



Historic England

Rapid Coastal Zone Assessment Survey Yorkshire and Lincolnshire: Phase 3

Palaeoenvironmental Survey of Selected Sites
Barmston Mere and Spurn Point, East Riding of Yorkshire
Cleethorpes, Northeast Lincolnshire

T. Brigham & D. Jobling, Humber Archaeology

Discovery, Innovation and Science in the Historic Environment



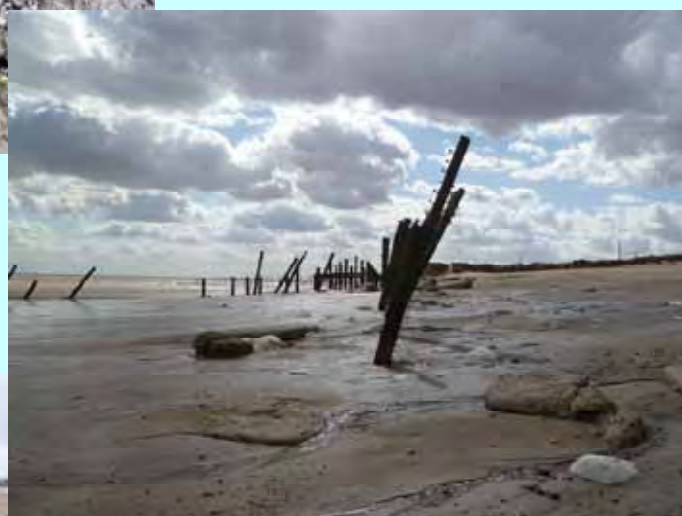
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Yorkshire and Lincolnshire: Phase 3

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Humber Field Archaeology
Archaeological Consultants and Contractors



RAPID COASTAL ZONE ASSESSMENT
YORKSHIRE AND LINCOLNSHIRE
Site Investigation and Assessment
Selected Palaeoenvironmental and Archaeological Sites
East Riding of Yorkshire, North-East Lincolnshire
PHASE 3

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1 SUMMARY

This assessment of selected sites of palaeoenvironmental and archaeological importance on the coasts of East Yorkshire and North–East Lincolnshire was undertaken by Humber Field Archaeology, on behalf of English Heritage as part of Phase 3 of the Rapid Coastal Zone Assessment (RCZA) of Yorkshire and Lincolnshire (Project 3729).

The assessment takes into account walkover surveys of the area undertaken for Phases 1 and 2 (Brigham *et al* 2008; Brigham & Jobling 2011), and previous campaigns of palaeoenvironmental sampling and fieldwork, together with the results of a programme of new coring and site investigations undertaken as part of this survey. This has allowed an appraisal to be made of the potential importance of each site, as well as an overview of the area.

The survey investigated aspects of four principal areas of archaeological and palaeoenvironmental significance: Barmston Mere, Skipsea Withow Mere and Kilnsea/Spurn Point in the East Riding of Yorkshire, and the remains of the ‘Humber Forest’, Cleethorpes, in North-East Lincolnshire (Fig 1). Fieldwork, including coring and sample collection, commenced at intervals from March 2012 onwards, followed by specialist palaeoenvironmental assessment and ¹⁴C dating. The results of monitoring a series of early modern wreck sites at Cleethorpes are also incorporated in this report.

Significant results of the work include the dating of two early to mid Neolithic and late Neolithic tree samples from Spurn and two late Neolithic timbers from Cleethorpes, contemporary with the later date from the north bank. One of the Cleethorpes timbers was selected from a group which appears to have been modified to form part of a structure, one of the earliest identified in the sub-regional intertidal zone, although its form and function could not be determined (Fig 13). The four sampled timbers were all associated with the remains of eroding land surfaces either side of the Humber. The land surface included *in-situ* tree stumps, branches and other debris below recent marine shingle and shell beds: coring at Spurn and Cleethorpes confirmed that the eroding deposits represented former woodland established on earlier estuarine deposits which was subsequently inundated, reflecting fluctuations in the Holocene sea level, affecting marginal areas around the Humber and North Sea coastline.

An 850m north–south borehole transect revealed two shallow depressions at Spurn between areas of former land surface. The depressions were filled with alluvium and are considered to form part of a network of post-glacial watercourses which all appear to have drained south-west into the Humber. The lack of biogenic deposits makes it less likely that these were shallow lakes or fens, although this remains a possibility.

Coring also confirmed that a Bronze Age barrow (‘Easington Barrow 1’), excavated several times over the course of a century, was constructed on alluvial fill at the western edge of a large channel, the Kilnsea (or Easington) Fleet. A contemporary barrow (‘Barrow 2’) and mini-henge excavated on the upper beach 200–250m to the north-east in 1998 also overlay the fill, suggesting that the Fleet had formed a still visible boundary.

Further north, a new profile of Barmston Mere was established by coring, revealing a sequence of post-glacial lacustrine deposition (Fig 3). Faunal remains present in core samples established that the mere was a pristine body of fresh water with the

level probably seasonally variable. A plan of the mere drawn from ground survey during Phase 2 was amended using LiDAR and aerial photographic images (Fig 2).

At Withow Gap, the site of the western exit of the former Skipsea Withow Mere, a profile of the channel and the lacustrine fill sequence was created using rectified photography of the most recent cliff exposure at this rapidly eroding site (Fig 5). This adds to the corpus of existing information for this site. A new outline plan of the inland extent of the wetland area west of the Gap was also produced using LiDAR images.

In addition, the report incorporates the excavation and assessment of two sites exposed on the North Sea foreshore at Kilnsea Warren in 2011 through the natural scouring of shingle. Both sites were reported to Humber Sites & Monuments Record by Yorkshire Wildlife Trust.

The first of these sites consisted of an arc of nineteen posts emerging from the edge of the upper beach shingle, observed during the course of a survey by the British Geological Survey. The main part of the structure was not exposed, but at an estimated c 17.5m diameter it is considered unlikely to have been part of a roundhouse as originally envisaged on discovery, and it may represent a timber mini-henge or other monument type (Fig 10). As this discovery was clearly of significance, the site was located again in 2012, with two timbers sampled for ¹⁴C dating as part of this project. The structure proved to have been constructed in the early Bronze Age and was therefore contemporary with the Easington barrows and henge located further to the north. This is the furthest south that direct evidence for prehistoric occupation has been identified at Spurn, although a small late Bronze Age/early Iron Age cremation cemetery was investigated on the foreshore a little further north in 1957, implying that more sites remain to be discovered.

The second structure was an eeltrap which was originally observed by a member of the public near the eastern edge of the middle beach, close to the site of the roundhouse (Fig 9). The remains, which were embedded in earlier estuarine and woodland floor deposits and filled with dark silt, were excavated and sampled, proving to have been constructed of cane sections and twisted withies. The cane was subsequently identified as possibly rattan, an exotic import which would date the eeltrap to no earlier than the later 17th century. Even at this late period, Spurn was located much further to the east, suggesting that the eeltrap was originally set in a saltmarsh channel on the Humber foreshore.

The report includes the results of a visual inspection of several post-medieval shipwrecks near Cleethorpes by the Archaeologist for North East Lincolnshire Council, providing data for addition to details recorded on previous visits to the area in 1999, 2007 and 2010. The inspection confirmed that the area is subject to rapidly fluctuating beach levels which have had a detrimental effect on the condition of the remains.

Two specialist reports have been incorporated: the first presents the results of radiocarbon (¹⁴C) dating of the six wood samples submitted to the Scientific Dating Team, English Heritage; the authors of this Palaeoenvironmental Report have also taken the opportunity to calibrate or recalibrate relevant previously published ¹⁴C dates using comparable methodologies in order to establish a standard dating baseline. The second report provides an assessment of a series of core, species and spot samples undertaken by Palaeoenvironmental Research Services.

Recommendations are made for further work. It has been suggested that the site and surroundings of Easington Barrow 1 should be monitored and the course and profile of the Kilnsea Fleet, which passes under the area of the barrow and two monuments further north, should be defined by targeted coring; the banks appear to have influenced the location of funerary monuments and the channel itself may have formed a ritual boundary, even in its final partly silted condition. Further borehole transects could usefully be undertaken along both shores of the Spurn peninsula to create a complete profile through post-glacial deposits from the north end to the tip, establishing the courses of the two possible channels located in 2012 and identifying any further examples.

It is recommended that the circular Bronze Age structure at Kilnsea Warren should be planned in its entirety and evaluated before the site is lost to confirm its function and internal layout, and also investigate the surrounding area and underlying ground surface for further signs of occupation. This is especially urgent as subsequent to the completion of the initial draft report, the entire area was subjected to severe storm surge damage in December 2013, leading to the severing of a substantial length of the neck of the Spurn peninsula south of Warren Head; the extent of damage to the monument itself and to the relict land surfaces in the area has not yet been determined.

It is also suggested in view of deteriorating and rapidly altering conditions that the area of the probable Neolithic structural remains from Cleethorpes should be investigated for traces of further structures and signs of occupation. The timbers potentially represent significant remains in a highly sensitive environment.

2 INTRODUCTION

2.1 Background

This report assesses the palaeoenvironmental and archaeological significance of a number of sites on the coasts of East Yorkshire and North–East Lincolnshire which were selected as the result of previous work. It forms part of a series of reports comprising Phase 3 of the Rapid Coastal Zone Assessment Survey (RCZAS) of Yorkshire and Lincolnshire (English Heritage Project 3729).

2.2 Definition of the study area

The study area is defined on Figure 1, consisting of a selection of sites defined in the Updated Project Design for Phase 3 of the RCZAS (Brigham 2012). Several sites where organic deposits or structures were identified at Phases 1 and 2 as already affected by coastal erosion (Brigham *et al* 2008; Brigham & Jobling 2011) were targeted for further investigation, including extent mapping and sampling, although the list has been amended

The task list is itemised below; some tasks identified in the UPD returning negative results (*greystone*) and others added (**bold**), for reasons given at appropriate points in section 4. The alphanumeric site numbers referred to (e.g. BA182) are those assigned during the course of the RCZAS, consisting of a two-letter parish prefix followed by a numerical site identifier:

Task C: mapping and sampling of eroding meres and former land surfaces

Barmston Parish

- Field investigation of the area around the mouth of Earl's Dike for signs of a possible Bronze Age/Iron Age settlement (BA166) and organic stream deposits/former mere for mapping and sampling;
- Field investigation, mapping and sampling of foreshore and cliff exposures of Barmston Mere (BA182).

Skipsea Parish

- Field investigation, mapping and sampling of foreshore and cliff exposures of Withow Mere (SK19).

Roos Parish

- Field investigation, mapping and sampling of foreshore and cliff exposures of former mere, Sand-le-Mere (RO93).

Easington Parish

- Investigation, recording and sampling of relict land surface EA353 on North Sea foreshore in vicinity of late Bronze Age/early Iron Age cemetery site EA236 and dated Neolithic peat exposures recorded at TA 4230 1470 and TA 4235 1385;
- Sampling of relict land surface around Bronze Age barrow EA117 and underlying Neolithic site EA119;
- Investigation and sampling of Humber foreshore, including area around jetty EA203;
- **Recording and sampling of eeltrap and surrounding land surface revealed by beach erosion;**
- **Sampling and dating of circular post structure revealed by beach**

erosion.

Cleethorpes Parish

- Monitoring of potential erosion and exposures of former land surfaces particularly around shipwreck sites (e.g. CL118, 131, 133) and possible fish traps or weirs (e.g. CL5, 129). If possible, retrieve wood samples from the latter sites;
- **Sampling and dating of prehistoric forest exposures.**

2.3 Statutory Status

Spurn Point is a National Nature Reserve, a Site of Special Scientific Importance (SSSI), forms part of the Humber Flats, Marshes and Coast Special Protection Area, and the Humber Estuary Special Area of Conservation and is also designated as a wetland of international importance under the terms of the Ramsar Convention (1976). It is a designated (non-statutory) Heritage Coast.

Skipsea Withow and Dimlington cliff are geological Sites of Special Scientific Importance, while Barmston Mere is a non-statutory Regionally Important Geological and Geomorphological site (RIGS).

2.4 Objectives

The general aim of this report is to collate and assess past and present information relating to the known palaeoenvironmental or archaeological resource of each selected area. The information includes the results of new coring surveys and radiocarbon dating undertaken as part of this project.

This assessment will contribute significantly towards the overall aim, which is to provide sufficient information to enable the formulation of a strategy to ensure the preservation, management or further investigation of any significant palaeoenvironmental or archaeological asset.

The individual sites are described in section 4 (Field Survey), with additional specialist data included in section 5 (Radiocarbon Dating) and section 6 (Palaeoenvironmental Sampling). The results are summarised in section 7 (Discussion and Recommendations).

3 METHODOLOGY

3.1 Introduction

The principal sources of information consulted are noted below and the data derived from them are included at appropriate points in the text; the original gazetteer numbers assigned in Phases 1 and 2 are also given. Where additional published and unpublished sources are quoted, their details are listed in the bibliography.

3.2 Sources

Various cultural heritage research and other sources were consulted during the course of Phases 1 & 2 and this Phase 3 assessment, which include:

- The Humber Sites and Monuments Record (HSMR)
- The Hull History Centre
- East Riding Archive Centre
- North-East Lincolnshire Historic Environment Record (NELHER)
- English Heritage Intertidal and Coastal Peat Database
- English Heritage Archive Record

Cultural heritage information for the study area is included where applicable in section 4 and summarised in section 7.

Photographs taken as part of the coring survey and other fieldwork have been included at the end of the report.

3.3 Radiocarbon dating

Six new ¹⁴C dates commissioned for this project by the English Heritage Scientific Dating Team are presented in section 5 and referred to throughout this report. The methodology for calculating and presenting these results is defined in section 5.2: in brief, they were calibrated in 2012 by the University of Waikato Radiocarbon Dating Laboratory using the OxCal programme (v4.1) and the IntCal09 calibration curve. These results are quoted as received, with the laboratory reference given.

There are, however, a considerable number of relevant earlier uncalibrated ¹⁴C dates from a variety of secondary sources, generally published in the 1970s and 1980s and quoted either in the form 'date+radiocarbon years BP', or more simply 'date+BP'. A smaller number of dates, particularly from the 1990s, had been calibrated ('date+cal BP' or 'date+cal BC') but have obviously not benefited from the continual refinement of software and methodology. Any quoted date can only be considered as accurate at the time of publication and is not directly comparable with dates calibrated thereafter, without recalibration using comparable methods.

In order to standardise earlier ¹⁴C dates cited in this report and provide direct correlation with those commissioned for this project, the authors have calibrated (or in some instances recalibrated) previously quoted dates using OxCal v4.2 software and the IntCal09 calibration curve (published 2009). Although IntCal13 became available in spring 2013 (Reimer *et al* 2013), there is only marginal difference of a few calendar years between dates calibrated using the two curves and a single protocol was therefore adopted for all dates. This allows, for the first time, like-for-like comparison between recent results and those quoted in the 1970s–1990s.

Following international convention, the original uncalibrated radiocarbon dates have been quoted after the calibrated calendrical dates as years BP (before 1950) followed by the originating laboratory sample code. This has been traced in most cases, but the secondary source is given in the few instances where the code could not be located.

As detailed in section 5.2, the newly calibrated/recalibrated results are quoted as a range of dates calculated with a 95.4% probability and rounded outward to the nearest 10 years in the form recommended by Mook (1986).

The calibrated calendrical date has been given first in the form cal BC to allow direct cross-reference with accepted archaeological BC/AD dates for periods of human development. For example the uncalibrated date 2960 ± 150 BP for a sample from a wooden post gives a calibrated calendrical range of 1500–830 cal BC, placing the timber in the late Bronze Age.

4 FIELD SURVEY

4.1 Introduction and methodology

As already stated in section 2.4, the original task list provided in the Updated Project Design (Brigham 2012, 26–7) differs in some instances from the programme of site works as finally implemented. The reasons for this vary from site to site and therefore a description of the original intent followed by the rationale behind any changes is provided here in each case.

All coring survey areas were approached in the same manner, with the same procedure outlined below employed in each instance.

Prior to any coring being undertaken, a proposed line of transect, comprising a number of individual boreholes, was plotted onto the Ordnance Survey map base for each area utilising AutoCAD software and saved in .dxf/.dwg format. The transect and borehole positions were then uploaded onto a Trimble GeoExplorer XT handheld GPS with a differential correction (dGPS), using FastMap Mobile Software. The signal was enhanced using a GeoBeacon receiver. The pre-loaded survey data were used to determine borehole locations with sub-metre accuracy on-site prior to coring. A temporary benchmark relating to Ordnance Datum was then installed at each location, the height subsequently determined using a Leica Smart Rover 1200 survey grade GPS system. This equipment was used primarily due to the remoteness of the sites in relation to standard benchmark locations.

The boreholes were augered using an Eijkelkamp Liner Sampler. This enabled up to 8–9m depth of coring; generally 4–6m was sufficient to reach a solid natural substrate, with various head attachments available dependent upon soil type: a sand auger head proved useful for beach deposits as well as heavy, compacted dryer clays, an alluvial silts head was invaluable for the majority of the soft sediments encountered below ground level. After augering, it was possible to establish the exact location of the majority of boreholes using the Leica Smart Rover 1200; the height above sea level was recorded using the same process.

Written descriptions of the deposits exposed within each core were compiled on site on a standard pro-forma HFA core deposit recording sheet. Samples retained for further analysis were obtained using a stainless steel core sampler head, which held a plastic liner to facilitate the removal of uncontaminated deposits. The samples, upon removal from the core sampler, were double-bagged in clear polythene bags with a sealing strip, followed by further bagging within a black polythene bin liner to prevent light, either natural or artificial, affecting the quality of the sample. The samples were retained at HFA in a temperature-controlled 'sensitive store' environment providing stable humidity and temperature prior to transportation for environmental analysis.

In addition to the boreholes, small block samples were collected from exposed relict land surfaces at beach level at two locations at the Spurn Point site. These were bagged and stored using the same methods.

Further, several wood samples were recovered from the exposed intertidal former land surfaces in several locations at Spurn Point and Cleethorpes. In both of these areas there were exposed remains of either tree root systems or structural remains. The samples were collected by hand and bagged using the same method as the core and block samples, with the addition of a small amount of water to prevent the samples from drying out.

