have been examined in the alluvial landscapes of continental northern Europe (for example, Berendsen 2007; Berendsen and Stouthamer 2001; Hijma *et al* 2009; Vos 2015; Vos *et al* 2015).

The use of subsurface mapping techniques to explore the extent and nature of known archaeological sites or settlements has also been undertaken using coring and augering methods (Canti and Meddens 1998; Schuldenrein 1991; Stein 1986, 1991), to investigate deposit depth and sediment composition prior to excavation on middens, mounds and tells (Barham and Mellalieu 1994; Reed *et al* 1968; Stein 1986), within rock-shelters (Bailey and Thomas 1987), to monitor physical and chemical ground conditions and preservation of archaeological deposits (Malim *et al* 2015) and to assist in reconstructing off-site palaeoenvironmental records (Apostolopoulos *et al* 2014; Barham 1993, 1999; Barham and Harris 1983, 1985). Coring or use of geotechnical data, such as that described by Culshaw (2005) for geological engineering, has also been deployed to assist in mapping archaeologically significant sedimentary environments beneath urban areas (Barham and Bates 1994a; Bates *et al* 2000; Canti and Meddens 1998; Densum and Doidge 1979; Koster 2016; Neal 2014) as well as 'artificial ground' that would include archaeological units defined by the British Geological Survey (Terrington *et al* 2015).

However, deposit modelling includes a far wider range of techniques other than simply coring, some of which have been utilised and discussed by Barham and Bates (1994a), Bates and Bates (2000), Bates *et al* (2007), Howard *et al* (2008, 2015), Stein (1986, 1991) and Tsokas *et al* (2011). These include other forms of engineering data such as Cone Penetration Tests (Koster 2016), LiDAR data (Howard *et al* 2015) and geological geophysics, particularly landscape-scale Electromagnetic (EM) and Electrical Resistance Tomography (ERT) survey (Bates and Bates 2016; Fischer 2016; Keay *et al* 2009; Missiaen *et al* 2008, 2015; Moscatelli *et al* 2014; Papadopoulos *et al* 2014; Soupios *et al* 2008; Verhegge *et al* 2016; Vouvalidis *et al* 2010).

In summary, four broad areas in which deposit modelling has been applied are:

- The contextualisation of archaeological finds, usually at a landscape-scale. This is typically practiced in association with Palaeolithic archaeology where bodies of sediment such as fluvial terraces and associated deposits can be traced for a considerable spatial extent (Bates *et al* 1997; Bridgland and White 2014, 2015).

- The creation of a topographic setting for an archaeological site and/or the tracing of elements of the site beyond its known boundaries, in either an urban or rural setting (Pint *et al* 2015; Wenban-Smith *et al* 2013).
- The understanding of site structure and internal character. This might be practiced within urban contexts where geotechnical data can provide access to ground that is otherwise difficult to access until the demolition of buildings (De Beer *et al* 2012; Koster 2016; Neal, 2014).
- The creation of models to allow the presence or absence of sites across a landscape to be predicted with more accuracy where sedimentary sequences are deep and conventional archaeological survey techniques such as aerial photography and fieldwalking are of limited value (Bates 1998, 2000, 2003; Bates *et al* 2000; Bates and Stafford 2013; Bates and Whittaker 2004).

The logic underpinning any deposit-modelling project is thus to provide both direct and remote views of the stratigraphy that is buried at depth in the study area (Bates 2000, 2003). Information thus obtained is subsequently utilised to build subsurface ground models, which may be simple or complex depending on the nature of the available data and the familiarity of the practitioner with the area and local geological units.

2.3. Archaeological deposit modelling in south-east England

Today, deposit modelling expertise within both academic institutions and the developer-funded archaeological community is common. This reflects in part the success of a number of geoarchaeologically focused Masters programmes run by UK universities as well as the explosion in archaeological projects in the wake of the introduction of *Planning Policy Guidance Note 16* in November 1990. However, the roots of the development of this branch of geoarchaeology lie within the Institute of Archaeology (IoA) at University College, London (UCL), and its then Director, Professor David Harris.

In the late 1990s, a small team of geoscientists were assembled at the IoA under the guise of the Geoarchaeological Service Facility (GSF). This unit emerged from a project funded by Dover District Council in 1990 to assess the environmental archaeological potential of the deposits in and around a new development in central Dover (Barham and Bates 1990). The unit was a developer-funded service within UCL that offered geological expertise to archaeological projects. It was built on the experience gained by its staff during studies of Quaternary sediment sequences at sites such as Boxgrove in West Sussex (Bates *et al* 1997; Roberts and Parfitt 1999) and of the urban archaeology of London in collaboration with the then Department of Urban Archaeology (DUA) at the Museum of London. Projects undertaken during the