A small number of working photographs were taken during the course of the various surveys using a Pentax WG-1 14 Megapixel camera with 5x optical zoom, adding to images collected in RCZAS Phases 1 and 2.

4.2 The survey

Each discrete geographical area where investigation was carried out is dealt with in order from Barmston in the north to Cleethorpes in the south.

4.2.1 Barmston

The underlying geology of Barmston is Upper Cretaceous Flamborough Chalk, overlain by boulder clay (glacial till), followed in the coastal area by extensive glacial sands and gravels, with intervening areas of lacustrine alluvium.

The area is now crossed by canalised drains entering the North Sea, but the Earl's Dike and Barmston Main Drain both represent the approximate line of natural features, the latter passing through and draining the hollow formed by the silted Barmston Mere (TA 168 587), the east end now lost to the sea (van de Noort *et al* 1995, 78–9). There may also have been a shallow mere at Low Grounds (TA 161 461), which was drained when it was breached, leaving desiccated organic deposits and the present low cliff. Inland there was a possible mere at Trusey Bottom (TA 168 589), although shallow, and perhaps of short duration.

Topographically, the area is gently undulating, principally above 8m OD, with some high points, including Hamilton Hill (26m OD) and Trusey Hill (14m OD). There is a low cliff in most places, almost absent in Low Grounds.

Site 1: Earl's Dike

On further investigation of the area around the mouth of Earl's Dike (Fig 1), no traces of a potential former mere or settlement remains (RCZAS ref: BA166) were visible, although the cliffs and upper beach have been subject to rapid erosion. As the site could not be located, no surface sampling or coring were carried out.

Site 2: Barmston Mere

Barmston Mere (RCZAS ref: BA182) was listed in July 2000 as a Regionally Important Geological and Geomorphological site (RIGS) by the East Yorkshire RIGS Group, in recognition of the early to mid Holocene sedimentary sequence revealed by previous sampling. A Bronze Age settlement constructed on the silted margin of the mere has also been identified; this was initially thought to be a 'lake settlement' built over open water (Smith 1911), but subsequent investigations revealed that it postdated the underlying lake peats by several millennia, although some peat may have formed later (Varley 1968; Head *et al* 1995).

The general outline of the mere had been mapped previously during Phase 2 of the RCZAS programme using GPS survey equipment. Minor amendments to the outline were based upon further site observations and close study of LiDAR and modern satellite aerial imaging of the area, producing a more accurate plan of its extent (Fig 2).

It is clear that Barmston Mere extended eastwards into the North Sea; several test cores bored to a shallow depth (less than 0.5m) have demonstrated that the lower

levels of mere deposits continue for at least 150m east of the current cliff line (Plate 3). These deposits are exposed at beach level in places, though more often than not they are obscured by 0.2–0.5m of sand and occasional shingle. Inland, the area is visible as a depression (Plate 4). This suggests that the mere has a minimum east–west width of 550m. Further, LiDAR imagery of the surviving inland area has suggested that the mere has a minimum extent of 820m north–south.

A single north–south transect (Fig 3) was completed along the remaining width of the mere in an area that had not been encroached upon by arable land (Plates 5, 6). The transect was located just inland of the beach exposure, starting at the upper, northern rise or former bank of the mere, running along the centre point to as close to the southern edge as possible.

Transect 1 Borehole 1

Depth BGL (in metres) at 4.05m OD	Description
0.00–0.40	Topsoil. Mid to dark brown soft sandy silt loam with modern rootlets
0.40–0.80	Pale grey soft gritty silty clays with some pale buff orange lenses
0.80–1.20	Mid grey soft silty clays with some decayed organics. Ground water table encountered at 0.80m
1.20–1.55	Mid to dark brown grey soft silty clays (lacustrine marl)
1.55–2.10	Mid grey orange soft silty sands with occasional small gravel (lacustrine marl)
2.10–3.20	Mid grey soft gritty silty clay with occasional pea gravel. Becoming sandier and looser with banding between the sands and clays (lacustrine marl)
3.20–3.40	Mid grey fine to medium soft silty sands (lacustrine marl)
3.40–3.55	Mid brown grey soft gritty silty clays (lacustrine marl)
3.55–3.90	Mid grey brown soft and fine silty clays with small chalk fragments <50mm (lacustrine marl)
3.90+	Light orange brown compacted sands and gravels, well sorted
	Coring ended due to impenetrable stone or gravel layer

Transect 1 Borehole 2

Depth BGL (in metres) at 4.12m OD	Description
0.00–0.70	Pale buff soft coarse sands
0.70–0.80	Mid grey soft silty clays
0.80–1.40	Dark and rich brown soft clayey organics with rootlets visible. Ground water table encountered at 1.30m
1.40–1.50	Mottled light grey yellow and blue soft gritty silty clays (lacustrine marl)
1.50–2.70	Light to mid grey very soft clay silt (lacustrine marl)
2.70–4.40	Dark blue grey very soft and fine organic silts (lacustrine marl)
4.40–5.00	Mid grey soft silty sands with occasional gravel inclusions (lacustrine marl)
5.00+	Light orange brown compacted sands and gravels, well sorted
	Coring ended due to impenetrable heavily compacted sands and gravels. Unable to drill through

Transect 1 Borehole 3

Depth BGL (in metres) at 3.97m OD	Description
0.00–0.10	Topsoil. Dark grey brown soft sandy loam

0.10–0.45	Golden soft coarse sands
0.45–0.50	Light blue grey soft clay sands
0.50–0.85	Dark grey brown soft organic clays with increasing amount of roots and rootlets around 0.30m into the deposit
0.85–0.95	Mid grey orange soft clay sandy silt (lacustrine marl)
0.95–1.60	Mottled orange, yellow and grey soft sandy silt. Ground water table encountered at 1.00m (lacustrine marl)
1.60–2.60	Light to mid mottled buff, orange and grey soft sandy clay silts (lacustrine marl)
2.60–3.70	Light pale blue grey soft sandy clay silts (lacustrine marl)
3.70–4.70	Dark grey soft and fine organic (decayed) silty clays (lacustrine marl)
4.70–5.70+	Pale grey very soft and fine clay silt (lacustrine marl)
	Coring ended at 5.70m as no more shafts available

Transect 1 Borehole 4/4A

Depth BGL (in metres) at 3.00m OD	Description
0.00–0.15	Topsoil. Dark grey brown soft silt sand loam
0.15–0.30	Pale golden soft coarse sands
0.30–0.45	Mottled yellow and grey soft gritty silty clays with some rootlets present
0.45–0.70	Dark blue grey black organic fine clays. Ground water table encountered at 0.70m (lacustrine marl)
0.70–1.60	Mottled yellow and grey soft gritty silty fine clays becoming softer at depth (lacustrine marl)
1.60–2.30	Pale grey soft silty fine clays (lacustrine marl)
2.30–2.70	Mid to dark grey blue fine silty clays (lacustrine marl)
2.70–4.00	Dark blue black soft and fine silty clays (lacustrine marl)
4.00–4.50	Pale brown buff silty clays
4.50–5.80	Pale buff grey silty gritty clays
5.80+	Mid grey brown hard clays with small stone, small degraded stone, chalk and coal flecking and inclusions. Probable glacial till
	Coring ended in BH4 due to extreme ground suction. Coring ended in BH4A due to reaching probable glacial till. NB: Returned to this borehole to auger deeper and obtain core samples. Recorded as Transect 1 BH4A for everything below 4.00m

Transect 1 Borehole 5

Depth BGL (in metres) at 4.26m OD	Description
0.00–0.40	Pale golden soft coarse sands
0.40–0.95	Topsoil. Mid grey brown soft clay sandy loam
0.95–1.50	Light to mid mottled grey and yellow soft sandy silt increasing in clay content after the first 0.20m into this deposit. Water table level encountered at 1.50m (lacustrine marl)
1.50–1.60	Mid buff grey soft gritty silty clays (lacustrine marl)
1.60–1.70	Buff grey soft sands mixed with mid grey silty clays (lacustrine marl)
1.70–2.70	Mid grey soft silty clays with small chalk fragment inclusions c. 50mm diameter together with occasional ironstone present (lacustrine marl)
2.70–7.00+	Very firm to hard mid blue grey silty sandy clays with occasional small stone inclusions c 50mm diameter. There is an increase in the amount of stone inclusions at around 3.50m. Increasing amount of fine sand content at around 3.50m to 4.00m. Graded colour change from mid blue grey to darker grey brown at around 4.00m. At 5.70m the material, although visually the same in colour and composition does becomes quite soft and stony. It is

	probable that this gradual change includes glacial till, or at least re-worked glacial till at the lower end of the core
	Coring ended due to non-retention of material as a result of extreme wetness from this level down

Transect 1 Borehole 6

Depth BGL (in metres) at 4.59m OD	Description
0.00–0.50	Mid brown soft clay sandy loam, increasing clay content at 0.30m+
0.50–1.00	Mottled yellow and grey very soft sandy silty clays
1.00–1.50	Mid blue grey moderate gritty silty clays (lacustrine marl)
1.50–1.90	Mid to dark blue grey fairly soft gritty silty clays with increasing amount of fine organic sediment (lacustrine marl). Ground water table encountered at 1.70m
1.90–3.30	Dark blue grey fairly soft silty organic clays
3.30–3.85	Light buff brown soft silty clays
3.85–4.00+	Mid buff brown heavily compacted clay sands. Small to medium sized gravel inclusions
	Coring ended as the coring equipment would not penetrate the compacted deposit listed above

Transect 1 Borehole 7

Depth BGL (in metres) at 4.01m OD	Description
0.00–0.10	Golden yellow loose coarse sands
0.10–0.55	Topsoil. Mid grey brown moderate silty sand loam
0.55–0.85	Light to mid buff grey brown moderate working soft sandy clays with occasional pebble inclusions (lacustrine marl)
0.85–0.90	Mid yellow orange fine soft silty sandy clays (lacustrine marl)
0.90–1.50	Mid orange grey brown soft silty sandy clays (lacustrine marl). Ground water table encountered at 1.20m
1.50–2.20	Light to mid blue grey silty organic clays with pale banding (lacustrine marl)
2.20–2.70	Mid grey buff soft to moderate clay sands with pea gravel inclusions
2.70–2.80	Mid orange heavily compacted sands and gravels, well sorted
2.80–3.70+	Mid grey brown hard clays with small stone, small degraded stone, chalk and coal flecking and inclusions. Probable glacial till, so coring ended

Transect 1 Borehole 8

Depth BGL (in metres) at 3.98m OD	Description
0.00–0.20	Golden yellow loose coarse sands
0.20–0.60	Topsoil. Mid grey brown moderate silty sand loam
0.60–1.00	Light to mid buff grey brown moderate working soft sandy clays with occasional pebble inclusions (lacustrine marl) with rooty or woody detritus towards the top of the matrix
1.00–1.75	Mid orange grey brown soft silty sandy clays (lacustrine marl). Ground water table encountered at 1.35m
1.75–2.10	Mid blue grey silty organic clays with pale beige banding (lacustrine marl)
2.10–2.90	Mid grey buff soft to moderate clay sands with pea gravel inclusions well mixed with dark organic silts
2.90–3.50	Light orange brown compacted sands and gravels, well sorted
3.50–3.90	Mid grey brown hard clays with small stone, small degraded stone and

	chalky flecking and inclusions. Probable glacial till, so coring ended
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Transect 1 Borehole 9

Depth BGL (in metres) at 3.95m OD	Description
0.00–0.30	Golden yellow loose coarse sands with reedy plant
0.30–0.65	Topsoil. Mid grey brown moderate silty sand loam
0.65–0.95	Mid to dark blue grey black organic fine clays. Ground water table encountered at 0.70m (lacustrine marl)
0.95–1.10	Buff grey soft sands mixed with mid grey silty clays (lacustrine marl)
1.10–1.45	Mid orange grey brown soft silty sandy clays (lacustrine marl). Ground water table encountered at 1.35m
1.45–1.95	Pale grey soft silty fine clays (lacustrine marl)
1.95–2.80	Mid grey soft gritty silty clay with occasional pea gravel and very occasional larger gravel inclusions. Becoming sandier and looser with banding between the sands and clays (lacustrine marl)
2.80–2.95	Mid brown heavily compacted sands and gravels, moderately well sorted
2.95–3.20	Mid grey brown hard clays with small stone, small degraded stone, chalk and coal flecking and inclusions. Probable glacial till, so coring ended

Transect 1 Borehole 10

Depth BGL (in metres) at 4.10m OD	Description
0.00–0.60	Topsoil. Mid grey brown moderate silty sand loam
0.60–1.20	Mottled yellow and grey very soft sandy silty clays with occasional gravel inclusions and rootlet inclusions
1.20–1.75	Light to mid buff grey brown moderate working soft sandy clays with occasional pebble inclusions some sharp sand inclusions (lacustrine marl). Ground water table encountered at 1.45m
1.75–2.10	Light to dark blue grey silty organic clays with pale banding (lacustrine marl)
2.10–2.75	Light to dark (increasing in hue at depth) blue grey soft to moderately soft clay silts with probable organic content increasing, also at depth (lacustrine marl)
2.75–2.85	Mid grey buff soft to moderate clay sands (lacustrine marl)
2.85–2.95	Mid to dark orange brown heavily compacted sands and gravels, well sorted
2.95–3.25+	Mid grey brown hard clays with small stone, small degraded stone, chalk and coal flecking and inclusions. Probable glacial till, so coring ended

In 1911, Reginald Smith reported the discovery of timber piles alongside Barmston Drain and suggested they were the remains of a 'lake dwelling', standing on piles over open water; subsequent excavations by William Varley in 1960 and 1962 revealed a cobbled floor, hearths, postholes and cooking pits (Fletcher & Van de Noort 2007); ¹⁴C dates from two posts yielded date ranges of 1500–830 cal BC/2960±150 BP (BM-122) and 1440–790 cal BC/2890±150 BP (BM-123), placing this settlement in the mid to late Bronze Age. The presence of peat surrounding the structures was considered to suggest that the settlement lay in a marshy hollow, but subsequent re-excavation by the Humber Wetlands Project in the 1990s allowed samples to be taken from the peat itself for dating purposes. These returned dates which revealed the structures to be much later than the ground beneath. Starting from the base to the top, the three dates obtained were: 10780–10250 cal BC/10720±110 BP (GU-5449); 10280–9440 cal BC/10190±110 BP (GU-5448); and 8730–8320 cal BC/9300±70 BP (GU-5450). The first two dates imply that the peat began to form during the Loch Lomond Stadial, a short cold period which ended c

11500 cal BP, and which saw the return of tundra following the milder conditions developing after the main glaciation. Peat bogs do continue to form in tundra, albeit at a much slower rate owing to shorter growing seasons and a general slowdown in the rate of the bacterial and microbiological processes which cause the decay of organic matter (Hicks 2011). A later wood sample dated 7530–7140 cal BC/8300±70 BP (Fletcher & Van de Noort 2007) represented arboreal regrowth following a return to warmer climatic conditions during the later stages of the early Mesolithic period.

Figure 3 shows the results of the borehole survey in profile, with individual core sections illustrated. Despite some limitations on the implementation of the work due to access, the figure demonstrates the broad profile of the mere. In the north, glacial till was not reached, although compacted sands and gravels were recorded at the base of BH1 & 2. Increasing suction within the drill column prevented the base of the next core (BH3) from being extracted, but in BH4/4A, possible reworked till was reached in approximately the position of the deepest part of the mere 7m below the present surface, although as no gravel was present, this may represent material eroded from the lake edges. Reaching BH6 & 7, it appears that at the southern edge of the mere, the base presented itself as a steep upwards slope with only a slight variation in height towards the later cores in the sequence. A basal gravel was present in BH6–10, similar to that at the north edge, but was penetrated in BH7–10, revealing till directly below.

Overall, the recorded sequence suggests that primary compacted or indurated sands and gravels lie directly above the till at the base of the mere, overlain by gritty silts and clays, which were mostly soft and contained occasional gravels. This secondary deposit was encountered in BH4/4A–8. Sealing these were varying lacustrine silt types which were present in all of the boreholes examined until immediately below the modern ground cover.

None of the boreholes encountered the peat recorded by Varley and the Humber Wetlands Project suggesting it was localised. There was, however, a small organic component in some of the clay silt deposits and these may represent very decayed peat or 'gyttja', a post-glacial (Flandrian) organic lacustrine mud which usually reflects the partial digestion of plant and animal remains under waterlogged anaerobic conditions. Gytja is often found at the base of better-preserved peat deposits; eventually, it is this deposit which forms coal under conditions of extreme heat and pressure.

Environmental samples from BH4a (see section 6.2) revealed stonewort (*Chara*) oogonia or nucules (chambers containing a single egg) at depths between 3.1–4.4m. Stoneworts are bottom-dwelling branched algae of the class Charophyceae which are encountered on the muddy beds of brackish and freshwater lakes. These organisms require particular conditions and their presence at different levels within the sample column reflects the slow silting of the mere and suggests there was little water movement, with a low nutrient level and no pollution. Stonewort can become covered in lime deposits which form a kind of stone-like exoskeleton instead of using cellulose for support, hence the name. When present in large numbers, decaying stonewort can lead to the calcification of lake bed sediments, forming a characteristic calcareous lacustrine marl.

Also present at all depths were several forms of diatom (algal phytoplankton) and many resting bodies (ephippia) of water fleas (probably mainly *Daphnia*), again an indication of good water quality, although resting eggs are only produced with the assistance of males at times of stress, in place of asexual female parthogenesis (clone production) during normal conditions, suggesting that the mere periodically

dried out or became unfavourable for other environmental reasons. Also present below 3.1m were fragmentary statoblasts; these shell-like bodies produced by bottom-dwelling filter feeding bryozoans ('moss animals') function in the same way as ephippia, preserving the ability of a colony to survive in occasionally adverse conditions.

Of the pollen which could be identified, birch (*Betula*) was present below 3.1m. This was an early post-glacial coloniser, appearing, for example, in the cooler second half of the Windermere Interstadial (short warm period) which followed the end of the main period of glaciation (Dimlington Stadial) between c 12750–11000 BC, and also recolonised following the subsequent short intervening cold period, the Loch Lomond Stadial which ended c 9500 BC. The volume of the organic component of the various samples was insufficient for absolute dating; further sampling with a larger diameter auger head may provide a larger volume of suitable material.

4.2.2 Skipsea

The underlying geological formation in Skipsea is Upper Cretaceous Flamborough Chalk, overlain by boulder clay (glacial till). There are some deposits of fluvio-glacial sands and gravels, including pockets east of Cliff House and south and west of Skipsea village, with a more extensive band of overlying lacustrine deposits, which also passes west and south of the village, before turning eastward to reach the cliff at Withow Gap. The latter marks the position of a series of small silted-up post-glacial freshwater meres, including Low and Skipsea Bail Meres, north-west and west of the village outside the study area at TA 149 566 and TA 158 558, and Skipsea Withow Mere to the east, which has been largely lost to erosion (Van de Noort *et al* 1995, 74–8). At Withow Gap, a declivity in the cliff marking the position of a channel where the mere was connected at one time to a smaller lake inland, and perhaps eventually to the Bail Mere (Plates 7, 8). The site is a recognised geological SSSI.

The Holderness meres are thought to have formed at the end of the last glaciation, the Late Devensian (Dimlington Stadial) on the surface of glacial tills, and remained as open water and marsh well into the Holocene. Most contain deposits ranging from the Late Glacial to the mid Holocene, including Bail Mere (Dinnin & Lillie 1995).

Site 3: Withow Mere

The end of the 20th century and the first decade of the 21st century covered a period of considerable land loss in Holderness. This period saw several years of long dry spells, which stressed the till cliffs, punctuated by short periods of exceptionally heavy rainfall, which caused large blocks of till to sheer away along fault line cracks. This has led to acceleration in the frequency and severity of cliff collapses at Withow Gap (Fig 1), revealing lengthy fresh exposures of lacustrine deposits. A large recent exposure was observed in 2009 (Plate 7), but this had cut further back in 2012 (Plate 8).

Withow Gap (Fig 4) is the location of a channel linking Skipsea Withow Mere (lost to erosion) to a smaller lake inland and probably ultimately to Bail Mere and Low Mere, all preserved by silting and infilling inland. As such, the Gap represents an extremely important Holocene exposure which has been classified as a Site of Special Scientific Importance (SSSI).

Only the westernmost deposits survive in the cliff; the area has been significantly affected by erosion since 2008 (Plates 7, 8) and mapping of the remaining inland portion of the channel was limited by the presence of private land boundaries, to

which access was not possible during the available project time. However, as with Barmston Mere, careful examination of current LiDAR imaging has allowed a general outline of the remaining mere to be established (Fig 4).

It was possible, however, to record a substantial new exposure noted during a site visit to record nearby First World War monuments. Following consultation with English Heritage, it was determined that sufficient work had been undertaken in the past and a planned core sequence across the mere would probably simply provide duplicate information. It was decided by HFA that a single core would be attempted in the central part of the exposed area (ostensibly the deepest part) to provide a simple comparative record of the soil sequence (see below); however, the loss of the alluvial soils auger head at c 4m depth precluded the retrieval of a full sequence to the base of the mere.

An additional approach taken at Withow was to employ systematic rectified photography of the freshly collapsed area of the low cliff face either side of the Gap. This comprised a section through the upper half of the mere sequence, similar to that of the new borehole (Plates 9–16).

The width of the mere face as exposed during the visits to the site was 53.73m north–south. Again, the depth of the sequence was incomplete as the current beach level banked up against the lower deposits of the mere. The maximum depth of deposits observed was 5.90m, a composite; measurement taken from the highest point at the northern and southern ends of the mere and related to the central, deeper depression. Borehole data collected by Hull University in 2002/2008 did, however, record that the bed of the mere extended to a depth of 7.97m below the top of the cliff in the centre of the channel (Marsters 2011).

The cliff face itself has been eroded into an irregular indentation across the width of the mere, a deeper embayment than the 2008 line. To counter this, a base line was established on the beach, with photographs taken at 5m intervals utilising 2 x 2m scale bars to allow subsequent rectification. These images were then transferred directly into AutoCAD, scaled at 1:1 and digitised. Figure 5 shows the subsequent illustration of the profile produced. This broadly complements the sequence commented on by Horne (2002) with the addition of heights related to Ordnance Datum.

Transect 1 Borehole 1

Depth BGL (in metres) at 5.83m OD	Description
0.00–0.15	Loose mid brown clayey sandy loam, very dry, occasional chalk inclusions
0.15–0.45	Firm mid brown sandy clays, occasional chalk inclusions
0.45–0.80	Soft pale buff to grey silty clays with indistinct mottling
0.80–1.50	Very soft dark brown silty organic clays, probably alluvial or colluvial. Ground water encountered at 1.40m
1.50–2.80	Soft and moist mid to dark brown silty organic clays, containing occasional wood and other fibrous organic inclusions
2.80–4.30	Smooth and soft mid to dark brown silty organic clays
4.30+	Very firm pale grey silty sands and clays
	Coring ended due to loss of auger head at around 4.50m

Although an early observation of lacustrine deposits and possible timber structures was made at Skipsea by Sheppard in 1894 (Marsters 2011), followed by Armstrong

(1923) and Godwin & Godwin (1933), the exact locations of these reported lake sequences are unknown, although they clearly comprised cliff exposures which were considerably wider than the present surviving section, being c 91m (100 yards) in 1933. The first significant work to modern standards was however undertaken at Skipsea Withow in 1983 (Gilbertson 1984; Gilbertson *et al* 1987). A subsequent investigation by Fachtna McAvoy, Central Archaeology Service (CAS), was carried out in 1993 to examine possible Neolithic timber structures (McAvoy 1995), with investigation of the soil samples by Dr Maureen McHugh, University of Newcastle (McHugh 1993) and the Environmental Archaeology Unit, University of York (soils Carrott *et al* 1994; thin sections Usai 1994).

This work produced much useful information regarding the post-glacial palaeoenvironmental history of the mere, concluding that the timbers initially noted by Sheppard formed part of a dam of material blocking the channel rather than a lake settlement. This may have formed naturally, although there was also a possibility that it represented a beaver dam.

More recent work was undertaken in 2002 and 2008 by the Centre for Lifelong Learning, Hull University (Horne 2002; Marsters 2011); this included the production of measured plans and sections with detailed recording and sampling of the exposure north and south of the central channel. Comparison of the location of the cliffline between 2002 and 2008 showed an apparent increase in the rate of erosion, certainly by comparison with the situation in 1984. The programme of field recording by Hull University was accompanied by several augered boreholes through the soil sequence and spot sampling of timbers exposed in the cliff. The samples were processed and the soil grain sizes and microfossils analysed.

The mere itself was formed at the surface of the Skipsea Till, a dark greyish-brown slightly stony to stony clay loam, which has been ¹⁴C dated by basal moss samples as being deposited some time after c 21360–19280 cal BC/18500±400 BP at the base (Penny *et al* 1969). It was laid down at the same time as the more localised Withernsea Till which overlaps it to the south, being deposited from a different direction.

The mere was probably c 1km in length as late as the medieval period, but erosion at the seaward end would either have quickly drained it or created a basin: the name of the village, from Anglo-Scandinavian *skip* (ship) + *saer* (lake) suggests that boats may have been able to enter, using the former mere as a haven, although this is conjecture. Certainly Sand-le-Mere and Withernsea Mere were used in this way after the seaward ends had been lost, at least as late as the 16th century.

The basal fill of this and other Holderness meres is known from previous work to be represented by largely minerogenic deposits comprising Late Devensian lacustrine clay silts and gravels similar to those recorded at the base of the Barmston Mere sequence (Flenley 1987; Dinnin & Lillie 1995). Gilbertson's work in 1983 revealed that at Skipsea, thick basal gravels overlay the initial silts. The presence of a small organic component is likely to indicate deposition within the Windermere Interstadial (c 12750–11000 BC), an early warming phase following glacial retreat. This was followed by a temporary cold phase, the Younger Dryas or Loch Lomond Stadial (c 11000–9500 BC), during which humans withdrew southwards, corresponding with the end of the Upper Palaeolithic period in the British Isles.

A birch log from within the basal silts dated to 10840–10580 cal BC/10710±70 BP (Gilbertson *et al* 1987), was deposited close to the beginning of the stadial, a period when birch woodland, which had spread over much of northern Europe during the

previous interstadial, would have been in retreat as the area reverted to scrub tundra. The end of the cold phase is presumably represented by the deposition of the substantial gravel deposits noted in this and other meres as a result of rapid melting at the onset of the Holocene, corresponding to the beginning of the Mesolithic period (c 9500 BC).

The gravel and initial silting was succeeded by a post-glacial (Flandrian) organic lacustrine mud (gyttja). The composition and formation processes of gyttja vary depending on the parent materials, but it normally reflects the partial digestion of plant and animal remains, often initially by aerobic bacteria, but continuing under anaerobic conditions as waterlogging develops.

At Withow Gap, the gyttja is located at the base of peat deposits which resulted from vegetational growth in and around the mere in the early Holocene, incorporating leaf, seed, pollen and woody material as the surrounding area reforested. The base of the peat at Withow Mere has been ^{14}C dated to 9470–9240 cal BC/9880±60 BP, the beginning of the Holocene/Mesolithic and it continued to form until the early Neolithic period, c 3370–3080 cal BC/4500±50 BP (Gilbertson *et al* 1987). This was broadly at a time when the sea reached a level similar to that of today, having inundated the final areas of dry land in the North Sea basin, separating Britain from the Continent by the end of the Mesolithic period.

Examination of two column samples taken by the Central Archaeology Service in 1993 by the Environmental Archaeology Unit, University of York (Carrott *et al* 1994) identified traces of moss, stonewort, bogbean, sedge, birch and poplar/aspen within a basal sand deposit which represent the local flora prevailing during the early Holocene. Roach, vole and caddis fly were also represented. Alder, oak and ash were present within the overlying gyttja, as well as cowbane, white water-lily and sedge, indicating an increasingly warm prevailing climate. The pollen analysis of samples taken in 1983 from the slightly more structured peat layers above included pine, willow, lime and ash (Gilbertson *et al* 1987). To this, the 1993 samples added evidence for a richer flora of alder, oak, alder buckthorn, hazel, lime, cowbane, white water-lily, yellow water-lily, hornwort, rush, pondweed and aquatic moss stems, as well as a variety of aquatic invertebrates.

Samples taken in 2008 by Hull University also revealed the presence of alder, oak, elm, birch and hazel (Marsters 2011), while the microfossil assemblage was dominated by stonewort (*Chara*), comparable to a similar prevalence in the Barmston Mere borehole samples taken in 2012 (see above).

The uppermost part of the sequence consisted of minerogenic deposits resulting from soil erosion as the area was increasingly deforested and exploited for agriculture from the Neolithic period onwards. Stonewort and rush were present in the 1993 samples, suggesting that at least part of the mere survived as a freshwater pond with periods of water clarity.

Although not bottomed, the cliff sequence recorded from the single borehole drilled during Phase 3 of the RCZAS (not illustrated) appears to correspond to the gyttja, peat and upper silt layers noted during previous recording programmes by other workers, and the comparative profile produced is the main benefit of the work. The cliff profile (Fig 5) differed from the borehole in the addition of lenses of sands and gravels towards the upper lips of the mere at the northern and southern edges.

There was a further sandy clay lens towards the northern edge lying between the second and third deposits recorded in the sequence. The presence of sandy lenses

at the edges of the mere was noted as part of the 2002/2008 survey by the University of Hull and was probably correctly interpreted as weathering of the sides (Marsters 2011).

There have been further cliff falls along the face of the mere exposure since 2012 resulting in a deepening of the indentation; this indicates clearly that the softer deposits within the mere itself are more at risk than the surrounding natural clays. The presence of large stones and beach cobbles in the Gap may also cause mechanical abrasion. Further, the level of beach sand varies throughout the year, at times leaving more of the profile visible, and thus subject to wave action.

4.2.3 Roos

The underlying solid geology of the Roos area is Upper Cretaceous Flamborough Chalk, overlain by boulder clay (glacial till). The northern part of the cliff zone reaches 27m OD at Hilston Mount and 25m OD as far south as Tunstall, but beyond that, falls to 6m OD in the Sand le Mere area. The area falls to 4m OD around the exit points of Roos and Tunstall Drains (Sand le Mere), where there are areas of alluvium indicating former channels, wetlands and meres extending inland at a similar level.

A recorded mere formerly existed on what is now the foreshore at Sand le Mere near TA 3195 3105 (Fig 1). Inland, Gills Mere survives in the north as a marshy hollow; Howmarr (west of Tunstall), Rose Mere (east of Tunstall) and Bramarr have been lost to siltation and later agricultural drainage.

Site 4: Sand-le-Mere

In 1898, Thomas Sheppard identified worked timbers of what he interpreted as a lake dwelling which would have been located at the landward end of the former mere. Burleigh's map of c 1560 seems to suggest the seaward end had been opened to form a small bay used by fishing boats at spring tide, although the remains of the mere were protected by a bank before 1622 (Sheppard 1912, 154).

An enclosed mere appears on Saxton's map of 1577, Speed's of 1610 and Blaeu's of 1662, which all show a considerable projecting 'bump' in the coastline at this point, eroded away by the early 18th century, and the mere is no longer indicated on later maps, suggesting it had largely vanished, although the bank was still being maintained until the early 20th century. These early maps all show that the stream forming the basis of later Tunstall Drain originally flowed south-west from Sand le Mere to the Humber; the south-western course is still followed by Keyingham Drain.

Evidence of the hollow forming the inland end of the mere remained into the 20th century. There are still traces of surviving lacustrine deposits consisting of estuarine silt containing molluscs such as cockles and mussels, although these are not always visible. Examination of the deposits by Humber Wetlands Survey suggested that the mere was subject to tidal influence from the Humber until between c 800–400 BC, after which the growth of freshwater peat commenced, representing two distinct phases in the life of the mere (Van de Noort *et al* 1995, 104).

On investigation in 2012, no visible traces were apparent in the cliffs or upper foreshore and no further work could therefore be undertaken in this location. The area is however still undergoing significant coastal erosion and it is likely that evidence for the mere will continue to be revealed on occasion.

4.2.4 Easington

The underlying solid geology in Easington is Upper Cretaceous Flamborough Chalk, overlain by glacial till (boulder clay) which in the north form high cliffs. At Dimlington High Cliff, the importance and completeness of the exposed post-glacial sequence of tills and sand/silt beds, including the Basement, Skipsea and Withernsea Members, has been recognised by designating the area as a geological SSSI. Between the Easington Gas Terminals and Kilnsea, the cliff falls to the level of the upper beach and has been overtopped by sands and gravels, forming a spit with wildlife lagoons created to the rear; there is surface erosion of early soil horizons here, leading in 1998 to the exposure of Neolithic and Bronze Age features.

Further south at Kilnsea the till cliffs rise slightly to c 10m OD but fall south of the remains of the First and Second World War Godwin Battery to end at Kilnsea Warren. Stretching southwards from this point for 5km to the edge of the deep channel of the Humber estuary is Spurn Point, a long spit of sand dunes and marine shingle created and maintained by longshore drift southwards along the Holderness coast from the Barmston area. East of Spurn, the Easington shore of the Humber lies almost entirely below 7m OD.

Erosion of the eastern shore of Spurn Point has been slowed down by sea defences erected in the 19th and 20th centuries, including wooden revetments, areas of seawall, dumped rocks and concrete, but these are no longer maintained and abnormal weather conditions have increasingly led — as in the past — to periodic breaches of the long neck of the headland. The western coast faces onto the Humber estuary, and there is accretion of foreshore silts in the area, particularly at the tip of the peninsula which seems to have been fairly stable since the 19th century.

In general, historic maps show that the post-glacial coastline of southern Holderness has been retreating to a straighter line from a formerly more pronounced out-turned curve. This places the coastline at Easington in the most exposed position and the historic tendency has been for Spurn to shift westward as the anchoring cliff at the north end retreats. As Spurn was broadly fixed in its position by artificial defences between the mid 19th and later 20th centuries rather than being allowed to move naturally, the retreat of the cliff at Kilnsea placed it in an increasingly exposed position further to seaward than the main land mass. As the defences are no longer maintained this may account for a recent increase in the rate of erosion of the neck as it moves rapidly back to a more sheltered position. Unless sea defences are established at Kilnsea to anchor the south end of the Holderness coast, the process of recession will continue: the present inland settlement at Kilnsea is a rebuilding of a village lost in the 18th and early 19th centuries.

Sites 5 & 6: Easington barrow and Neolithic land surface

Spurn Point Transect 1, which consisted of five boreholes, was orientated north-south across the area of Bronze Age barrow EA117 ('Easington Barrow 1') and underlying Neolithic occupation surface EA119 on the coast north of Kilnsea (Fig 6). The site was excavated in two seasons (1996 and 1997), by members of the East Riding Archaeological Society (ERAS) and had been investigated in the 1890s by Dr. H. B. Hewetson of Leeds and subsequently in 1962 by Rod Mackey. The excavated barrow was visible on a previous visit in 2009 as a circular patch of darker vegetation (Plate 17).

Observations of the remaining relict land surface in the area are discussed below the relevant borehole transect results. The boreholes were shallow and their profiles

have not been illustrated; they were intended to examine the soil horizon, which overlies the surface of the natural subsoil under only a light modern surface cover of soil. The latter has been removed in some areas by erosion and replaced by thin seasonally deposited windblown or water-deposited sand.