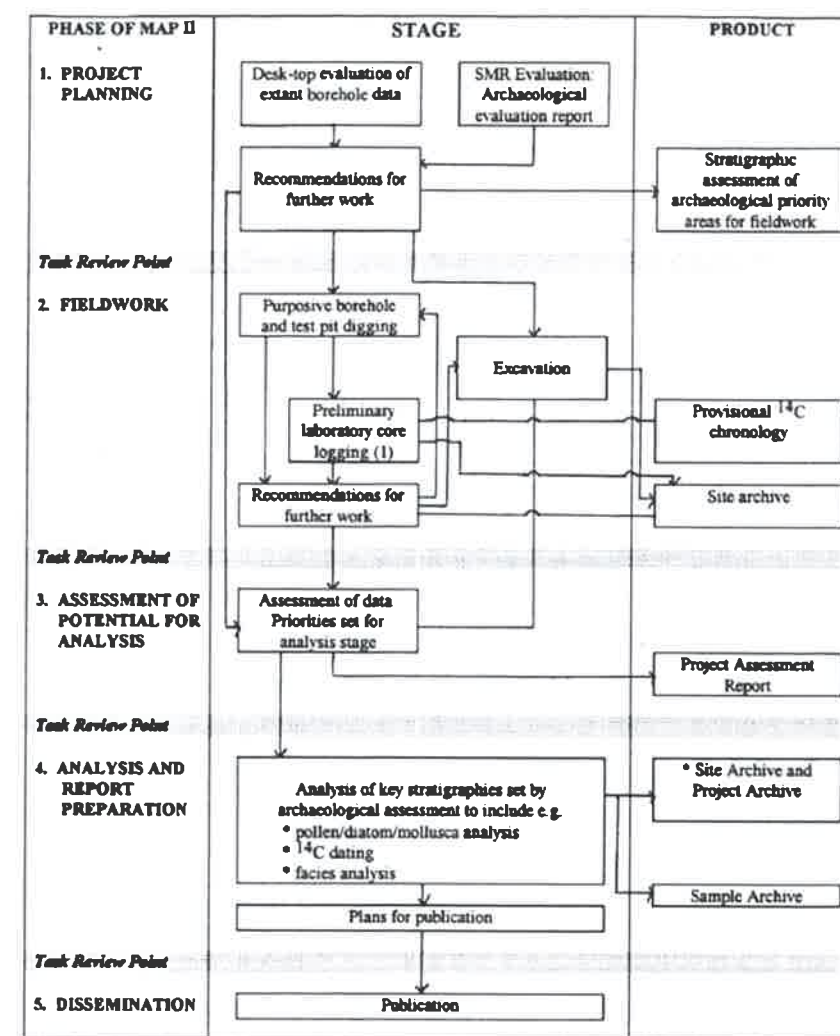


Figure 2.2: A suggested work-cascade for integration of borehole work into the archaeological project design following MAP II structures (from Barham and Bates 1994a)

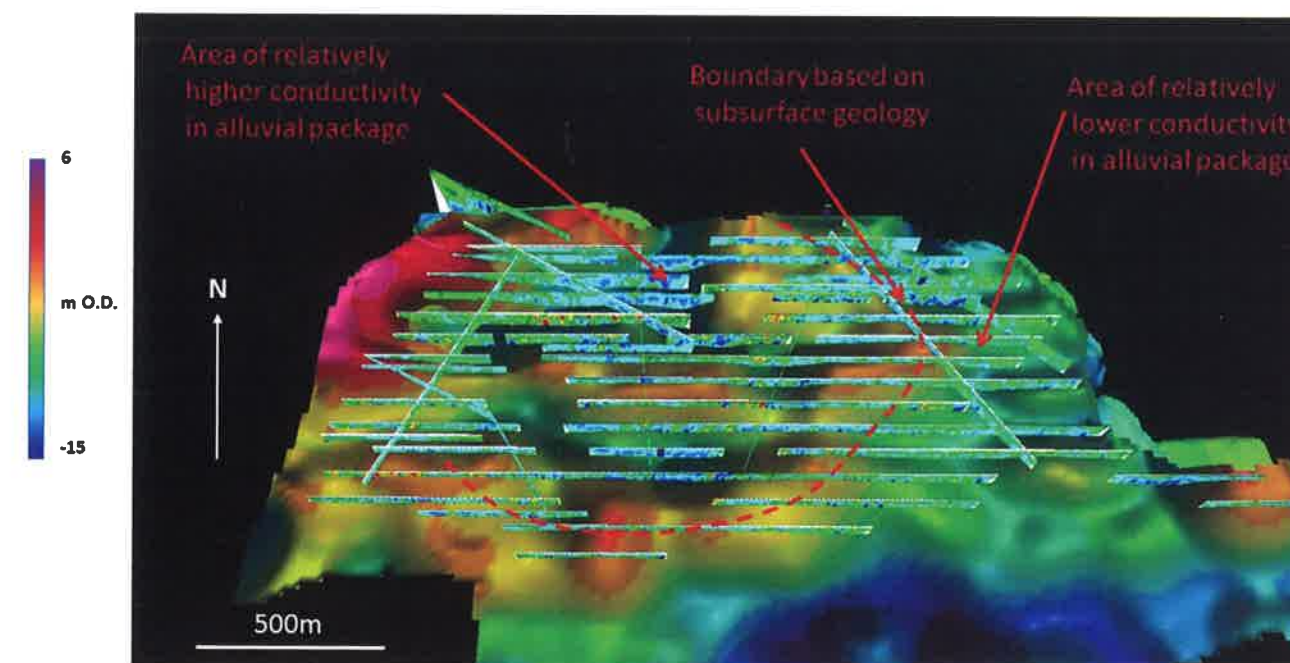


Figure 2.3: Geoelectrical profiles across the London Gateway site (from Bates *et al* 2012)

lifespan of the GSF (1990–1997) focused on the analysis of geotechnical (primarily borehole) data to create deposit models for areas of deeply stratified alluvium in the valleys of the Thames and other major river systems in south-east England. The GSF was the first group to provide routinely specialist geoarchaeological services to the major field units working in south-east England (for example, to Canterbury Archaeological Trust, Oxford Archaeology, Wessex Archaeology and the Museum of London Archaeological Service). This success quickly resulted in the creation of in-house geoarchaeological support within the major contractor units in the south-east. Guidance documents for the utilisation of boreholes within archaeological projects were produced in-house by the GSF (Barham and Bates 1994a; Figure 2.2). In addition, major infrastructure projects were undertaken (Barham *et al* 1995; Bates and Barham 1993), including the Dover case study described below. Ultimately, these methodologies were applied as part of the package of archaeological projects that was developed in response to the construction of the High Speed 1 rail route through Kent (Bates and Stafford 2013). Towards the end of the lifespan of the GSF, the application of geological geophysics to archaeological problems was being explored; this has since developed a significant role in deposit modelling in southern England (Bates and Bates 2000, 2016; Bates *et al* 2007).