Transect 1 Borehole 1

Depth BGL (in metres) at 0.75m OD	Description
0.00–0.50	Loose and waterlogged golden yellow brown medium sands
0.50–2.00	Mid to dark grey sandy silt clays, likely alluvial
2.00–2.50+	Mid to light grey silt clays, likely alluvial in nature. Very soft and wet
	Coring ended due to increasing non-retention of deposits within the core

Transect 1 Borehole 2

Depth BGL (in metres) at 0.83m OD	Description
0.00–0.30	Loose and waterlogged golden yellow brown medium sands
0.30–1.50	Mid to dark grey sandy silt clays, likely alluvial
1.50–2.40+	Mid to light grey silt clays, likely alluvial in nature. Very small, 'granular' black speck inclusions, possibly organic. Very soft and wet
	Coring ended due to increasing non-retention of deposits within the core

Transect 1 Borehole 3

Depth BGL (in metres) at 1.12m OD	Description
0.00–0.60	Loose and waterlogged golden yellow brown medium sands
0.60–1.30	Mid to dark grey sandy silt clays, likely alluvial
1.30–2.20+	Mid to light grey silt clays, likely alluvial in nature. Very soft and wet
	Coring ended due to increasing non-retention of deposits within the core

Transect 1 Borehole 4

Depth BGL (in metres) at 1.27m OD	Description
0.00–0.30	Loose and waterlogged golden yellow brown medium sands
0.30–1.70	Mid to dark grey sandy silt clays, likely alluvial
1.70–2.30+	Mid to light grey silt clays, likely alluvial in nature. Very small, 'granular' black speck inclusions, possibly organic. Very soft and wet
	Coring ended due to increasing non-retention of deposits within the core

Transect 1 Borehole 5

Depth BGL (in metres) at 0.98m OD	Description
0.00–0.50	Loose and waterlogged golden yellow brown medium sands
0.50–1.20	Mid to dark grey sandy silt clays, likely alluvial
1.20–2.00+	Mid to light grey silt clays, likely alluvial in nature. Very soft and wet
	Coring ended due to increasing non-retention of deposits within the core

The area around Easington Barrow 1 today appears to be self-contained, located between the beach and sea area to the east and fields to the west. The cliff is low to non-existent in the area between Kilnsea and Easington gas terminal (Plate 18) and the area behind the barrow is bounded directly to the east by a shallow sand-based 'bank' which appears to have accumulated naturally at the extent of the normal tidal reach (Plate 17). The central area then dips gently to the west away from the beach and contains two extant inland lagoons, which are composed of a mixture of sea water from tidal flooding and rain water. Depending on the amount of water present, these lagoons expand or contract; during the 2012 survey they were at medium capacity, based upon the author's previous visit to the site in 2009.

At the time of the visit the ground surface consisted of a significant amount of sand cover, blown or washed over the low bank, which obscured the relict land surface. What was visible, however, was the site of Barrow 1. The condition of the barrow was much the same as during an initial visit to the site in 2009 (Plate 17), with the infilled ditch marked quite clearly as a circle of darker vegetation in the sparser growth within the surrounding sand.

The ground surface, including any possible Neolithic deposits underlying the barrow (EA119), was not visible due to the level of the current blown sand cover. On balance, the site appears to be relatively stable despite its proximity to the beach and high tide level. The continued recession of this area of coastline will eventually lead to exposure and loss of the site and any previously unrecorded remains, however.

The borehole survey (Fig 6) has confirmed that although on a low rise, the barrow is located on alluvial deposits: the cores did not reach glacial till at 2.4m below the present surface. This implies that it was constructed on marginal land during a sea level regression or standstill, which also seems to have been the case further south at Kilnsea Warren (Site 8); the presence of the Neolithic occupation surface below Barrow 1 would suggest that the regression had begun before the Bronze Age transition. This was dated by ¹⁴C of hearth deposits to 3360–2850 cal BC/4354±100 BP (BM-268). Two posts from a circular structure sealed by the barrow mound deposits were dated to the early Bronze Age 2240–1730 cal BC/3613±100 BP (BM-270), 1980–1520 cal BC/3450±90 BP (BM-269), suggesting a broad date centred around 2000 BC. The site is thought to lie on the west side of an infilled channel, the Kilnsea or Easington Fleet, which flowed south-west across the present low cliff line north of Kilnsea before turning on a more westerly course to join the Humber south of the village where there was a further group of barrows (Sheppard 1966; Dinnin 1995; Van de Noort *et al* 1999).

A late Neolithic/early Bronze Age henge and a second barrow ('Easington Barrow 2'), also overlying Neolithic activity recorded 200–250m further to the north-north-east in 1998 (RCZA refs EA104, EA105) were constructed on the fill of the Fleet. The ditch of the henge had been filled by later alluvial deposits, and it is therefore likely that all three monuments were originally constructed on the west bank of the Fleet channel after it had already partly silted, with the process completed when the trend of rising sea level resumed in the late Bronze Age/iron Age. The channel may not have ceased to flow entirely until the eastern end had been truncated by coastal erosion, and the presence of barrows and a henge along its course suggest it may have been a significant local boundary.

A soil sample examined from 1.8–2.9m depth within BH1 revealed little of interest to throw light on the nature of the sediment; some vegetative material was present, including a single fruit (achene) of common knotgrass (*Polygonum aviculare*), a plant

of waste ground, which is liable to have grown along the banks and washed into the channel.

Site 7: Humber foreshore, Kilnsea

The marginal land area either side of the present Humber seabank west of Spurn oscillated several times from mudflat and saltmarsh to dry land, including woodland, as Holocene sea levels fluctuated and the Humber channel itself shifted. This continued until the present estuary shoreline between the west side of Spurn and Sunk Island was largely stabilised by the 17th century with the construction of a series of seabanks, more-or-less in their present position. This was a response to a period of severe land loss, particularly in the first half of the 14th century, when several villages were inundated in the area. Deposits and features dating from the Mesolithic period onwards therefore survive in areas where land surfaces have been buried by silting rather than eroded. The current situation in this area still favours accretion, although there is evidence that the low tide line is moving northwards.

The area forming the junction between the shoreline and the west side of the Spurn peninsula has seen considerable recent accumulation of uncompacted estuarine sediments and no older exposures or traces of a late medieval jetty/early post-medieval jetty (EA203) recorded in the area were visible for sampling. A timber jetty is known to have existed at Kilnsea in 1691, and may be shown on the 'Lord Burleigh' navigation chart of c 1560 although its exact location is not known; it may have been located near the point where Easington Road met the Humber shore. Future investigation and coring could be attempted once the beach levels have reduced.

Site 8: Spurn Foreshore, Kilnsea Warren

Four borehole transects were undertaken within this area which lies well to the south of Sites 5 and 6 extending from the root of the Spurn peninsula where the till cover finally dips below beach level and is replaced by sand and shingle (Fig 7). The first of these, Transect 2, was orientated east–west over part of the area of relict land surface EA353 initially mapped in 2009 and again in 2012 (Plate 19–23), and the area of a circular Bronze Age structure (Site 10) recorded in 2010 and 2011. The second, Transect 3, was also orientated east–west over a further exposed prehistoric land surface further south (Plates 24, 25). The single borehole forming Transect 4 was located south of this area to determine whether any further remains were present.

Transect 5 was orientated north–south along the beach following the junction between the angled shingle to the west, and the flat beach sands to the east, with traces of prehistoric woodland visible at the south end (Plate 26). The length of this transect was c 850m, intersecting Transects 2 and 3, but terminating some distance north of Transect 4.

The seaward end of the palaeoenvironmental sequence which formed along the north shore of the Humber estuary has continually been exposed as Spurn has moved westward, appearing as an eroding line of outcropping silts and biogenic deposits between the low tide mark and the upper beach. In the Kilnsea Warren area exposures vary in extent from areas of eroding blocks and tree roots along the lower edge of the middle beach during normal conditions to wider exposures across the middle and upper beach as areas of sand and shingle are periodically removed. Deposits also outcrop on the lower beach at extreme low tide further to the east.

On the upper and middle beach any features of archaeological or palaeoenvironmental interest exposed on the surface, such as the circular Bronze Age timber structure (Site 10) and post-medieval eeltrap (Site 9), are likely to be damaged by exposure as shingle is periodically removed by natural cycles. However, provided the shingle returns relatively quickly, the worst area of erosion is confined to the eastern margin where the movement of lower beach shingle creates a wave-cut platform. This margin will continue to move naturally westward with the peninsula as the cliff to the north recedes, but there is also additional movement of the low tide line caused by a rising sea level.

Transect 2 Borehole 1

Depth BGL (in metres) at -1.09m OD	Description
0.00–0.20	Dark brown soft organic clays with traces of root and rootlet material
0.20–0.35	Very sticky light blue grey moderate clays with black ?organic speckling. Sample taken: Sample 2
0.35–0.60	Mid brown fine grained moderate clays, sticky. Contains small irregular stones, gets firmer after 0.20m into the deposit
0.60–1.00+	Glacial till (Boulder Clays)

Transect 2 Borehole 2

Depth BGL (in metres) at -1.15m OD	Description
0.00–0.20	Loose beach shingle
0.20–0.55	Very sticky and moderate light blue grey clays with fine black speckling (possibly organic)
0.55–0.75+	Glacial till (Boulder Clays)

Transect 2 Borehole 3

Depth BGL (in metres) at -1.05m OD	Description
0.00–0.20	Loose beach shingle
0.20–0.25	Very dark grey fine and soft organic silts
0.25–0.75	Very sticky and moderate light blue grey clays with fine black speckling (possibly organic)
0.75+	Glacial till (Boulder Clays)

Transect 2 Borehole 4

Depth BGL (in metres) at -1.13m OD	Description
0.00–0.15	Very dark grey soft organics (land surface), rootlet material present. Block sample taken: Sample 3
0.15–0.40	Very sticky moderate light blue grey clays with occasional dark speckling or flecks (possibly organic)
0.40–0.55	Mid brown soft to moderate clays
0.55–0.85+	Glacial till (Boulder Clays)

Transect 2 Borehole 5

Depth BGL (in metres) at -1.27m OD	Description
0.00– 0.30	Loose sand and shingle
0.30–0.70+	Glacial till (Boulder Clays)

Transect 2 (Fig 7) confirms the presence of shallow alluvial silts/clays deposited over the glacial till along the former northern Humber shore, which a nearby Bronze Age circular post structure (Site 10: Plates 27, 28) demonstrates became dry land as the sea level fell temporarily. The visible remains include an area of dissected blocks comprising an upper organic deposit, representing the base of the woodland floor horizon, overlying alluvial silts and glacial till (Plates 21–23).

The considerable expanse of former land surface allowed a surface environmental sample to be taken next to BH1. Assessment revealed some fine plant material containing rush (*Juncus*) capsules and seeds of the goosefoot family (Chenopodiaceae). The presence of rush reflects damp or wet conditions, although as the species could not be determined, it is unclear whether it represented salt, fresh or brackish water conditions; any one of these environments are to be expected in the area surrounding the former Humber estuary. The goosefoots are more characteristic of wasteland: although some forms, such as the saltmarsh goosefoot *Chenopodium chenopodioides* are found on saltings and grazing marshes, these are relatively rare and are currently present in the south of England.

Further traces of the goosefoot family were recovered from a surface sample collected next to BH4 together with nettle (*Urtica dioica*). Also present were a number of brackish/marine snail species including *Hydrobia ventrosa* and *H. ulvae*, the former characteristic of estuaries and non-tidal lagoons, the latter of intertidal sand and mud, particularly in estuaries. A significant organic component of the sample was the soil-dwelling ectomycorrhizal fungus *Cenococcum geophilum*, which is common on woodland floors, having a symbiotic relationship with certain tree species in arctic, temperate and sub-tropical environments. It can, however, also appear in heathland and peat bogs, as well as arable soils (Jensen 1974). The palaeoenvironmental report (section 6) notes the presence of the fungus in three locations, but does not discuss it further because of the possibility that it could represent modern contamination. However, the location of the three sampling sites on the foreshore some distance from the modern shoreline, the presence of other woodland species and surviving tree or root segments in some cases makes this highly unlikely.

Taken together, the results of the two samples suggest that the area was transformed from a damp or wet environment, presumably close to a shoreline, marsh or channel system, to dry land during a regressive interval. The area was wooded for a time, before once again becoming estuary foreshore and eventually, part of the North Sea intertidal zone.

Transect 3 Borehole 1

Depth BGL (in metres) at -1.15m OD	Description
0.00–0.10	Dark brown fibrous organic surface, fairly soft, but also friable and compacted in areas. Significant amount of tree root and tree bole exposure (Humber Forest) surface exposure. Block sample taken: Sample 4. Tree root sample taken for radiocarbon (¹⁴ C) dating: Sample 5
0.10–0.60	Mid brown very soft and very sticky clays
0.60–1.10+	Glacial till (Boulder Clays)

Transect 3 Borehole 2

Depth BGL (in metres) at -1.20m OD	Description
0.00–0.60	Loose beach sands
0.60–2.00+	Very fine, working soft initially very dark grey silts. The deposit gets increasingly harder and more compact at depth
	Coring ended due to lack of further shafts

This short transect (Fig 7) examined a surface exposure of a former wooded land surface overlying modified alluvial deposits forming the woodland floor and resting on glacial till (Plate 24). In BH2, beach sands had scoured the surface of the underlying deposits, but from 0.6m depth, alluvial silts extended below 2.00m which could indicate a deeper watercourse or marginal area exposed to flooding; further examination by means of transects or gridded coring would be required to locate untruncated deposits sealing the silts and determine the extent and depth of the possible feature and its relationship to the surface recorded in BH1.

A surface sample taken from adjacent to BH1 consisted entirely of organic material, principally fine plant detritus, including rush (*Juncus*) and a single nutlet of the *Teucrium* genus. Although the species of neither could be determined, the presence of rush suggests a wetland environment, but while one *Teucrium* species present in the British Isles, the currently rare water germander (*T scordium*), also prefers water margins; the much more common wood sage (*T scorodonia*) colonises the very different habitats provided by dry woodland floors, grassland or dune systems.

Also present were traces of the woodland floor-dwelling fungus *Cenococcum geophilum* and as there were remains of a partly exposed tree root system in the vicinity of BH1 it is likely that the organic deposit exposed at beach level is the base of a woodland soil which has been largely removed by later erosion. A sample of a branch or root recovered from close to BH1 (Plate 25) returned a ¹⁴C date of 3640–3370 cal BC (Wk-35945), the early Neolithic period.

This is considerably older than other samples taken during the course of this project, suggesting that the timber had become embedded in later deposits, as the surface of the silt exposure itself was at the same level as the presumed late Neolithic surfaces recorded in Transect 2. It is, however, slightly earlier than the surface recorded below Easington Barrow 1 (see below) which may therefore have been occupied towards the end of the forest phase as and began to be cleared for agriculture.

Transect 4 Borehole 1

Depth BGL (in metres) at -1.19m OD	Description
0.00–0.60	Loose beach sands, coarse
0.60–1.00+	Heavily compacted fine grey silts
	Coring ended due to extreme water influx and sand infilling

This single borehole (Fig 7) identified alluvial silts similar to those identified in Transect 3 BH2. Although any deposit sealing the silts has again been removed by tidal scouring and there is too little additional information to be specific, it would appear that Transect 4 also represents the presence of a watercourse or a marginal area subject to flooding.

Transect 5 Borehole 1

Depth BGL (in metres) at -1.12m OD	Description
0.00–0.20	Mid to light, oxidising dark grey compacted organic and silty land surface. Small but frequent tiny fibrous organics and other organic types present
0.20–0.50	Mid blue grey fine and soft ?alluvial silts. Minor amount of dark organic inclusions
0.50+	Glacial Till (Boulder Clays)

Transect 5 Borehole 2

Depth BGL (in metres) at -1.57m OD	Description
0.00–0.60	Fine waterlogged and well sorted brown sands
0.60+	Glacial Till (Boulder Clays)

Transect 5 Borehole 3

Depth BGL (in metres) at -1.48m OD	Description
0.00–0.50	Fine waterlogged and well sorted brown sands
0.50+	Glacial Till (Boulder Clays)

Transect 5 Borehole 4

Depth BGL (in metres) at -1.53m OD	Description
0.00–0.30	Fine waterlogged and well sorted brown sands
0.30+	Glacial Till (Boulder Clays)

Transect 5 Borehole 5

Depth BGL (in metres) at -1.39m OD	Description
0.00–0.50	Soft blue grey silty clays, minor amount of organics and black organic flecks
0.50–0.75	Very soft fine clays, very smooth, purple brown in hue and very clean with little to no inclusions
0.75–0.95	Moderately hard blue grey compacted clays
0.95–1.15+	Soft light green grey brown silty clays, with frequent organic fibrous material inclusions
	Coring ended due to tidal constraints

Transect 5 Borehole 6

Depth BGL (in metres) at -1.44m OD	Description
0.00–0.40	Fine waterlogged and well sorted brown sands
0.40–1.30	Smooth and soft dark grey silty clays
1.30–1.70	Smooth and soft dark grey clays
1.70+	Very soft grey silts with a slight brown tinge or hue

	Coring ended due to non-retention of deposits within any of the auger heads
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Transect 5 Borehole 7

Depth BGL (in metres) at -1.48m OD	Description
0.00–0.40	Fine waterlogged and well sorted brown sands
0.40–0.50	10–30mm diameter pebbles
0.50–1.70	Moderate grey brown silty smooth clays
1.70–2.20+	Very hard grey brown clay silts
	Coring ended due to non-penetration of the above deposit with any of the auger head attachments

Transect 5 Borehole 8

Depth BGL (in metres) at -1.29m OD	Description
0.00–0.60	Fine waterlogged and well sorted brown sands and gravels
0.60–1.00	Quite soft brown grey clay sands, no inclusions
1.00–1.20	Soft and pliable brown grey sandy clays, fairly gritty in texture
1.20–2.60	Soft and pliable very smooth brown grey sandy clays
2.60+	Very soft mid grey silts (alluvial)
	Coring ended due to non-retention of deposits within any of the auger heads

Transect 5 Borehole 9

Depth BGL (in metres) at -1.41m OD	Description
0.00–0.20	Fine waterlogged and well sorted brown sands and gravels
0.20–0.40	Moderate mid grey silts
0.40–0.50	Soft brown silty clays with organic fibrous inclusions
0.50–0.70	Soft and pliable light grey silty clays
0.70+	Glacial Till (Boulder Clays)

Transect 5 Borehole 10

Depth BGL (in metres) at -1.52m OD	Description
0.00–0.20	Fine waterlogged and well sorted brown sands and moderately sized (10–30mm diameter) gravels
0.20+	Glacial Till (Boulder Clays)

Transect 5 Borehole 11

Depth BGL (in metres) at -1.15m OD	Description
0.00–0.50	Fine waterlogged and well sorted brown sands and moderately sized (10–30mm diameter) gravels
0.50+	Glacial Till (Boulder Clays)

Transect 5 Borehole 12

Depth BGL (in metres) at -1.25m OD	Description
0.00–0.20	Fine waterlogged and well sorted brown sands and moderately sized (10–30mm diameter) gravels
0.20–1.20	Soft brown grey clay silts, slightly 'gritty'
1.20–1.50	Soft green grey fine gritty silty clays with small angular flint fragment and very small stone fragment inclusions (1–3mm diameter)
1.50+	Glacial Till (Boulder Clays)

Transect 5 Borehole 13

Depth BGL (in metres) at -1.59m OD	Description
0.0–0.30	Fine waterlogged and well sorted brown sands and moderately sized (10mm – 30mm diameter) gravels
0.30–1.90	Soft and pliable brown grey clay silts
1.90+	Firm green grey coarse silt clays
	Coring ended due to non-penetration of the above deposit with any of the auger head attachments

Transect 5 Borehole 14

Depth BGL (in metres) at -1.73m OD	Description
0.00–0.20	Fine waterlogged and well sorted brown sands
0.20–2.10	Soft brown grey silt clays with occasional sand content
2.10+	Glacial Till (Boulder Clays)

Transect 5 Borehole 16

Depth BGL (in metres) at - -1.76m OD	Description
0.00–0.30	Fine waterlogged and well sorted brown sands
0.30–0.40	Shingle/stones and pebbles
0.40–2.50	Soft light to mid blue grey sandy silty clays, probably alluvial in nature
2.50+	Glacial Till (Boulder Clays)

Transect 5 Borehole 17

Depth BGL (in metres) at -1.84m OD	Description
0.00–0.40	Fine waterlogged and well sorted brown sands and moderately sized (10–30mm diameter) gravels
0.40–1.50+	Soft mid pink purple brown clay silts
	Coring halted due to intention to return for further coring in the immediate area

Transect 5 Borehole 18

Depth BGL	Description
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(in metres) at -1.76m OD	
0.00–0.10	Soft dark grey brown organic material/land surface
0.10–0.50	Soft to moderate mid blue grey fine silty clays
0.50+	Glacial Till (Boulder Clays)

The earlier transects (Nos 2–4) were undertaken to establish a useful baseline for the main transect (No 5) which yielded the most important information regarding the profile of the buried landscape below Spurn.