The many organisations undertaking deposit

modelling in the south-east of England that were influenced by the GSF have produced multiple deposit models. Amongst the numerous examples of deposit models generated from borehole data, a number stand out for their scale of investigation. These include the Museum of London Archaeology works in the Lea Valley (Corcoran *et al* 2011), Oxford Archaeology's investigations along the line of the A13 (Stafford *et al* 2012) and Wessex Archaeology's mapping of the former Crayford Silts around Crayford (Wessex Archaeology 1999). Projects characterised by smaller-scale borehole investigations are exemplified by works at Belmarsh (Hart *et al* 2015), Canning Town (Nichols *et al* 2013), Silvertown (Crockett *et al* 2002; Wilkinson *et al* 2000) and Barking (Green *et al* 2014). Finally, the integrated use of boreholes with geological geophysics is demonstrated in works undertaken by Oxford Archaeology at the London Gateway port (Bates *et al* 2012; Figure 2.3).

2.4. Dover: a case study

The town of Dover in Kent (Figure 2.4) provides an important case study of not only the application of deposit modelling to the understanding of buried archaeology but also the history of deposit modelling within the Western Heights and Castle Hill areas, with the central part of the town occupying a low-lying position next to the canalised river Dour. The town centre lies at or close to sea

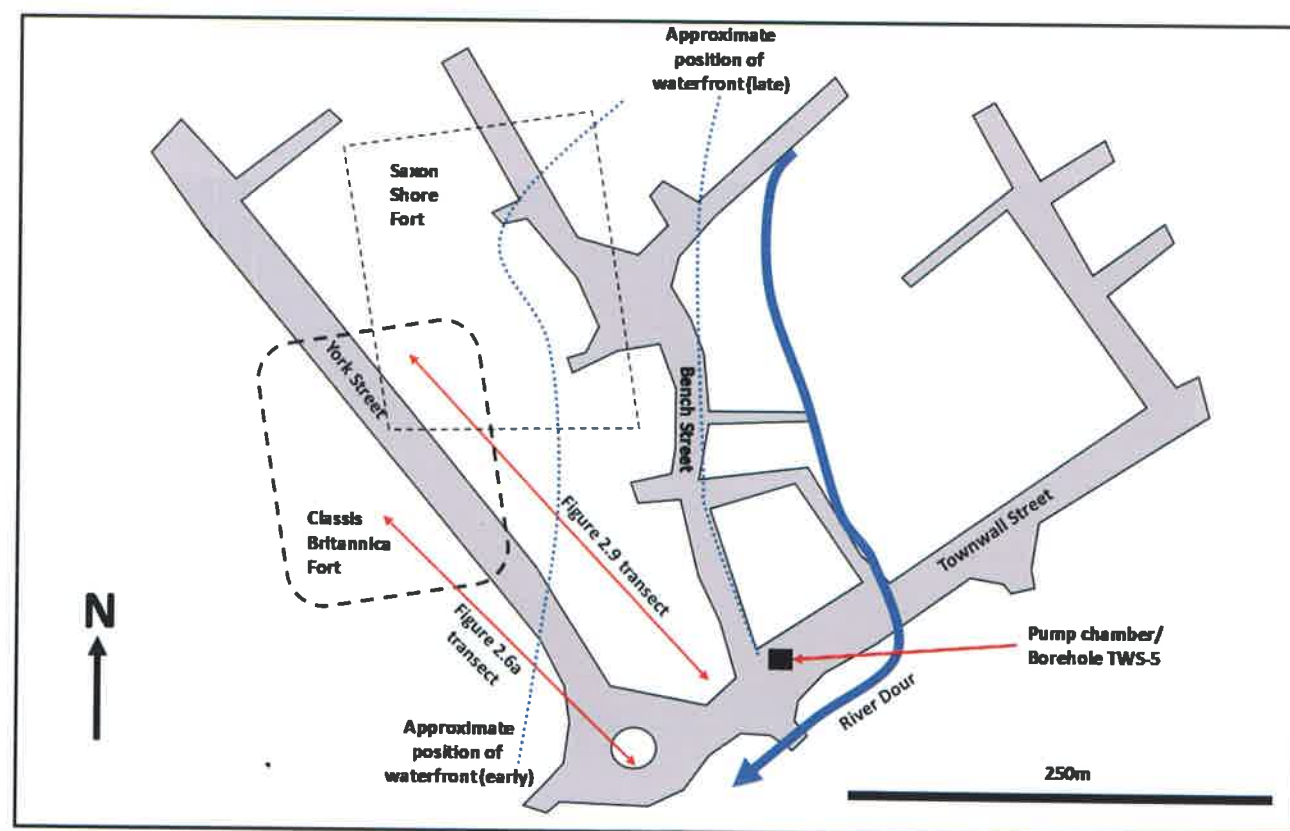


Figure 2.4: Site location plan for Dover

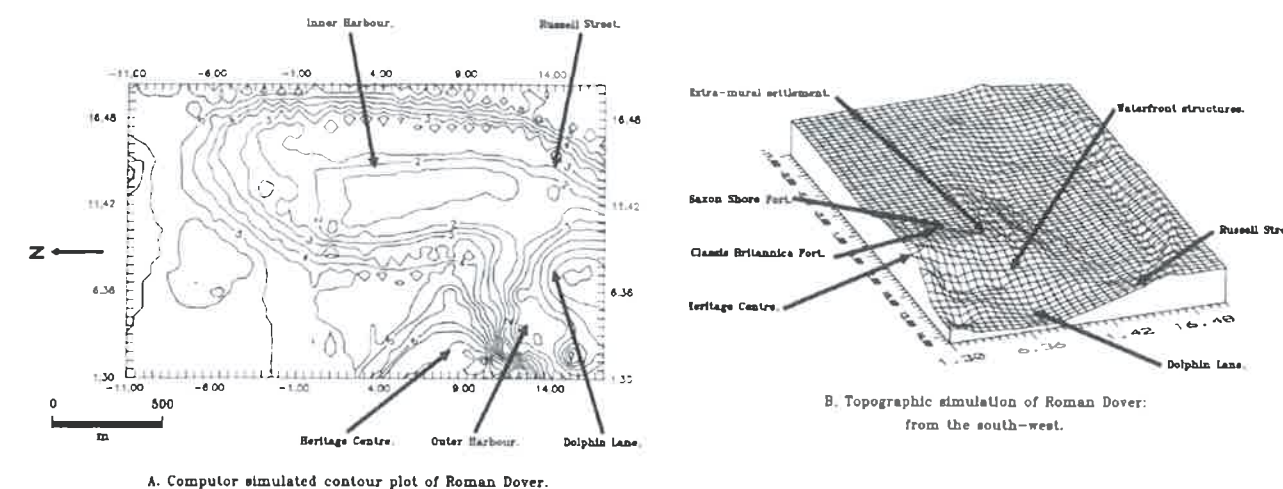


Figure 2.5: Plan and isometric view of the base of the Roman harbour (as modelled in 1990 by Barham and Bates (1990))