The results from Transect 5 (Fig 8) show that in some areas, such as BH2–4, 10 & 11, traces of earlier land surfaces have been eroded away locally. This is clearly shown at ground level where the remaining extents of exposed prehistoric surfaces visible at the time of the survey have been mapped using GPS.

The intervening cores demonstrated that between these surviving areas of exposed land surfaces were two well defined broad and shallow depressions, identified as possible palaeochannels or meres, filled with soft alluvial silts and buried beneath the sand cover of the modern beach. The absence of organic deposits representing vegetation growth suggests that the features are more likely to have been channels than meres, although this is inconclusive given the small areas examined. The northern depression may have had an overall width of c 270m (BH5–9) and a depth in excess of 2.60m below beach level at BH8 (–3.89m OD). The southern depression was offset from its northern neighbour by a distance of between 100–150m. This second depression is suggested to have had a width of c 330m (BH12–17) and a depth of c 2.50m below beach level at BH16 (–4.26m OD). In this transect the truncated till surface either side of the depressions and in the intervening space lay between –1.32m OD and –2.26m OD, but the original level from which the depressions were cut has clearly been lost.

Although undated, these possible palaeochannels would represent lost parts of a post-glacial drainage system feeding into the Humber rather than flowing in the opposite direction to the North Sea, a system which also includes Hedon, Keyingham and Winestead Fleets further to the west. Both the new ‘channels’ may have followed a broadly east–west or south-westerly orientation, passing beneath the Spurn peninsula to join the Humber like the Kilnsea Fleet a little to the north. These would have had their sources somewhere in the lowlying post-glacial landscape well to the east of the present Kilnsea village, flowing south-west through the saltmarsh forming the north shore of the Humber. As such, the channels may well have continued to flow until erosion of their seaward ends allowed the sea to enter; Sheppard (1966) estimated that the Kilnsea Fleet was finally lost in the 9th century AD, a period when the cliff line still lay well to the east. Levels taken along Transect 5 shows, broadly, that the foreshore still generally drops towards the south from –1.12m OD in the north to –1.76m OD in the south, a fall of 0.64m over a distance of around 700m.

The assessment of selected cores established some information regarding the past environment of the area. A sample from the organic deposit forming the upper 0.0–0.3m of BH1 produced pollen grains of alder (*Alnus*), probably hazel (*Corylus*), the goosefoot family (Chenopodiaceae) and spores of ferns of the *Polypodium* genus, as well as some foraminiferans. The latter were presumably incorporated when the base material was deposited under estuarine conditions, but the remaining assemblage clearly represents woodland/scrub. There was insufficient organic material to date this assemblage either through the range of species present or through ¹⁴C sampling. Hazel dominated woodland locally from c 7000–5000 BC (Dinnin 1995), with elm also present. Alder dominated thereafter, initially with elm and from c 3000–500 BC with

oak, while ash and lime also spread during this period, but both hazel and alder are likely to have been present for much of the Holocene. A sample from the underlying alluvial sediment in BH1 (depth 0.3–0.6m) revealed little of interest.

At the south end of the transect at BH18, a sample of wood from a partly exposed tree root system in a surviving area of former land surface returned a late Neolithic ^{14}C date of 2880–2570 cal BC (Wk-35947); the tree species was unfortunately indeterminate (section 5.3). A sample from the upper 0.3m of the borehole column itself contained a relatively small organic component, mainly indeterminate vegetative material and scraps of twig or root. Some soil-dwelling fungal tissue (sclerotia) of *Cenococcum geophilum* was also present, a species inhabiting woodland floors: although also found in other habitats, the presence of *in-situ* roots in the vicinity supports a woodland origin. Also present were pollen grains of the goosefoot family (Chenopodiaceae) and foraminifera, the latter an indication that the base soil was modified estuarine alluvium. A second sample from the underlying 'raw' alluvial deposit lower in the column (0.3–0.6m) revealed little of interest, the very small organic component near the top being intrusive from the base of the upper segment.

Taken together, the results of the borehole samples and ^{14}C date suggest a Neolithic date for the development of the woodland, with hazel perhaps being a survivor from its earlier dominance.

A follow-up visit was made to the site in April 2013 (as part of a separate programme of archaeological works undertaken by HFA; see Jobling 2013). The 2012/2013 winter storms had caused a great deal of damage to the exposed land surfaces. The northernmost land mass was now heavily fragmented with deep fissures breaking the surface apart representing an approximate 30% loss of material based upon visual assessment of this particular exposure since the coring programme was undertaken. The southernmost land exposure was similarly affected. Further, the shifting sands had also exposed further patchy areas of former land surfaces with associated wood/timber remnants within the survey area.

The apparent acceleration of erosion in this area suggested that a detailed programme of surveying and recording of the exposed timber elements and the extent of the former surface should be undertaken in the very near future prior to these early assets being lost to the sea.

Site 9: Eeltrap, Spurn foreshore, Kilnsea Warren

In September 2011, an eroding wicker or wattle structure on the foreshore at Spurn Point at TA 4218 1414 (Fig 7) was reported to Andrew Gibson, Outer Humber Officer, Yorkshire Wildlife Trust, by a member of the public and the information was passed to Humber Sites & Monuments Record. The remains, which rested on a bed of eroding silts representing an area of former land surface and alluvial silts (Plate 29), were examined and recorded by Ruth Atkinson (SMR Officer) and Dave Atkinson (HFA) during a short window between tides before the site eroded further (Plates 30, 31).

As found, the structure was 1.10m in length along the southern edge and 1.20m along the northern edge, consisting of longitudinal twisted wattles retaining shorter sections of rods at 90° (Fig 9). There was also a hoop of twisted 'rope' at the east end 240mm in length and 20mm in diameter with a loop formed at each end with a diameter of 50mm. The structure was filled with a black clay deposit surrounded by brown alluvial clays containing bleached bivalve shells of the filter feeder *Scrobicularia plana*; many of these were intact, set vertically in the eroded surface,

suggesting that they may have been overwhelmed by silts. The presence of the fill material is crucial, as it demonstrates that the structure was *in situ* and had not moved since it was abandoned.

Block samples of the wickerwork and surrounding clay were taken. Samples of the clay and species samples of wattle were forwarded to Palaeoenvironmental Research Services (PRS) for examination, while the main block was excavated at HFA premises to examine construction details by carefully removing the attached clay (Plates 32, 33). Although much had been lost, the structure proved to consist of short lengths of cut cane held in place by twisted wattle strands, with the ends of similar cut lengths forming adjoining sides. At one end was a twisted loop (Plate 34). It is likely that the original form was a tapered four-sided box structure with the loop at the open end; more usually they are circular in section, either cylindrical or conical, but the principle remains the same whatever the type: eels enter the long tapering basket and are unable to turn or back out; the loop opening can form a funnel to make escape even less likely, although some have an additional funnel inside.

The cane used in the short stiffening sections of the sides was identified as rattan or a similar species by PRS (section 6; Plates 1, 2), which suggests that the eeltrap was no earlier than the late 17th century when this material began to be imported; the twisted wattle may also have been rattan, but had the appearance of a more flexible species such as willow or hazel. At the time of deposition, the northern section of the Spurn peninsula would have been located considerably further to the east and the trap was presumably set in a channel crossing the Humber foreshore, a very different environment to its eventual exposed location on the North Sea shoreline. Between the later 19th century and the second half of the 20th century, Spurn had already shifted to cover the area of the abandoned trap, but has subsequently moved even more rapidly. The northern area was swept away by the December 2013 storm surge and will presumably reform still further to the west.

A subsequent visit was made to the area of the trap by an HFA team in 2012, using a mapping grade hand-held GPS to define the extent of the brown alluvial clays. The natural removal of the sand and shingle cover which had revealed the eeltrap also exposed a larger extent of the land surface which had been modified to form an intertidal area in the Humber estuary following submergence and had been colonised by bivalves before the Spurn peninsula migrated westward.

Soil samples taken from the area around the eeltrap contained examples of a number of molluscs commonly found on intertidal foreshores, including *Hydrobia ulvae* and its predator, *Retusa trunculata*. Bivalves were present, identified by PRS as members of the Tellinidae family, which include the common Baltic clam, *Macoma balthica*, although some at least were probably the visually similar peppery furrow shell *Scrobicularia plana* of the closely-related Semelidae family, which was identified in the surrounding area and has given its name to the marine 'Scrobicularia clay' encountered as a post-glacial deposit in East Yorkshire, Lincolnshire, Cambridgeshire, Lancashire, Cheshire and elsewhere. Both species appear in the same type of environmental conditions and have the same burrowing habit.

Site 10: Circular timber structure, Spurn foreshore, Kilnsea Warren

The eastern edge of an arc of nineteen roundwood stakes averaging 35mm diameter was exposed following the temporary natural removal of upper beach shingle on the Spurn foreshore at Kilnsea Warren, TA 42166 14520 (Fig 7): the Easington henge and Barrow 2 were revealed in the same way in 1998 further north at TA 4097 1828 and TA 4098 1822.

The stakes were observed, photographed and recorded on 8th November 2010 by a team from the British Geological Survey during a programme of geological coring (Plates 27, 28). Accurate dGPS positions were taken on each stake, allowing the structure to be plotted and an estimate of the diameter of the full circle to be made by HFA; this proved to be c 17.5m (Fig 10). The stakes were quickly reburied by shingle as the beach changed gradient and were not visible on a return visit by the BGS on 10th November. Details were passed to HFA by Andrew Gibson, Yorkshire Wildlife Trust following a subsequent visit by HFA staff to the nearby eeltrap site in September 2011.

In September 2012, HFA located the structure by removing local areas of upper beach shingle to reveal several posts driven into the former land surface noted elsewhere in the area. Samples were taken from the tops of two timbers for ¹⁴C dating and submitted to the Scientific Dating Team, English Heritage; prior species identification by Palaeoecology Research Services suggested that they were either hazel, alder or birch. The dates of the two samples were similar, and suggested a date firmly in the early Bronze Age, 2040–1880 cal BC (Wk-35946). This is entirely consistent with the position of the structure in an intertidal zone: although the apparent 'fresh' condition of the wood noted by PRS had suggested the possibility of a post-medieval or early modern date, the good state of preservation appears to have been the result of the exclusion of aerobic bacteria through waterlogging from a very early period, suggesting a rapid local rise in the water table, probably connected to sea level change.

At present, there is insufficient data to interpret the function of the structure. It may represent the outer wall timbers of a roundhouse, but the large size, particularly for such an early date, suggests that it was either a mini-henge or a circular enclosure: only further investigation and excavation of the interior can elucidate this.

The date places the Kilnsea Warren structure rather earlier than a later Bronze Age/early Iron Age cremation cemetery located in the intertidal zone nearby in 1957, but contemporary with Easington Barrow 1 located further north near Kilnsea, which was dated to c 2000 cal BC (Site 6: EA117), and Barrow 2 and the mini-henge recorded at Easington in 1998. The ditch fill of the henge was cut by a cremation ¹⁴C dated c 2500–2000 cal BC (Faulkner (ed) 2006). Also, significantly, a cleated oak plank from a sewn-plank boat was found on the Kilnsea foreshore in 1996 and was dated to c 1870–1670 cal BC (Van de Noort *et al* 1999), only a little later than the various structures. The boat is considered likely to have been used within an estuarine rather than marine environment: although the timber was found out of context on the North Sea foreshore, exposures of peat sealed by clay containing *Scrobicularia plana* occur nearby (ibid), and the site was located close to the east side of the Kilnsea Fleet (Fig 6).

The existence of large channels, such as the Kilnsea Fleet and two further examples revealed by the 2012 coring programme does imply a network of inland waterways crossing an area which at times was dry land and at others either saltmarsh or reedswamp.

4.2.5 Cleethorpes

The underlying solid geology of the area is composed of chalk from the Upper Cretaceous (Neale 1988). This in turn is overlain by a drift geology of Skipsea Till (Catt 1990, 21–3) from the Tertiary period which in turn in the Cleethorpes area has been covered by estuarine and riverine alluvium (ibid, 10).

The topography of the parish is one of low-lying, former marshland (mostly below 5m OD), which extends beyond the study area inland gradually rising to the Lincolnshire Wolds. One significant topographic feature within the parish is the low clay cliff of till which forms the Cleethorpes seafront (Wise 1990, 212).

On the foreshore are extensive areas of former land surface. In the north these consist of an eroding till shelf from which any surface deposits have been removed (Plate 35), but extending to the east is the Neolithic 'Humber Forest', consisting of peat and embedded tree stumps which are exposed at low tide, covered by more recent oyster beds and gravels (Plates 36, 37).

The majority of the parish is used for residential purposes along with its attendant infrastructure and some light industry. The seafront has seen the establishment of amusement arcades and similar venues to serve the tourist industry, which originally developed during the Victorian period.

Site 11: Cleethorpes Land Surfaces and Wreck Sites

Land surfaces

An area of an exposed land surface of peaty clay with the remains of decayed tree stumps or branches was examined at low neap tide in 2012 by Doug Jobling (HFA) in the company of Hugh Winfield (North-East Lincolnshire Council) (Plates 37–9). The area was centred at TA 30689 09768 (Fig 11), forming part of the 'Humber Forest' (NELHER 0082/0/0).

A single core was drilled in the south-western half of the land surface, to determine an average depth of deposits; samples from the core were also retained for examination. Further, some wood samples were obtained from the exposed land surface, some of which were naturally occurring and some of which appeared to have originated as structural elements characterised by drill holes (Plates 39–41); the structural elements were mainly identified during the cleaning of the samples prior to later examination (see below).

Transect 1, Borehole 1

Depth BGL (m)	Description
0.00–0.20	Dark blue grey black loose silts and sands with frequent gravels, some fine organics and modern whelks and mussels present on the exposed surface
0.20–1.00	Mid to light brown grey very slightly clayey silts with fibrous organic content
1.00m+	Glacial Till (?Holderness Association)
	Coring ended due reaching post-glacial clay deposition

The Humber Forest is considered to be of late Neolithic to early Bronze Age date; a tree stump has previously been radiocarbon dated to 2920–2290 cal BC/4090±120 BP (OxA-132). Areas of gravel and oyster beds appeared to overlay the tree remains. Although the peaty layer can be found all along the North-East Lincolnshire coast, this is the only area where tree remains have been found so far. An early Bronze Age axe hammer (NELHER 0082/1/0) had previously been located in stratified peat in the western part of the area at TA 30430 09730, the wooden handle dated 1940–1490 cal BC/3390±100 BP (OxA-130) (Leahy 1986).

A sample was assessed from the upper part (0.0–0.3m) of the soil column of the single borehole. The main components of interest were the remains of marine shellfish, including cockle (*Cerastoderma edule*), mussel (*Mytilus edulis*) and possibly flat periwinkle (*Littorina obtusata*). These species were representative of the present fauna in this area, but brackish water/marine snails including *Hydrobia ulvae* could have been incorporated at an earlier stage when there was more of an estuarine influence. Traces of fungal hyphae were present which presumably spread when the upper deposit was dry land; given the proximity of tree remains they may represent the forest floor species *Cenococcum geophilum*, which has been identified in three similar situations north of the Humber (sections 4.2.4, 6.3.3).

A series of wood samples obtained whilst the coring was ongoing appeared to represent both naturally occurring elements and possible structural remains (Plates 40, 41). The potential structurally-related examples (CLEE 2/sample 22 and CLEE 6) are reproduced as Figure 13. Both were similar in terms of their tool marks; each had a series of through or partial drilled holes, between 8–18mm in diameter placed along their length. They may have supported thin withies or poles set vertically or horizontally, but could alternatively have been for attaching strings or lines; the structures may therefore have functioned as net frames or racks or could have been part of non-loadbearing screens or walls in a building.

CLEE 2/Sample 22, which was identified as alder/birch/hazel, returned a radiocarbon date of 2880–2500 cal BC (Wk-35948). A branch from the same area, which appears to have been unworked, but was possibly from the same structure (CLEE 5/sample 25), returned an overlapping date of 2910–2670 cal BC (Wk-35949). Both of these results agree with a previous date for a tree stump (see section 7.1), placing the possible structures in the late Neolithic period.

Given the extent of the exposed land surface, c 0.24ha in this one area alone, it is likely that there are similar man-made structures with the same properties present which have not been identified previously. Otherwise the majority of the timber exposed in this area appears to be naturally occurring tree root systems, large trunks or branches. It was only during cleaning of the timbers that the tool marks became readily apparent.

Wreck sites

A group of post-medieval/early modern shipwrecks identified previously were visited in April 2012 by Hugh Winfield, Archaeologist and Historic Environment Record Officer, North-East Lincolnshire during the process of updating HER records, having been visited for RCZAS Phase 1 (2007) and Phase 2 (2009–10), although they were not visible on the latter occasion (Fig 12). One wreck (CL118) had also been recorded in 1999 by John Buglass (Buglass 2002) who subsequently undertook fieldwork in the same area as part of the Phase 1 assessment.

The results of the 2012 investigation, including photographs (Plates 43, 45–7, 49) were kindly forwarded to the RCZAS project by Hugh Winfield and although not strictly categorised as palaeoenvironmental sites, these are summarised below as they provide some information on the apparent increase in the rate of erosion of the intertidal area since initial record made in 1999.

Beyond the area of the shipwrecks, a series of possible fish weirs was visible at extreme low tide (Plate 50), but were not accessible for health and safety reasons.

The sites were visited at a c 0.8m OD neap tide, allowing full access. Overall the picture was that of a high degree of sand movement, probably due to the recent high winds, and further break-up of the wrecks, contrasting with a high sand state in 2009/10. The wrecks in question are: CL118 (NELHER 1000/33/0), NELHER 1000/33/1 (not in RCZA), CL133 (NELHER 1000/20/0) and CL131 (NELHER 1000/21/0).

CL118 (NELHER 1000/33/0)

Located at TA 33031 07561 are the remains of a 25 x 6m vessel which may survive to a height of 2m up from the keel, recorded previously by John Buglass (Buglass 2002) and visible in 2007 (Plate 42). The remains appeared to be from the keel to the turn of the bilge on the starboard side. The stern was first up the beach but there was no sign of a rudder. It was very solidly built with a sternpost, sternson etc and a possible iron plate at the base of the stem/sternpost.

The hull appeared to be carvel built with the hold lined with ceiling planks. It was mostly treenail fastened although it had some iron nails. The frames were also closely spaced. It had a large keelson and rider keel which appeared to be broken at both ends. There were two mast steps which are set well fore and aft with mortices for stanchions along its length. There were also some iron bolts along the keel structure and a large iron plate near the bow. It was flat bottomed with a distinctive shape. The wreck was probably either a smack or a yawl.

CL118 was not visible in 2009/10 when the area was visited again for RCZAS Phase 2. The wreck was re-examined by Hugh Winfield at the April 2012 neap tide (c 0.8m OD). Following high winds a significant amount of sand has been moved further exposing the wreck and revealing a large section of hull which appears to have broken away in antiquity (Plate 43). Outer hull and ceiling planks had come loose since 2007, and the ribs had degraded further; the starboard side was taking the brunt of the damage as it was on the side of the very deep scour created by the tide, and the wreck leaned to the port side.

NELHER 1000/33/1

This wreck, located at TA 3310 0740, was previously buried with the exception of some protruding ribs; it was barely visible and inaccessible at the time of the RCZAS Phase 1 visit in 2007 (Plate 44) and not at all in 2009/10, and was therefore not given an RCZAS reference. However the sea had scoured away a great deal of the overlying sand in 2012 (Plates 45, 46), and had also exposed a big hole in the hull at the stern end which had allowed in the water to clear some of the hold; it is possible that the hole was the original cause of the wrecking). The vessel was heavily built, like CL118, but apparently without the tall keelson in the hold area, and was trenail fastened with no sign at all of any metalwork. Exposed hull and ceiling planks had been pulled off and lay scattered about. The use of trenails suggests an early date, possibly pre 18th-century, although it may simply be a local variation in shipbuilding.

The remains appear to be from a medium sized vessel, smaller than CL118.

CL133 (NELHER 1000/20/0)

This wreck was visible from a distance in 2007, but could not be reached at low tide. It was not visible in 2010, but was exposed in 2012, including its cargo/ballast of chalk boulders (Plate 47). Only part of the vessel could be seen, it is not clear if the other part is buried or absent. This vessel is held together with iron bolts and has

some form of metal lattice-work in the hold. Despite being further out to sea than the two previous wrecks, the woodwork was in worse condition and was being attacked by burrowing creatures; there was no surviving outer hull on the exposed section apart from the areas around the iron bolts, although the ribs and ceiling planks were present. Part of a deck was also present, having collapsed into the hold.

CL131 (NELHER 1000/21/0)

This wreck site, which was known in 1999, was only visible at a distance in 2007, but the tide was not low enough to examine it. It was not visible in either 2010 or 2012, although a large sand bank to the north-east of 1000/20/0 could be obscuring it. A local regular kite surfer confirmed to Hugh Winfield the presence of another wreck close by, but only the very top of the remains were visible at extremely low tides, and it is unclear whether this was CL131 or another wreck.

NELHER 1000/33/2

A discrete pile of chalk boulders was located in 2007 at TA 330 077 near to wrecks CL118 and NELHER 1000/33/1 (Plate 48); this was again present in 2012, but scoured by the rough weather, and had been resolved as a pile of large chalk boulders similar to the ballast/cargo in CL133 (Plate 49). There were ship timbers amongst the rocks, but it was not clear if these were *in situ* or washed-in, although they are more likely to be associated with the stones. As the boulders are concentrated in a small area rather than scattered, and are associated with timbers, this can be interpreted as a possible wreck site.

5 RADIOCARBON DATING

Peter Marshall and Alan Hogg, English Heritage Scientific Dating Team

5.1 Introduction

Six samples of waterlogged wood were submitted to the University of Waikato Radiocarbon Dating Laboratory. The samples were pretreated following the acid-base-acid (ABA) method, in which the sample is heated with dilute hydrochloric acid (HCL) followed by dilute sodium hydroxide (NaOH), and given a final treatment in dilute hot HCL. The radiocarbon ages for each sample were then determined by liquid scintillation counting of benzene (Hogg *et al* 1987).

The laboratory maintains a continual programme of quality assurance procedures, in addition to participating in international inter-comparisons (Scott 2003; Scott *et al* 2010). These tests indicate no significant offsets and demonstrate the validity of the precision quoted.

5.2 Radiocarbon results and calibration

The results (Table 1) are conventional radiocarbon ages (Stuiver & Polach 1977), and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver & Kra 1986). The calibrations of these results, which relate the radiocarbon measurements directly to the calendrical time scale, are given in Tables 1 and 2.

All have been calculated using the datasets published by Reimer *et al* (2009) and the computer program OxCal v4.1 (Bronk Ramsey 1995; 1998; 2001; 2009). The calibrated date ranges cited are quoted in the form recommended by Mook (1986), with the end points rounded outward to 10 years.

The ranges in Table 1 have been calculated according to the maximum intercept method (Stuiver & Reimer 1986); the probability distributions shown in Table 2 are derived from the probability method (Stuiver & Reimer 1993).

5.3 Interpretation

The two measurements on timbers from the sub-circular arrangement of stakes which penetrate an earlier land surface (?prehistoric Humber Forest) are statistically consistent and could be the same actual age ($T'=0.6$; $v=1$; $T'(1\%)=3.8$; Ward & Wilson 1978). The latest of these two results (Wk-35946) therefore provides the best estimate for the date of the structure: 2040–1880 cal BC.

Table 1 Probability distributions of dates

Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver & Reimer 1993)

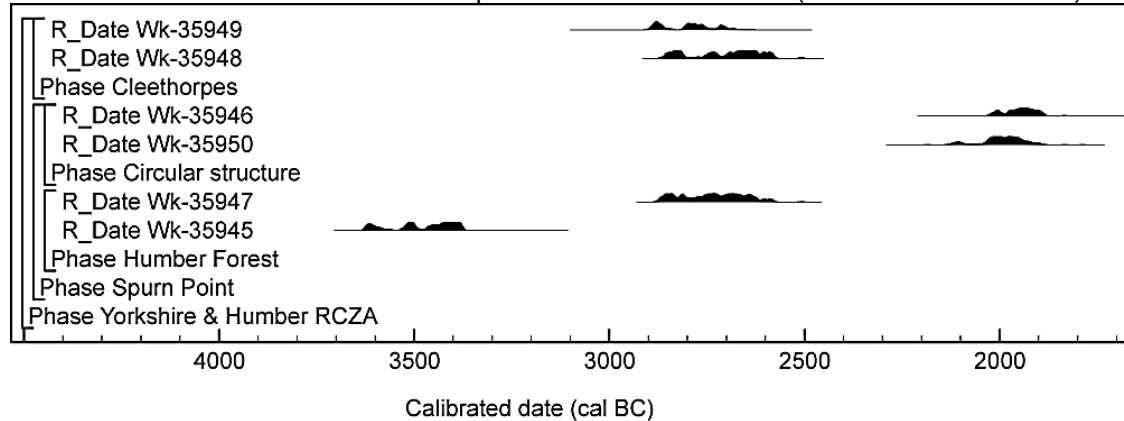


Table 2 Radiocarbon results

Laboratory number	Sample	Material+	$\delta^{13}\text{C}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% confidence)
Spurn Point					
Wk-35945	5	Indeterminate roundwood/woody root, c 30mm diameter with bark, from a semi exposed root system which forms part of a partially exposed area of the Humber Forest	- 27.7	4701±37	3640–3370 cal BC
Wk-35947	19	Indeterminate roundwood with bark c 8 years, from a semi exposed root system which forms part of a partially exposed area of the Humber Forest	- 26.0	4138±37	2880–2570 cal BC
Wk-35950	17	Alder/birch/hazel roundwood c 25 years with bark, from a sub-circular arrangement of stakes which penetrate an earlier land surface (?prehistoric Humber Forest)	- 29.0	3625±33	2130–1890 cal BC
Wk-35946	18	Alder/birch/hazel roundwood c 12 years with bark, from a sub-circular arrangement of stakes which penetrate an earlier land surface (?prehistoric Humber Forest)	- 28.3	3590±32	2040–1880 cal BC
Cleethorpes					
Wk-35948	22	Alder/birch/hazel, age indeterminate but roundwood with bark in places, 40mm diameter, from a possible structural element located almost centrally to the exposed land mass which is the sunken Humber Forest exposure	- 27.4	4110±34	2880–2500 cal BC
Wk-35949	25	Alder/birch/hazel roundwood c 12 years with bark, from part of a branch located almost centrally to the exposed land mass which is the sunken Humber Forest exposure	- 25.9	4212±38	2910–2670 cal BC

6 PALAEOENVIRONMENTAL SAMPLING

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6.1 Introduction

A total of 26 samples (13 sediment samples collected by hand-augering, three from deposits exposed at the surface and ten wood/woody root spot samples) were collected from four main site areas at Barmston, Cleethorpes, Skipsea Withow Gap and Spurn Point on the Yorkshire and Lincolnshire Coasts (see HFA report for grid references of locations). In addition, the remains of a putative 'eeltrap' recovered in a separate 'rescue' exercise by HFA staff in autumn 2011 was included as this appeared to fall within the remit of the project as a whole (assessment of this artefact was separately funded, however). Dating for the deposits was not available at the time of writing but some of the surface exposures were provisionally considered to be Neolithic and the 'eeltrap' was exposed on the shore in a situation which appeared to suggest that it could be of Bronze Age date.

All of the samples (the core samples effectively small 'GBA'/'BS', the wood samples 'SPOT' *sensu* Dobney *et al* 1992 – the 'eeltrap' was considered as a combination of the two) were submitted to Palaeoecology Research Services Limited, Kingston upon Hull, for an assessment of their bioarchaeological potential.

6.2 Methodology

Sediment samples

The sediment samples were inspected and their lithologies recorded following a standard *pro forma*. Subsamples, or in some cases the entirety of the available sample, from all but three were processed for the recovery of plant and invertebrate macrofossils, broadly following the techniques of Kenward *et al* (1980; 1986). The samples not included within this assessment were the two core samples collected from Skipsea Withow Gap, where extensive previous work was considered to make this redundant (decision by English Heritage as conveyed by D. Jobling pers. comm.) and a third core sample (Sample 16) from Spurn Point collected from the 'middle' of a sequence within a palaeochannel rather than the base or top and considered to be of limited value given that it did not represent the beginning or end of the depositional process (D. Jobling pers. comm.).

Preservation of organic remains in the samples submitted was primarily by anoxic waterlogging and the washovers were examined wet; note that separate mineral residue fractions were not obtained from most of the samples (the, generally, small proportions of mineral content remaining with the washovers) — the exceptions to this being the sediment processed from two samples associated with the putative 'eeltrap' from Spurn Point.

All of the processed sample fractions were examined for their content of macrofossils, and the general character of the material, using low-power microscopy (x7 to x45). Plant macrofossil remains were identified to the lowest taxon necessary to achieve the aims of the project by comparison with modern reference material (where possible) and the use of published works (e.g. Cappers *et al* 2006).

Insects and other invertebrates were also recorded and beetles (Coleoptera) were identified to a basic/preliminary level (where possible) by reference to published works (e.g. Lindroth 1974; Harde 1984).

Identifications for mollusc remains were made via comparison with modern reference material at PRS and the use of published works, principally Hayward & Ryland 1995 for marine snails and shellfish.

Nomenclature for plant taxa follows Stace (1997). Nomenclature for insects follows Kloet & Hincks (1964–77), marine snails and shellfish follow Hayward & Ryland (1995).

Some items identified as soil-dwelling fungus (cf. *Cenococcum geophilum* Fr.) sclerotia were present in three of the samples (two of the surface exposures at Spurn Point, Samples 3 and 4, and also from coring Sample 14 in this area). Determining whether these are recent or charred (archaeological) remains is difficult owing to the morphology of the sclerotia and their presence and abundance has been recorded but they are not discussed further.

Microfossil 'squash' subsamples (of ~1ml) were taken from each of the samples from coring. These were examined using the 'squash' technique of Dainton (1992), originally designed specifically to assess the content of eggs of intestinal parasitic nematodes; however, this method routinely reveals the presence of other microfossils, such as pollen and diatoms, and here these were the focus of the examinations. The assessment slides were scanned at x150 magnification and at x600 where necessary.

During recording, consideration was given to the suitability of the macrofossil remains for submission for radiocarbon dating by standard radiometric technique or accelerator mass spectrometry (AMS) — several of the 'wood' spot samples were specified as being of particular interest for this purpose.

'Wood' spot samples

Identifications were attempted for all of the 'wood' spot samples submitted. Pieces were broken or cut with a single-edged razor blade to give clean cross-sectional surfaces and the anatomical structures were initially examined using a low-power binocular microscope (x7 to x45) and subsequently (where necessary) at higher magnifications (x60 to x600) using a transmission microscope to view thin-sections mounted on slides. Identifications were made with reference to published works (Hather 2000; Schoch *et al* 2004).

6.3 Results

The results are presented below by site area. For sediment samples, a brief summary of the processing method and an estimate of the remaining volume of unprocessed sediment follow the sample numbers (in round brackets)

Depth ranges are quoted below current ground level.

6.3.1 Barmston

Four core samples were collected at this site area all of which were from the borehole designated as BH4A. The results of the assessment are presented below in

sample number order – which equates to stratigraphic sequence uppermost deposit first.

Depth range 1.5–1.7m

Sample 6 (0.16kg/~0.15 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.15 litres of unprocessed sediment remain)

Moist, mid grey (oxidising rapidly to mid grey-brown and with occasional patches of black from possible sulphide staining resulting from decayed organic material, perhaps rootlet), soft and slightly sticky (working sticky), silt. A little blackened (?ancient) rootlet present.

The remains after processing amounted to just ~3ml composed of roughly equal parts of sand and indeterminate plant detritus. No identifiable plant macrofossils were present but cladoceran (including *Daphnia*) ephippia were abundant and indeterminate fragments of invertebrate cuticle super-abundant. Almost all of the invertebrate material was in the form of 'filmy scraps', with most appearing to be from larval forms; the only exceptions noted were two ant (Formicidae) heads.

The 'squash' subsample (at ~1.6m depth) was almost entirely inorganic, with just a trace of organic detritus and no identifiable microfossils seen.

Depth range 2.4–2.7m

Sample 7 (0.1kg/~0.1 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.1 litres of unprocessed sediment remain)

Moist, mid brown (in upper 50mm) to mid to dark grey-brown (in lower 30mm) to dark grey (remainder), soft (working soft and slightly sticky), silt. No obvious inclusions. Note: the core 'sleeve' had partially collapsed and had damaged the sediment core within.

The remains after processing amounted to just ~2ml mostly of sand and small (to 2mm) lumps of undisaggregated sediment, with indeterminate plant detritus forming approximately one-quarter of the overall volume. There were no identifiable plant macrofossils present but cladoceran (including *Daphnia*) ephippia were common and fragments of indeterminate insect cuticle were abundant; as previously noted for Sample 6 (see above), the invertebrate material was in the form of 'filmy scraps', with most appearing to be from larval forms but here there were no remains which could be identified more closely.

The 'squash' subsample (at ~2.55m depth) was mostly inorganic but with quite a large component of organic detritus (perhaps one-third). Diatoms were numerous and their preservation was quite good with at least six different forms represented. There were also some plant tissue fragments and a few pollen grains/spores (these were rather poorly preserved, however, being crumpled/broken and/or eroded). No eggs of intestinal parasites were seen.

Depth range 3.1–3.4m

Sample 8 (0.1kg/~0.1 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.1 litres of unprocessed sediment remain)

Mostly moist, dark grey to black, soft and slightly sticky (but wet, mid to dark grey-brown and unconsolidated in upper 50mm), silt. No obvious inclusions.

The remains after processing amounted to just ~3ml and consisted largely of small lumps (to 5mm) of undisaggregated sediment, together with a little sand and indeterminate plant detritus. *Chara* (stonewort) oogonia were present in small numbers as were cladoceran ehippia (including some of *Daphnia*) and degraded fragments of statoblasts (too poorly preserved for closer identification). Fragments of indeterminate invertebrate cuticle were common but, again, almost all were 'filmy scraps' many of which appeared to be from larval forms. Only two of these remains were identifiable more closely, both being ant heads.

The microfossil 'squash' subsample (at ~3.25m depth) was approximately equal parts inorganic and organic detritus. Many diatoms were seen most of which were well preserved (although some were rather crumpled/eroded) and represented at least nine different forms. Other microfossils were also present but in smaller numbers. There were some pollen grains/spores (variably preserved but some were in good condition and these included birch (*Betula*) and a few fungal hyphae and plant tissue fragments but no eggs of intestinal parasites were recorded.

Depth range 4.0–4.3m

Sample 9 (0.16kg/~0.15 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.15 litres of unprocessed sediment remain)

Moist, very dark grey to black, soft and slightly sticky (doesn't work), silt. No obvious inclusions.