level and overlies a thick sequence of marine, freshwater and terrestrial deposits that document the development, flooding and infilling of the estuary and an early harbour of Dover; together, these sequences span at least the last 20,000 years (Barham and Bates 1990; Bates and Barham 1993; Bates *et al* 2008, 2011a). These natural sediments and the presence beneath central Dover of the remains of an older harbour were first noted by Leland:

'Dovar is xii miles from Cantorbury and viii miles from Sandwich. There hath bene a haven yn tyme past, and yn token thereof the ground that lyeth up betwixt the hilles is yet in digging found wosye. There

hath be found also peces of cables and ancores, and Itinerarium Antonini calleth it a haven' John Leland, 1539–1545 (Hearne 1710–1712).'

However, it is possible that an older account describing the estuary at Dover exists in the form of Julius Caesar's *Commentaries on the Gallic War*:

'He himself reached Britain with the first squadron of ships, about the fourth hour of the day, and there saw the forces of the enemy drawn up in arms on all the hills. The nature of the place was this: the sea was confined by mountains so close to it that a dart

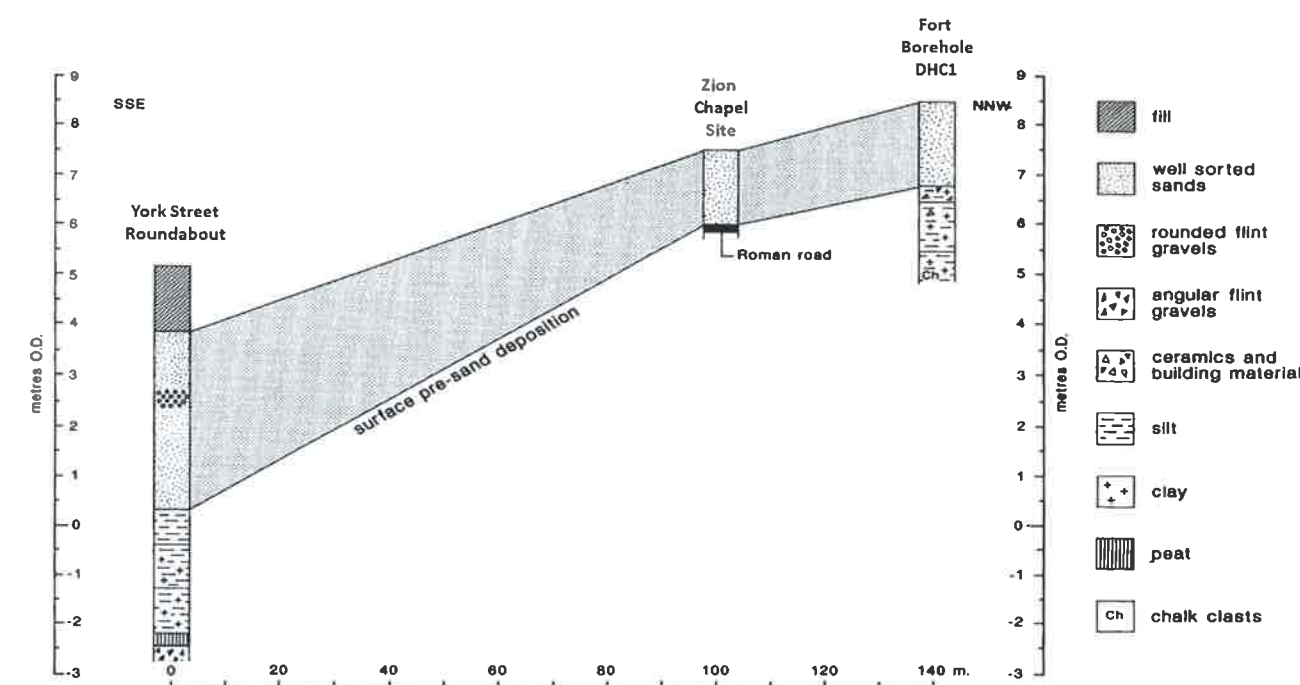


Figure 2.6a: Cross section based on boreholes from the Roman fort to York Street roundabout showing correlation of natural and anthropogenic sediments

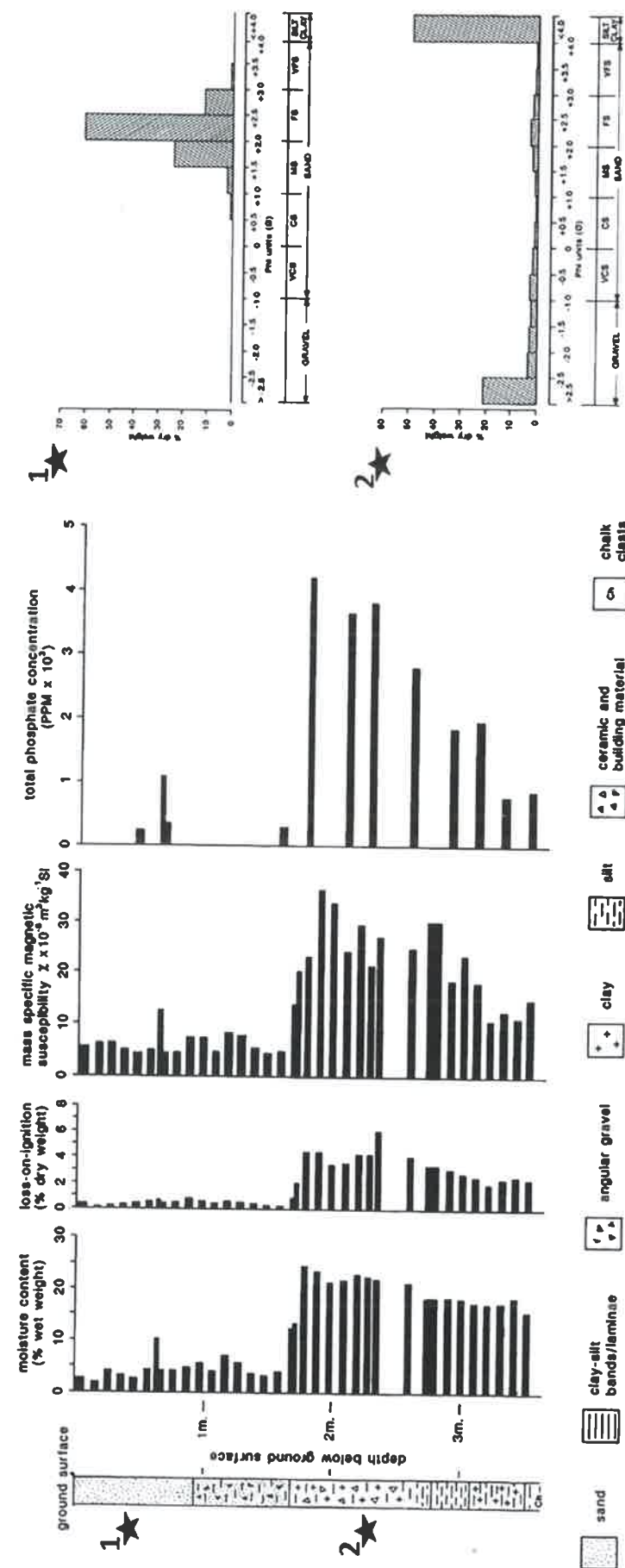


Figure 2.6b: Sedimentological data (including particle size distributions) of sediments from the borehole through wind-blown sands and anthropogenic sediments at the Classis Britannica fort. Both figures modified from Barham and Bates (1994b)

could be thrown from their summit upon the shore' (Caes. Gall. Book 4, Chapter 23, McDevitte and Bohn 1869).

Whether or not Caesar is describing the ancient estuary of the lower Dour Valley we know that Dover was home to the Roman forts of the Classis Britannica (Philp 1981) and the later Saxon Shore (Philp 2012) and was the home port for these fleets. The house with the Bacchic Murals (Philp 1989) as well as an older Bronze Age boat (Clark 2004) were also discovered in the town centre area. In all cases, the locations of these structures or finds are, in part, controlled by the position of the original estuary and its history of development.

The Roman harbour (Rahtz 1958; Rigold 1969) has long since been infilled and until recently little was known about it in any detail. Unravelling this history of harbour infilling and growth of the town has a long history in Dover, beginning in the 19th and first half of the 20th century (Bavington-Jones 1907; Elsted 1856; Knocker 1857). These early observations were augmented by opportunistic glimpses prior to the Second World War (Amos and Wheeler 1929) and formal excavations during construction and infrastructure renewal following bomb damage after the war (Rahtz 1958; Threipland 1957; Threipland and Steer 1951). Widespread investigations coincided with larger-scale works associated with urban regeneration during the 1970s and 1980s (Philp 1981, 1989, 2003, 2012) and modifications to the A20 road and town sewers in the early 1990s (Bates and Barham 1993).

Early schematic attempts to contextualise the archaeological remains within the landscape of the Roman

harbour were made by Rigold (1969) and this was followed in 1990 by an attempt to draw together all available data into a proto-deposit model for the town centre (Barham and Bates 1990). This work produced the first modelled projected outlines of the shape of the inner and outer Roman harbours (Figure 2.5) based on a combination of borehole data and information extracted from the excavation records. Although crude, the topographic projections appeared to support the ideas of Rigold (1969). This preliminary phase of deposit modelling (or more strictly speaking, surface modelling) was accompanied by borehole investigations undertaken in conjunction with excavations by Oxford Archaeology at the Classis Britannica fort (Wilkinson 1994). These works (Barham and Bates 1994b) attempted, for the first time in Dover, to connect physical elements of the landscape (in this case, windblown sands and the harbour fill sediments) with the archaeological structures of the Classis Britannica fort. This was achieved through the drilling and analysis of purposive boreholes articulated within the deposit model framework then available (Figure 2.6a&b).

The opportunity to test the 1990 model came with the A20 roadworks. Excavation of a deep sewer trench through the town centre (largely along roads that needed to be kept open; Figure 2.7a) precluded the idealized archaeological practice of clearing sites in advance of commencing construction. Thus because of the urbanized character of the area, coupled with the deeply stratified nature of the sediments within the former harbour, conventional approaches to the investigation of the archaeological record required adaptation. The first stage of this project therefore commenced with a desk-top evaluation of extant borehole and trench data. The result of the assessment was



Figure 2.7a: View of sewer trench under excavation. Figure 2.7b: Excavated site. Figure 2.7c: End of trench for recording protected by trench boxes. All photographs by the author

the development of a strategy that combined conventional set-piece excavations (where possible; Figure 2.7b) with a rolling watching brief as excavation of the sewer trench was undertaken (Figure 2.7c). The trench was up to 4m deep in places and utilised drag boxes for shoring, which allowed geoarchaeologists access to the leading edge of the cut for recording and sampling (Figure 2.7c). It was also decided that a series of purposive boreholes (funded by Historic England) were to be drilled in advance of cutting of the trench in order to recover samples through the underlying sediments and to ground truth the geotechnical data. The boreholes would thus inform the archaeological team of the likely presence (and depth) of key stratigraphic units that might be associated with archaeological remains. One outcome of this process was the identification of organic silts and tufa deposits of probable prehistoric age in the base of the valley (Figure 2.8a), some of which were likely to be impacted on by construction activity in the form of the sewer trench and ancillary works.