The remains after processing amounted to just ~2ml consisting of roughly equal thirds sand, small lumps (to 2mm) of undisaggregated sediment and indeterminate plant detritus. The only identifiable plant macrofossil remains present were a few stonewort oogonia. Cladoceran (including *Daphnia*) ehippia were common, ostracod valves were present and indeterminate insect cuticle fragments were abundant. The last were, in common with those recorded from the three previous samples from this deposit sequence (see above), predominantly 'filmy scraps' and largely appeared to derive from larval forms. The occasional adult insect remains noted comprised some ant heads and a single non-diagnostic beetle (Coleoptera) leg sclerite.

The microfossil 'squash' subsample (at ~4.15m depth) was approximately three parts inorganic to one part organic detritus. Remains noted comprised a few plant tissue fragments, fungal spores and micro-invertebrate cuticle fragments, together with a single possible diatom frustule (very poorly preserved – distorted and broken). No eggs of intestinal parasites were seen.

6.3.2 Skipsea Withow Gap

Two samples were collected by hand-augering at this location – Samples 10 and 11 both from the core designated BHSW1 at 1.0–1.2m and 3.4–3.6m depth (below current ground surface), respectively. However, this area has been the subject of extensive study in the past (D. Jobling pers. comm.) and, consequently, the samples were not examined further for the current assessment.

6.3.3 Spurn Point

Fourteen samples were collected in this area as part of the RCZAS. Six of these were sediment samples from hand-augering (Samples 1, 12, 13, 14, 15 and 16), three were sediment samples from deposits exposed at the surface (Samples 2, 3 and 3) and the rest (Samples 5 and 17–20) were spot samples of wood (or woody

root). In addition, the putative 'eeltrap' and the two associated sediment samples (Samples ET1 and ET2) were also recovered from Spurn Point.

TR1 BH1 – Depth range 1.8–2.0m

Sample 1 (0.12kg/~0.1 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.1 litres of unprocessed sediment remain)

Moist, mid to dark grey-brown to very dark grey to black, stiff (working soft and somewhat plastic), slightly sandy slightly clay silt, with an outer 'coating' of mid brown sand (?contaminant from coring). No obvious inclusions.

The remains after processing amounted to just ~15ml mostly of sand, with a trace of indeterminate vegetative detritus and two more or less complete and one fragmentary waterlogged achene of *Polygonum aviculare* L. (knotgrass). There were also occasional tiny (to 1mm) pieces of coal (probably derived from the local drift). Separate washover and residue fractions were not created.

The 'squash' subsample (at ~1.9m depth) was mostly inorganic with a little organic detritus (including a few heavily degraded ?plant tissue fragments). Microfossil remains were restricted to a few very poorly preserved pollen grains/spores (including grass-type), ?fungal spores (also very poor preservation) and fungal hyphae. No eggs of intestinal parasites were recorded.

TR2 BH1 – surface exposure

Sample 2 (1.5kg/~1.25 litres sieved to 300 microns with washover; no unprocessed sediment remains)

Moist, mid to dark brown to mid to dark grey (with patches of light and light to mid grey and light to mid yellow-brown), brittle to crumbly (working soft), humic, silt. Other than the humic content there were no obvious inclusions.

The remains after processing amounted to ~200ml which was almost all fine indeterminate plant detritus, including some small (to 3mm) unidentified wood fragments and abundant small (also to 3mm) pieces of ?bark. Approximately one-tenth of the material was examined and identifiable plant macrofossil remains included some rush (*Juncus*) capsules, Chenopodiaceae sp?. seeds (all either crushed or noted as fragments), a single other 'seed' fragment and fine (to 3mm) unidentified charcoal (this last being quite common). Invertebrate remains were present in the form of occasional records of mites (Acarina), a single wing, 'scraps' of non-diagnostic beetle leg sclerites and indeterminate cuticle fragments; none of the remains could be identified more closely, however. Other remains noted included a little sand, a trace of coal (to 2mm and presumably derived from the local drift) and a few Foraminifera.

TR2 BH4 – surface exposure

Sample 3 (1.8kg/~1.5 litres sieved to 300 microns with washover; no unprocessed sediment remains)

Moist, mid brown to dark grey (with some patches of light grey and light to mid brown), brittle to crumbly (working soft and somewhat plastic), humic, ?slightly clay silt. Other than the humic content there were no obvious inclusions.

The remains after processing amounted to ~300ml and the composition was similar to that from Sample 2 (above). Almost all of the material was fine indeterminate plant detritus, including some small (to 3 mm) unidentified wood fragments and pieces of

?bark (most also to 3mm but occasionally to 12mm) which were common, together with a little undisaggregated sediment (in small lumps to 2mm). Approximately one-tenth of the material was examined and identifiable plant macrofossil remains included some Chenopodiaceae sp?p. seeds (all either crushed or noted as fragments), a few ?common nettle (cf. *Urtica dioica* L.) achenes and a little fine (to 2 mm) unidentified charcoal. Invertebrate remains were mostly present in the form of indeterminate cuticle fragments (which were common) but there were also a few mites, some non-diagnostic beetle body parts (e.g. leg and abdominal segments) and occasional more useful beetle remains including elytra (wing cases) and pronota (none of which could be identified within the constraints of an assessment but some would probably be identifiable to further study) and a small number of snails. The last were of brackish water/marine forms with those sorted from the examined fraction being a single *Hydrobia ventrosa* (Montagu) and five fragments representing a minimum of four individuals of *H. ulvae*. Other remains noted included sand, occasional small stones (to 9mm), a few foraminiferans and soil-dwelling fungus (cf. *Cenococcum geophilum* Fr.) sclerotia (which were common).

TR3 BH1 – surface exposure

Sample 4 (1.02kg/~1 litre sieved to 300 microns with washover; no unprocessed sediment remains)

Moist, mid brown to mid to dark grey-brown (with patches of light grey), brittle to crumbly (working more or less soft), moderately humic, silt. Other than the humic content there were no obvious inclusions.

The remains after processing amounted to ~100ml which was almost all fine indeterminate plant detritus, including abundant small (to 6mm) unidentified wood fragments and some pieces of leaf 'skeleton', with a little undisaggregated sediment (in lumps to 5mm). Approximately half of the material was examined and plant remains included abundant rush capsules and a single *Teucrium* sp. nutlet, together with a trace of fine (to 3mm) indeterminate charcoal. Invertebrate remains were restricted to a few mites and a little indeterminate insect cuticle. Other remains included a trace of sand and soil-dwelling fungus sclerotia were common.

Adjacent to TR3 BH1 – wood/root spot sample

Sample 5

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

TR5 BH1 – Depth range 0.0–0.3m

Sample 12 (0.12kg/~0.1 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.1 litres of unprocessed sediment remains)

Upper 50mm of moist, mid brown, soft, silt. Middle 130mm of moist, dark brown/grey-brown, soft, ?humic, silt. Lower 50mm of moist, light grey, soft and slightly sticky, clay silt. There were no obvious inclusions within the sample and the total length of sequence represented within the sampling tube was 230mm.

The remains after processing amounted to just ~20ml mostly of indeterminate waterlogged vegetative detritus with some sand (a separate residue fraction was not created). There were occasional 'scraps' of insect cuticle present (including a few beetle sclerites), one or two small woody fragments (perhaps twigs but they could also be fragments of woody root) and some small lumps (to 3mm) of compressed sediment which had not fully disaggregated.

The 'squash' subsample (at ~0.15m depth) was mostly organic detritus (including abundant plant tissue fragments) with a trace level inorganic component. Microfossils seen included numerous pollen grains/spores (including *Polypodium*, ?hazel – cf. *Corylus*, grass-type, ?*Chenopodium* and alder – *Alnus*), some diatoms (of at least three different forms) and occasional microscopic foraminiferan remains – preservation of these remains was variable but at least some were fairly well preserved and would probably provide some information from detailed study. Some fungal spores and hyphae were also present.

TR5 BH1 – Depth range 0.3–0.6m

Sample 13 (0.16kg/~0.15 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.15 litres of unprocessed sediment remain)

Moist throughout. Uppermost 10mm dark brown/grey-brown, soft, ?humic, silt (as seen overlying the grey clay silt in Sample 12). Remainder of light grey (to light to mid grey in lower 30–40mm), soft (working soft and slightly sticky), clay silt, with stones (6–20mm) present in lower 30mm.

The remains after processing amounted to just ~10ml mostly of sand and small stones (one to 18mm but predominantly of 2–6mm), with a little fine (to 2mm) coal and a small waterlogged organic component of perhaps 20% by volume (separate washover and residue fractions were not created). The waterlogged organic material was mostly indeterminate vegetative detritus, with very occasional 'scraps' of ?invertebrate cuticle.

The 'squash' subsample (at ~0.45m depth) was almost entirely inorganic with just a trace of organic detritus. No identifiable microfossils were seen.

TR5 BH7 – Depth range 1.9–2.1m

Sample 16

This sample was excluded from the assessment as it was collected from the 'middle' of a sequence within a palaeochannel rather than the base or top and it was considered to be of limited value given that it did not represent the beginning or end of the depositional process (D. Jobling pers. comm.).

TR5 BH18 – Depth range 0.0–0.3m

Sample 14 (0.24kg/~0.2 litres sieved to 300 microns with washover and two microfossil 'squash' subsamples; approximately 0.2 litres of unprocessed sediment remain)

Moist throughout. Uppermost 40mm of mid to dark brown, soft, amorphous organic sediment and the remainder of light to mid brown/grey-brown, soft and slightly sticky (working soft and slightly plastic), ?slightly clay silt, with stones (2–6mm) present (in the lower ?clay silt component only).

The remains after processing amounted to just ~10ml mostly of sand and small stones (to 4mm), with a little fine coal and charcoal (to 3mm and 2mm, respectively) and a small waterlogged organic component of perhaps 10% by volume (separate washover and residue fractions were not created). The waterlogged organic material was mostly indeterminate vegetative detritus (including some small, to 5mm, compressed lumps that had not fully disaggregated), with occasional small fragments of twig or woody root. No invertebrate remains were seen. A few soil-dwelling fungus sclerotia were present.

Two 'squash' subsamples were examined from this sample, one from within the organic sediment and one from the underlying ?clay silt. The first of these (at ~0.02m depth) was mostly organic detritus (including some plant tissue fragments), with a little inorganic content. Some pollen grains/spores (including ?*Chenopodium* – preservation was variable with some in quite good condition and others eroded and crumpled or broken), fungal spores and microscopic foraminiferans were noted and there were also a few fragments of micro-invertebrates. The second 'squash' (at ~0.15m depth) was almost entirely inorganic with a trace of organic detritus and some fungal hyphae (but no other microfossil remains) present.

TR5 BH18 – Depth range 0.3–0.6m

Sample 15 (0.24kg/~0.2 litres sieved to 300 microns with washover and microfossil 'squash'; approximately 0.2 litres of unprocessed sediment remain)

Moist, mid brown to light to mid grey-brown (in lower 60mm), soft and slightly sticky (working sticky), slightly clay silt, with stones (6–20mm) present at approximately 80mm from the base and small inclusions of dark brown ?amorphous organic sediment at 40–50mm from the top.

The remains after processing amounted to just ~10ml mostly of sand and small stones (one to 12mm but predominantly of 2–6mm), with a little fine (to 2mm) coal, a single indeterminate charcoal fragment (to 6mm) and a trace level waterlogged organic component of perhaps 1% by volume (separate washover and residue fractions were not created). The waterlogged organic material was exclusively of indeterminate vegetative detritus, with no plant or invertebrate macrofossil remains present.

The 'squash' subsample (at ~0.45m depth) was almost entirely inorganic with a trace of organic detritus and some fungal hyphae but no other microfossil remains were recorded.

SPU.ARCH 3 – wood spot sample

Sample 17

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

SPU.ARCH 11 – wood spot sample

Sample 18

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

Adjacent to TR5 BH18 – wood spot sample

Sample 19

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

Adjacent to TR5 BH18 – wood spot sample

Sample 20

This sample comprised a single piece (weight 37g) of roundwood/root with bark to 112 x 20mm in diameter at its narrow end and to 30mm in diameter at the wider end.

The piece was saturated and very soft, with significant mineral penetration around the centre of the narrower end, and it was not possible to create clean sections for examination by cutting with a razor blade. Snapping provided a slightly more useful section and revealed occasional 'pores' of consistent size but there were no growth rings visible. It is perhaps more likely that this material was woody root rather than wood but confirmation would require more detailed study than could be accommodated within the assessment.

'Eeltrap' – species identification and associated sediment sample results

A sample of lengths of plant stem from an artefact interpreted as an eeltrap recovered from Spurn Point, East Riding of Yorkshire, was examined for identification and comment. The item was exposed on the shore in a situation which appeared to suggest that it could be of Bronze Age date and the majority of the structure was retained by the excavator for illustration and conservation. This material, and the associated sediment (see below) was recovered as a 'rescue' exercise prior to, and distinct from, the RCZAS.

The stems are of the order of 50–60mm in length and generally about 7–8mm in diameter. They are cylindrical, more or less smooth and with occasional nodes (points of insertion for leaves) which tend to run obliquely across the stem rather than forming a horizontal ring (Plate 1).

The anatomy of the stems was investigated through transverse thin-sections cut across the diameter of selected specimens using a hand-held single-sided razor blade, the sections being mounted on slides in water and viewed at relatively low magnifications (x100, x400), using a transmission microscope. The stems exhibited an arrangement of vascular strands (water- and food-carrying tissues) typical of monocotyledonous plants (those with a single seed-leaf) with bundles scattered throughout the cross-section (Plate 2). They cannot be from a tree or shrub within the dicotyledons (to which all such woody plants belong). The only monocotyledonous plants likely to produce stems of such a size are certain large grasses and bamboos, sedge-relatives like papyrus, and certain palms.

Grasses, with the notable exception of maize/sweet corn (*Zea mais* L.) have a central pith cavity (usually hollow, except at the nodes, and therefore forming a tube), and this is also the case for most bamboos (Metcalf 1960, 579). Papyrus has a stem characterised by 'aerenchyma', where the parenchyma tissue between the vascular bundles is pierced throughout by air-channels (an adaptation typical for a plant rooted in water).

One particular group of palms, rattan (to which economic category several genera belong), however, have a solid stem with the scattered bundles seen in the fossil specimens and there is a general similarity between the tissues seen in the sections and the available images of rattan stem sections (e.g. Tomlinson 1961). Rattans are one of the major sources of 'canes' used to make basketry and furniture, so entirely in keeping with the kind of artefact excavated. On this basis, the stems seem unlikely to be older than, say, the 17th century, when trade links with the Far East, the home area of most rattan palms, had become established.

Sediment sample collected from around the 'eeltrap' when recovered

Sample ET1 (5.36kg/~4.5 litres sieved to 300 microns with washover; no unprocessed sediment remains)
[sample number created by PRS for internal record keeping purposes]

Very moist, light to mid grey to grey-brown (with large areas of dark grey to black), soft to unconsolidated, silty sand, with some patches of mid grey silt and small areas of light yellow-brown sand. Stones (2–20mm) and ‘woody fragments (small pieces of ‘cane’ from the ‘eeltrap’) were present.

The small washover (60ml) included approximately 20 fragments of the rattan ‘cane’ object (to 45mm and maximum diameter 7mm), with the remainder consisting of indeterminate vegetative detritus, a little coal (to 8mm but mostly less than 3mm), three fragments of *Hydrobia* sp. snail shell (representing a minimum of two individuals (mni = 2)) and some ‘scraps’ of indeterminate insect cuticle.

The mineral residue (dry weight 1915g) was mainly sand (<1mm; 1750g), with some rounded pebbles (to 21mm) and a little undisaggregated sediment (to 10mm) and fine ?coal/shale (to 2mm). Biological remains were exclusively of shell which included three cockle valves (to 28mm; mni = 2) with abundant fragments of other marine bivalves (to 34mm; smooth-shelled and some if not all probably Tellinidae sp?p.).

There were also 88 fragments (mni = 75) of *Hydrobia ulvae* (some of which were rather ‘fresh’ in appearance and perhaps modern), together with six *Retusa truncatula* (Bruguière), a species which feeds on *H. ulvae* (and perhaps foraminiferans and small lamellibranchs – Hayward & Ryland 1995, 544). One additional snail apex fragment was tentatively identified as *Maragriles helycinus* (Fabricius). A small amount of magnetised material was recovered (0.3g) which consisted of small stones (to 5mm) and sand, with no evidence of metalworking debris.

Sediment ‘excavated’ from around the ‘eeltrap’ structure

Sample ET2 (2 kg/~1.75 litres sieved to 300 microns with washover; no unprocessed sediment remains)

[sample number created by PRS for internal record keeping purposes]

Moist, light to mid grey to grey-brown, unconsolidated to soft, slightly clay, silty sand, with occasional stones (2–20mm) and a little fragmented marine shell including cockle.

The very small washover (20ml) again included approximately 20 fragments of rattan ‘cane’ (to 24mm and maximum diameter 4mm), with the remainder being mostly indeterminate vegetative detritus. A little coal (to 4 mm but mostly less than 2mm) was present and there were also some indeterminate ‘scraps’ of insect cuticle; amongst the latter were occasional non-diagnostic beetle sclerites (two legs and two abdominal segments were recorded).

The mineral residue (dry weight 775g) was mainly sand (<1mm; 666 g), with some rounded pebbles (to 28mm) and a little undisaggregated sediment (to 5mm). A fragment of cockle shell (to 20mm) was present, together with seven valves of other small marine bivalves (to 15mm, all bar one complete smooth shells, again, probably Tellinidae sp?p.).

Snail remains consisted of 11 fragments of *Hydrobia ulvae* shells representing at least eight individuals. A small amount of magnetised material was recovered from the fine (<2mm) fraction (0.5g). This included a component of rounded (?waterworn) coal/shale, probably eroded from the natural drift, but no slag particles, hammerscale or other metalworking evidence was apparent.

6.3.4 *Cleethorpes*

Six samples were collected in this area one of which was a sediment sample from hand-augering (Sample 21) and the rest (Samples 22–26) spot samples of wood (or woody root).

TRCL BH1 (CLEE1) – Depth range 0.0–0.3m

Sample 21 (0.22kg/~0.2 litres sieved to 300 microns with washover and microfossil ‘squash’; approximately 0.2 litres of unprocessed sediment remain)

Moist, mid grey-brown to mid grey, soft and slightly sticky (working sticky), clay silt, with stones (2–20mm) and charcoal present (both particularly within the upper 50mm of the sample).