Tufa and peat were identified from boreholes at the intersection of Bench Street and Townwall Street (Figure 2.4, TWS-5) where a major chamber was being dug for the installation of pump equipment for an underpass from Bench Street to the seafront. Consequently, additional care was taken in monitoring this excavation for these deposits, of presumed late Prehistoric age. The

result of this exercise was the discovery of the Dover Bronze Age boat (Clark 2004) (Figure 2.8b&c). Despite succeeding in applying deposit modelling to predicting the location of sediments of archaeological significance (and finding the Bronze Age boat) the next logical step in the geoarchaeological study (analysis of the borehole sequences, construction of an urban archaeological database and the creation of a detailed deposit model for central Dover) did not occur. The reasons for this were complex and centred on problems of funding coupled with the detachment of the analysis of the boat from the main A20 project works (none of which has ever been progressed beyond assessment).

Since the mid 1990s, refinements of subsurface models for Dover have been piecemeal (Figure 2.9). Particular focus was rightly given from an early stage to the sequences associated with the Dover boat (Clark 2004). Keeley *et al* (2004) published an account of the palaeoenvironmental context of the boat but failed to contextualise adequately this find within either its local or regional geographic context. This failure to contextualise such an important find (despite the availability of suitable datasets) has created significant problems since then, particularly with regard to whether or not the craft was a sea-going vessel (Bates 2013). More recently, work on the right (west) bank of the Dour (closest to the Roman



Figure 2.8a: Tufa and peat in base of pump pit at Townwall Street-Bench Street intersection.

Figure 2.8b: Wood appearing from the tufa that was the first indication of the presence of the Bronze Age boat in the trench. Figure 2.8c: Bronze Age boat resting within tufa and on peat. All photographs by the author

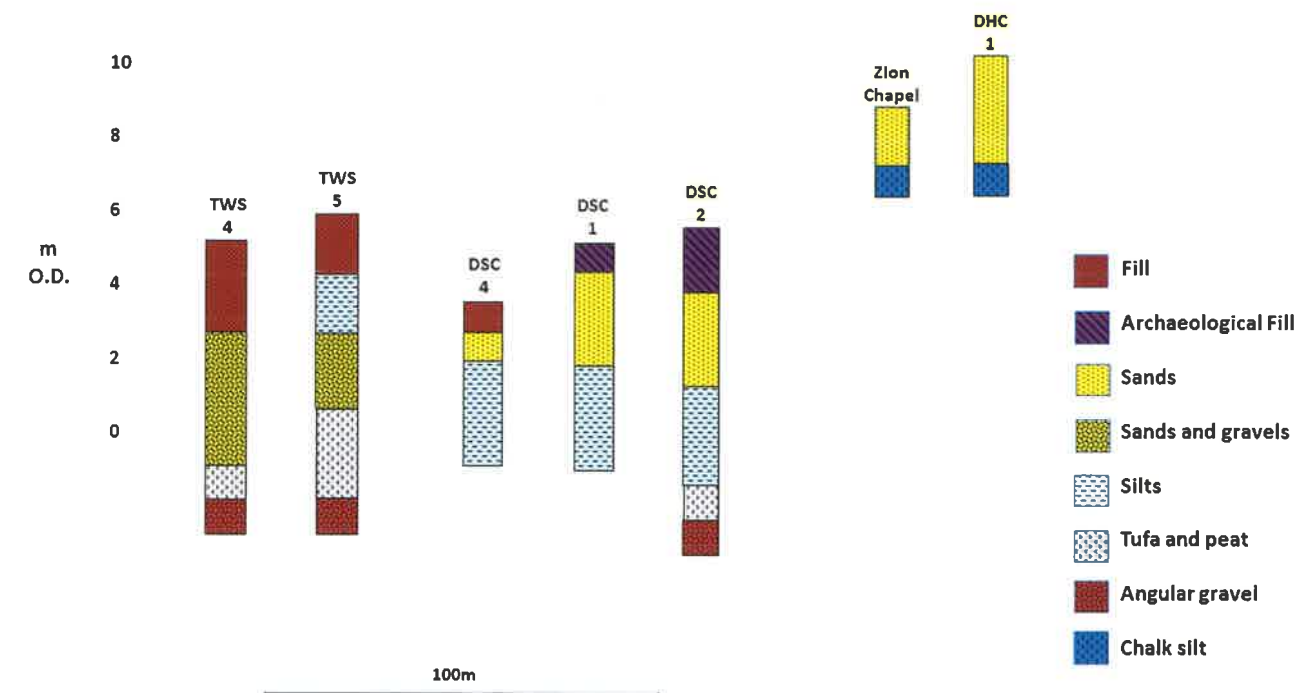


Figure 2.9: Transect constructed from boreholes across town centre area from high ground on west towards the east (from Bates *et al* 2011a)

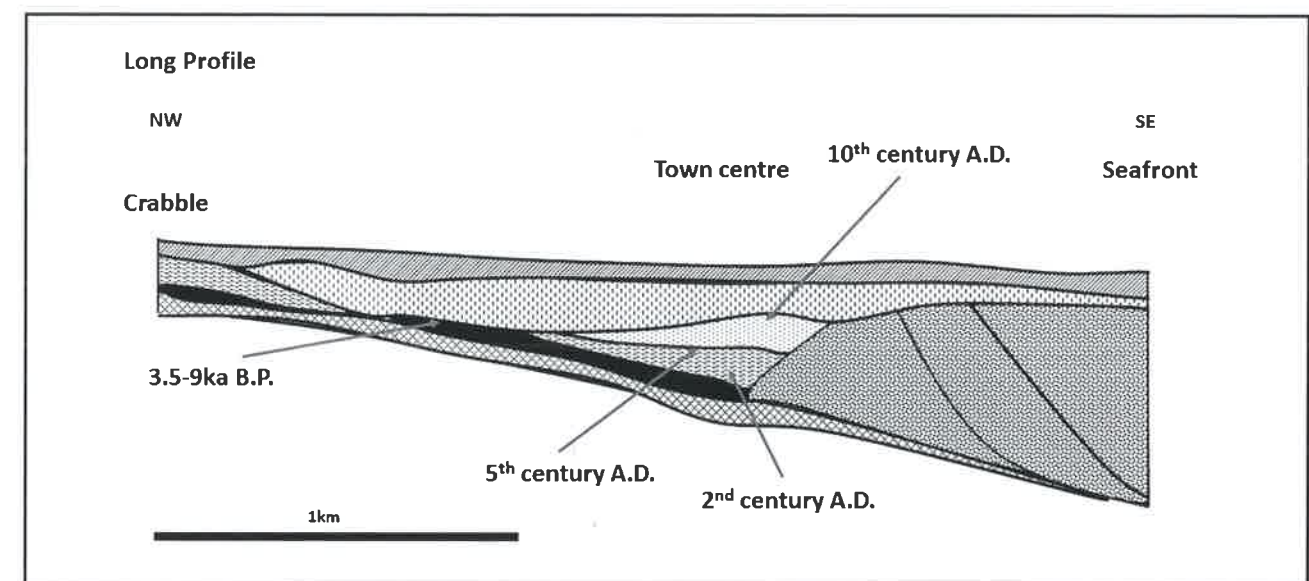


Figure 2.10: Idealised transect along west side of the river Dour for the town centre area constructed from borehole and excavation data (from Bates 2013)

forts) was enabled by the construction of a television screen in Market Square in 2011 (Bates *et al* 2011b). This was linked to a partial re-evaluation of the A20 boreholes and included limited investigation of some samples still extant from the 1990s drilling works. The result was the publication of the first truly integrated deposit model for part of Dover town centre (Bates *et al* 2011a). A simplified long profile down the west side of the Dour Valley is shown in Figure 2.10.

In contrast, the left bank of the River Dour remains rather less well understood. Investigation by Oxford Archaeology of the St James area in 2008 provided an insight into sediments and sequences but little attempt was made to link this to sequences west of the river (Oxford Archaeology 2008) and no assessment of recovered samples was undertaken. At the time of writing in 2016, the Canterbury Archaeological Trust (CAT) are overseeing the archaeological component

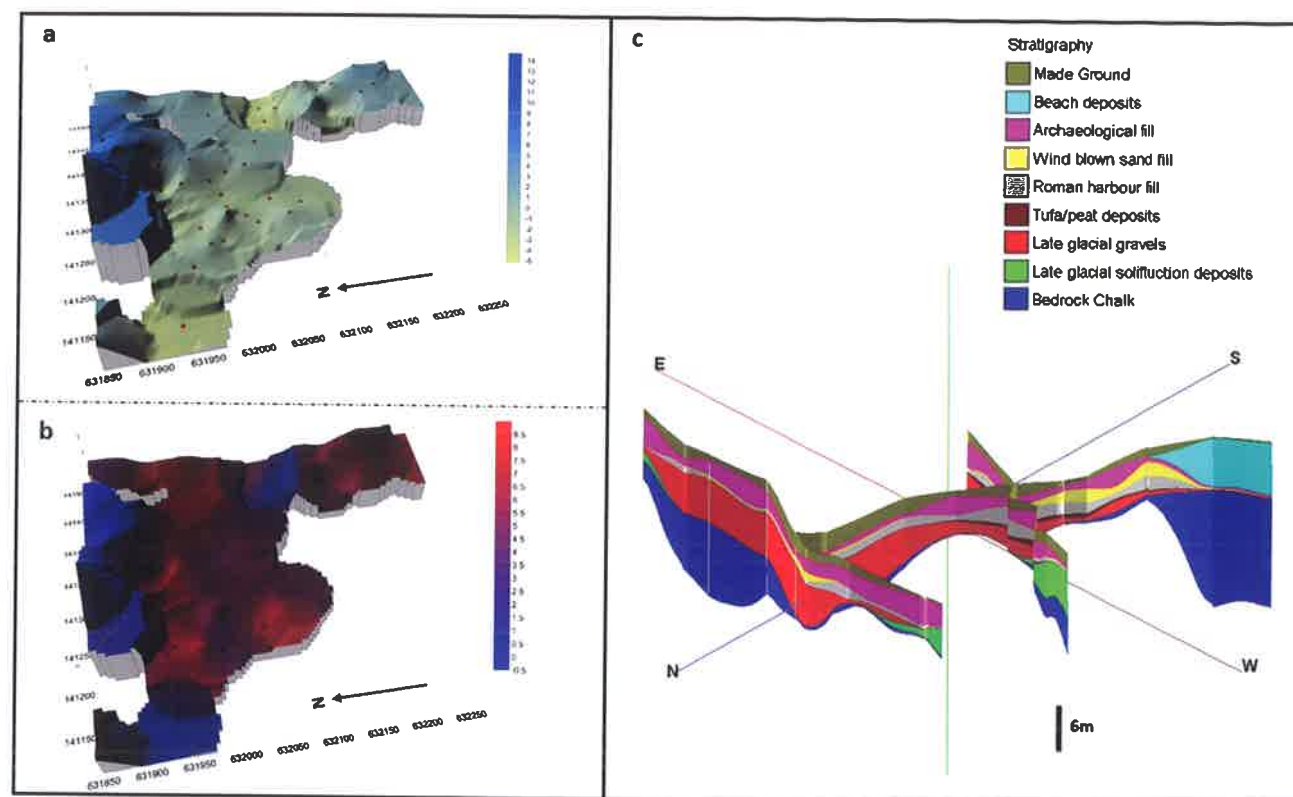


Figure 2.11a: Gravel surface topography and borehole locations (red dots) for town centre area (bounded by York Street, Townwall Street and Russell Street). Figure 2.11b: Thickness of archaeological sediments for the town centre area. Figure 2.11c: Fence diagram of major stratigraphic units for town centre area

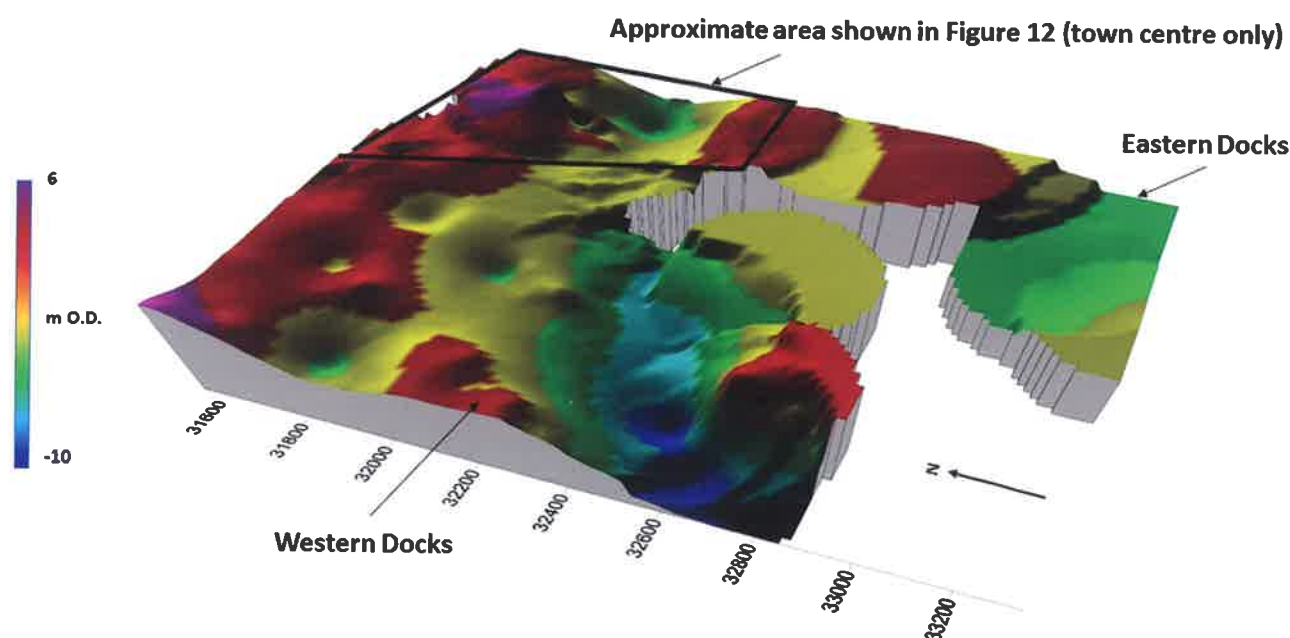


Figure 2.12: Gravel surface topography (base of Holocene) from Western Docks to town centre and Eastern Docks

of a major development project across the St James area; opportunities for ground-truthing of the Oxford Archaeology study as well as historical accounts of the area are on-going, and will utilise a strategy combining open trenches and boreholes. Whilst limited attempts to model the extent and thickness of archaeological deposits across both the east and west sides of the Dour have been made by the author (Figure 2.11), these remain tentative models pending the integration of the 2016 CAT works.

Expansion of the town centre derived model to other parts of the Dour catchment have also been undertaken. In 2004, sediments identified in 1990 and believed to be contemporary with those enclosing the Dover Boat were under threat at Crabble Mill, around 2km upstream of the town centre (Barham and Bates 1990). Excavation and analysis of the sequences were undertaken and published by Bates *et al* (2008). More recently, preparation for redevelopment of the Western Docks area in 2015 resulted in geotechnical works that provided the basis for an expanded deposit model for the town and docks area (Figure 2.12). These works resulted in ground-truthing of the model through subsequent borehole drilling. The investigation included, for the first time in Dover, the incorporation of bathymetric and seismic profile data into the ground models. In addition to providing detailed information for the urban area, the combination of datasets has been used to consider the landscape setting of the Bronze Age Langdon Bay Hoard, recovered some 500m off-shore (Bates 2013).

2.5. Discussion

Today, nearly 20 years on from the demise of the GSF, the wide range of multi-technique projects that geoarchaeologists undertake in southern England reflects the trajectory established by the GSF in the 1990s. Innovations in computing power, enabling database construction and 3-dimensional modelling of data (Aldiss *et al* 2010; Ford *et al* 2010; Kessler and Mathers 2004; Mathers *et al* 2014), allied with digital acquisition of geophysical data, has allowed complex models to be generated of the subsurface in greater detail than before (see for example Bates *et al* 2012). An increased familiarity of curatorial staff with the concept if not the practice of deposit modelling has resulted in a widespread adoption of this approach.

The future of deposit modelling appears rosy, but we should perhaps be cautious of the volume and detail in the data that is currently available to us. How often are we tempted, when under time and cost pressures, to 'input the data' to the software and 'press the button' to obtain an answer without adequately thinking through the data? How familiar are we with the contexts from which our data is derived? Have we adequately created a forward model, either mentally or physically, before we go into the field to collect data (Bates and Bates 2016)? How easy is it for

others to understand our models and, more importantly, the limitations of the models? We rarely, if ever, articulate problems with our models. Those whose projects are tied to developer-funding are often discouraged from being overly critical of the findings of a project when it has been made possible through such funding streams; we cannot be seen to have used the money unwisely! These are all questions and issues that need to be addressed and in some cases require an answer.

Acknowledgments

Through 35 years of deposit modelling the list of people to whom I am grateful is seemingly endless. However, a number of people have played a significant role in helping with the development of approaches to this subject. Firstly I would like to thank Anthony Barham who ran the GSF in the 1990s and David Harris who employed me in the GSF. Keith Parfitt, Paul Bennett and Barry Corke of the Canterbury Archaeological Trust – none of this would have happened without your input and support. I would like to thank my brother Richard Bates, who has been the brain behind the geological geophysics I have used in many projects, John Whittaker, who has tirelessly processed samples for me over the years, and the University in Lampeter, through which I have conducted many geoarchaeological projects since 1997. Finally, I would like to thank Francis Wenban-Smith, Liz Stafford, Chris Pine, staff at Oxford Archaeology and Archaeology South-East, and all others all who have been involved with investigations.

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