The remains after processing amounted to ~30ml which was mostly sand (incorporating abundant sand-grain-sized fragments of indeterminate marine shell) and stones (to 38mm), with a little indeterminate plant detritus (but no identifiable plant macrofossils) and abundant pieces of fine (to 2mm) rounded coal (presumably eroded from the natural drift).

Larger fragments of marine shellfish included four cockle (*Cerastoderma edule* (L.)) valves (to 6mm, two of which were a tiny, to 2mm, joined pair) and an additional fragment (to 7mm) of a larger valve, one small (to 15mm) mussel (*Mytilus edulis* L.) valve and one fragment of flat periwinkle (cf. *Littorina obtusata* (L.)).

There were also some brackish water/marine snails in the form of six *Hydrobia ulvae* (Pennant) and a further 11 apex fragments of *Hydrobia* sp., together with an apex fragment (to 2mm) of another unidentified pyramidal marine snail and one fragment of a valve (to 7mm) from an unidentified marine bivalve.

The ‘squash’ subsample was approximately equal parts inorganic and organic detritus (including some plant tissue fragments). Some fungal hyphae were recorded but no other microfossil remains were seen.

CLEE2 – wood spot sample

Sample 22

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

CLEE3 – wood/root spot sample

Sample 23

This sample comprised seven individual pieces (total weight 751g) ranging in size from approximately 65 x 21 x 17mm to 230 x 80 x 35mm, with the largest exhibiting a possible drilled hole and occasional remains of barnacles on the second largest.

All of the pieces were saturated and very crumbly and it was not possible to create clean sections for examination either by snapping or cutting with a razor blade. Consequently, it was not possible to determine if the remains were of wood or woody root, although subjectively the former appeared more likely, or the age of growth represented; none of the pieces appeared to be of small/young roundwood, however, and no bark was obvious on the surfaces.

CLEE4 – wood/root spot sample

Sample 24

This sample comprised four individual pieces (total weight 1770g) ranging in size from approximately 180 x 60 x 42mm to 300 x 60 x 55mm, with one perhaps being roughly pointed at one end.

All of the pieces were saturated and very crumbly and it was not possible to create clean sections for examination either by snapping or cutting with a razor blade. Consequently, it was not possible to determine if the remains were of wood or woody root, although subjectively the former, again, appeared more likely, or the age of growth represented; all of the pieces appeared to be of quite substantial 'roundwood' (or root) and no bark was obvious on the surfaces.

CLEE5 – wood/root spot sample

Sample 25

This sample was one of those selected for consideration for radiocarbon dating and details are recorded in Table 3.

CLEE6 – wood spot sample

Sample 26 – 1 of 2

This sample comprised a single roughly 'Y'-shaped piece (weight 1045g) with one of the arms of the 'Y' truncated and maximum linear dimensions of approximately 300 x 175 x 60mm. The longer of the two arms of the 'Y' and the corresponding side of the trunk were heavily encrusted with barnacles with occasional additional barnacles in other areas. The piece was saturated and very soft and it was not possible to create clean sections for examination with a razor blade but snapping proved slightly more successful.

Examination of the fresh sections revealed the piece to be of wood (rather than woody root) and probably of a diffuse-porous species. Closer identification could not be made within the constraints of the assessment but may well be possible through more detailed study. The wood was fairly substantial roundwood and, although the sequence of growth rings was indistinct (owing to the rather poor preservation), appeared to represent between 25–50 years of wood growth.

CLEE6 – wood spot sample

Sample 26 – 2 of 2

This sample comprised four individual pieces (total weight 460g) ranging in size from approximately 68 x 42 x 21mm to 235 x 55 x 42mm, which exhibited numerous drilled holes and occasional remains of barnacles on the largest. The four pieces may originally all have been one item — certainly two pairs of fragments could be refitted so there were originally no more than two pieces.

All of the pieces were saturated and very soft and it was not possible to create clean sections for examination by cutting with a razor blade. Snapping of the largest fragment was slightly more successful revealing it to be of fairly substantial 'roundwood' representing 30–40 years of wood growth and of a diffuse-porous species. Closer identification could not be made within the constraints of the assessment but may well be possible through more detailed study.

6.4 Discussion and statement of potential

Although at least a little waterlogged preservation of organic material was recorded from all of the core and surface exposure samples, identifiable macrofossil remains were few, of limited interpretative value and insufficient or unsuitable (e.g. aquatic plant remains and occasional fragments of fine indeterminate charcoal) for submission for radiocarbon dating.

Occasional remains from some of the samples did provide unsurprising indications of marine influence at the time of deposit formation, however; for example, macroscopic foraminifera from the Spurn Point surface exposure Samples 2 and 3 and brackish water snail species from the latter and also from Sample 21 (depth 0.0–0.3m) at Cleethorpes.

Freshwater was indicated in all four of the samples from Barmston (Samples 6-9, depths 1.5–1.7, 2.4–2.7, 3.1–3.4 and 4.0–4.3m, respectively) by the presence of cladoceran ehippia and supported by records for stonewort (*Chara*) oogonia (suggesting hard water) in the two deepest deposits and traces of statoblasts from Sample 8 and ostracods from Sample 9. Abundant rush (*Juncus*) capsules from Sample 4, a surface exposure at Spurn Point, suggested stands of these wetland plants at this location (lesser numbers were also seen in Sample 2 another exposed surface deposit at Spurn Point).

Microfossil remains were, in the main, similarly uninformative although diatoms from the Barmston samples taken at depths of 2.4–2.7m and 3.1–3.4m (Samples 7 and 8, respectively) and microscopic foraminiferans from two of the Spurn Point core Samples 12 (TR5 BH1 0.0–0.3m) and 14 (TR5 BH18 0.0–0.3m) could perhaps provide some additional information regarding the aquatic depositional environment. Similarly, further study of pollen from samples 12 and 14 *may* provide some further information regarding the terrestrial vegetation.

The putative 'eeltrap' recovered at Spurn Point could not be confirmed as such from the available evidence. The artefact's construction from rattan 'canes' indicates that it is unlikely to date to any earlier than the 17th century, however (consequently, although provision was made for radiocarbon dating of the artefact this was not undertaken). Biological remains from the associated sediment samples were exclusively of brackish water/marine mollusc taxa consistent with the shoreline location from which the 'eeltrap' was recovered; for example, *Hydrobia ulvae*, which was recovered from both samples, is sub-littoral to 20m but most abundant above the mean tidal level (MTL); see Hayward & Ryland 1995, 515.

Remains for radiocarbon dating were restricted to the slightly better preserved wood spot samples recovered – i.e. those which could be at least partially identified to species and, more importantly, for which the age of wood growth could be reasonably closely determined (Sample 26 and see Table 3).

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Table 3 'Wood' spot samples targeted for possible radiocarbon dating

Context code	Sample	Notes on material submitted	Approximate total wt (g) of material submitted (but wood waterlogged)	Additional material available Yes/No	Other notes
CLEE2	22	Single wood fragment with three bored holes; bark present in places; age of wood growth indeterminate but is roundwood of only c 40mm diameter; provisional identification alder/birch/hazel	115	Yes – perhaps twice quantity of that submitted; additional parts of originally one item (as drawn)	–
CLEE5	25	Single wood fragment; bark present in places; age of wood growth approx. 10 years (certainly less than 20); roundwood of c 50mm diameter; provisional identification alder/birch/hazel	385	Yes – similar quantity to that submitted; separate fragment which has occasional barnacles on surface in one discrete area	Fragment (x1) of cockle (<i>Cerastoderma edule</i> (L.)) shell recovered when wood fragments washed
ADJACENT TO TR3 BH1	5	Single 'Y'-shaped forked wood fragment; bark over approx. two-thirds of surfaces; age of growth indeterminate; roundwood/woody root to c 30mm diameter; species indeterminate – could be woody root as recorded in the field	200	No	Fragment snapped cleanly but resists cutting with razor blade (rather 'gritty' as if mineral replaced or impregnated to some degree)
ADJACENT TO TR5 BH18	19	Single wood fragment; bark present in places; age of wood growth approx. 8 years; roundwood but more oval in cross-section, average diameter c 24mm (long diameter 33mm, short diameter 15mm); species indeterminate – no good cross-section obtained	85	No	–
SPU2.ARCH3	17	Single wood fragment; bark present over much of surface; age of wood growth approx. 25 years; roundwood of c 35mm diameter; provisional identification alder/birch/hazel	150	No	Wood looks rather 'fresh'
SPU2.ARCH11	18	Single wood fragment; bark present over much of surface; age of wood growth approx. 12 years; roundwood of c 35mm diameter; provisional identification alder/birch/hazel	125	No	Wood looks rather 'fresh'



Plate 1 Spurn Point 'eeltrap': Rattan cane stem showing node (black and white bars are each 5mm)

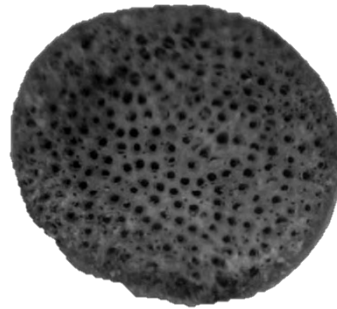


Plate 2 Spurn Point 'eeltrap': Rattan cane stem: end section showing scattered vascular bundles. Width (diameter) of stem is c 7mm

7 DISCUSSION AND RECOMMENDATIONS

7.1 Discussion

The coastlines of East Yorkshire and Lincolnshire owe their current form to the ongoing deposition and erosion of sediments from the latter phases of the final Late Devensian glaciation, the Dimlington Stadial (Rose 1985), which ended c 12750 BC, to the present.

As the ice sheets retreated northwards towards the end of the Dimlington Stadial, substantial deposits of clay, sand and stones (glacial till) and localised areas and ridges of morainic sand and gravel were left behind. The till was saturated and able to flow under pressure from the overlying ice mass (Evans *et al* 1995), filling the low-lying basin east of the cliffline of the preceding Ipswichian interglacial. In the west, the cliff forming the edge of the basin followed the eastern edges of the Yorkshire and Lincolnshire Wolds, an elongated north–south range of low rolling Cretaceous chalk hills bisected by the Humber estuary which drained an extensive lake basin further west in the area of the Vale of York and Humberhead Levels. In the east, the till presumably extended to the edge of the UK ice sheet, several kilometres beyond the present coastline.

The till comprises three main deposits, or Members, the lowest of which, the Basement Till, antedated the final glaciation. This deposit was probably laid down c 300000–130000 BP towards the end of an earlier glacial period, the Wolstonian, which preceded the Ipswichian (Catt & Penny 1966; Madgett & Catt 1978). This Member was largely planed off by later ice movements, surviving only in the Dimlington area in southern Holderness, where the eroded cliffs provide an excellent cross-section through the drift sequence, and have been recognised as a SSSI. The original extent of this deposit is unknown, although it may have covered a similar area to the later tills.

Overlying the Basement Till, the Skipsea and Withernsea Tills represent Late Devensian deposition: a *terminus post quem* has been established for the deposition of the Skipsea Till by ¹⁴C dates obtained from moss samples retrieved from silted hollows in the truncated surface of the Basement Till (Penny *et al* 1969). The results suggest a date after c 21360–19280 cal BC/18500±400 BP, although the silts were overlain in places by windblown sands, suggesting a hiatus. The Skipsea Till extended over most of Holderness, with the Withernsea Till more localised to the area between Aldbrough and Easington, forming the major upper component near Dimlington. Although overlying the Skipsea Till and differing in appearance, both deposits are considered to have been laid down at the same time, flowing together from two separate sources in the north and north-west.

The till varied in depth from less than 1m against the Wolds edge to c 50m either side of the Humber; the deep area around Dimlington in particular contained pockets and layers of sand, silt, gravel and occasional large erratics, with surface sand/gravel deposits elsewhere, such as Brandesburton and Gransmoor.

During the Ipswichian, the mouth of the Humber is assumed to have met the North Sea c 50km west of its present exit point, close to modern North Ferriby (the ‘Humber Gap’), although it may have extended eastward for an unknown distance by means of a channel cut through Wolstonian till deposits. Whether or not this was the case, the deposition of a vast area of till at the end of the Devensian forced the Humber to travel a longer distance to the east. With an immense volume of water still locked up in ice sheets, the sea level was much lower than at present (Tooley 1982) exposing the North Sea Basin as part of a vast area extending well beyond the present coastline, a

low rolling landscape which was dissected by substantial rivers (including the Humber, Thames, Ouse and Rhine which extended far beyond their previous and present reaches), and studded by marshes and meres which remained a characteristic of Holderness into the medieval and early modern periods until finally lost through greatly improved drainage.

A ridge of gravel moraine marking a temporary halt in the retreat of the Devensian ice sheets was deposited along the north bank of the Humber east of the village of Paull, continuing to Spurn as a submerged gravel shoal, The Binks, which pass below the distal end of Spurn on an arcuate ridge of till towards the north-east. This band of more resistant material protected the northern shore from the rapid Humber current and may have helped to deflect the course of the estuary south-eastwards as it extended east of the Humber Gap across the new area of land, instead of continuing on a more direct easterly course towards modern Withernsea. From the Binks, the ridge of moraine continued northwards towards the Easington area, where it may have proved crucial in the later development of the coastline, protecting Spurn and the cliffs as far north as Dimlington from the full force of the North Sea by reducing the height and impact of waves. A similar moraine deposit south of the Humber between Grimsby and Tetney helped to protect the southern shore from erosion.

In East Yorkshire the main watershed lay in the Wolds to the north and the Holderness basin was therefore drained by streams which flowed southwards into the Humber rather than towards the sea, although there were almost certainly streams beyond the present cliffline — now lost to erosion — which would have flowed eastward to join the course of the Humber as it turned to flow northwards. The River Hull was fed by a number of tributary streams including several which flowed to the south-west away from the coast near Barmston. To the east of the Hull valley, a series of lesser streams drained the south-eastern part of Holderness, flowing directly into the Humber rather than the Hull, including the Hedon, Keyingham, Winestead and former Kilnsea (or Easington) Fleets.

The post-glacial landscape was recolonised by flora and fauna in the short warmer phase which followed the Devensian, the Windermere Interstadial (c 12750–11000 BC). The benign conditions of the first half of the Interstadial allowed the return of late Upper Palaeolithic hunter-gatherers to Northern Europe, including Britain, pursuing large game herds of wild horse, red deer, reindeer, mammoth, the extinct aurochs (*bos primigenius*) and other species. In the second half of the Interstadial, conditions became steadily harsher, ending in another short cold phase, the Loch Lomond Stadial (Younger Dryas, c 11000–9500 BC), seeing a temporary return to scrub tundra conditions and the abandonment of the area by its itinerant human population, who followed the herds south.

As mentioned, the volume of water held in ice sheets and glaciers and the depression of the landmass under their additional weight ensured that sea level was considerably lower than at present at its lowest point during the last glaciation, c 24000 BC (Clark *et al* 2012). At the end of the Devensian, sea level was still probably c 120m lower than at present. The area either side of the Humber basin was therefore part of a much broader landscape, originally extending far out into what is now the North Sea, generally referred to in modern sources as 'Doggerland' (Van der Noort 2004, 22–4). As the ice sheets retreated and water was released, sea levels initially rose extremely rapidly. Although the pace decreased, the North Sea basin was flooded over a relatively short time period and the final land bridge with the continent was breached c 6000 BC, when the North Sea was probably still c 17m below modern levels. Drainage in the lowland area became increasingly blocked by silts deposited by the rising sea, leading to overbank flooding and the deposition of a sequence of alluvial waterlain

sediments within the Humber estuary and its tributaries, including bands of organic materials formed through the growth of vegetation during periods of relative stability and preserved under anaerobic conditions.

North of the Humber, the glacial till rises to form cliffs of varying height between Flamborough Head and Kilnsea; the highest cliffs, at Dimlington, reach c 35m OD, but those in the area to the north around Barmston and Skipsea and to the south in the Kilnsea area are much lower, one stretch between Easington and Kilnsea lying at upper beach level. Since the area to the east was flooded during the Mesolithic period, the coastline has receded considerably as the result of erosion to form a shallow curving bay which projects outwards between Dimlington to Easington before kicking back towards Spurn. The cliffs near Dimlington may be comparatively protected to a degree by offshore morainic deposits which reduce the power of the waves, whereas the area to the north is affected by strong circulating currents, but the overall tendency is to retreat towards the buried Ipswichian coastline. It is possible that a stable position may be reached between the present and past coasts depending on the rate of sea level rise, but the creation of sea defences at Hornsea and Withernsea is presently artificially deforming the coast into a series of three shallow sub-bays, with deposition to the north of the defences and increased erosion immediately to the south.

At the south end of the main land mass, the Spurn peninsula has been created and maintained through longshore drift of sand and shingle along the Holderness coast (May 2003). In the past, shingle on the eastern side was washed over the headland during storms and deposited to form a ridge, leaving the peninsula intact but moving progressively westward, although this may have manifested as an alternating pattern of destruction and reformation rather than a constant movement (de Boer 1963, 1964, 1967). The extensive quarrying of gravel and cobbles for roadmaking and building in the early modern period, however, has left the long highly vulnerable neck consisting mainly of sand dunes which have little resistance to wave action: over 50000 tonnes are estimated to have been removed annually in the 18th and 19th centuries. The lighter remaining sand is pulled away from the shore rather than rolled back, although the inland dunes have been stabilised by encouraging plant growth, particularly marram grass (*Ammophila arenaria*). This section of the headland has until recently been protected by artificial defences which are no longer maintained; theoretically, longshore drift will naturally return shingle to the area, but the retreat of the coast at Kilnsea by c 2m per annum is increasingly exposing the northern end of Spurn.

Further south, the broad spatulate end of Spurn is more stable, protected by the arcuate shingle and till reef of the Binks which follow the north edge of the deep Humber channel before turning north-east. Sediment is also washed around the tip to be deposited on the estuary side, widening the point. A second arcuate ridge of till lies north of The Binks, roughly at the mid-point of the peninsula, passing under the headland to terminate immediately to the west at the Old Den, a shoal of muddy shingle on the western Humber shore of Spurn which was an island in the 16th century, possibly earlier. The peninsula may originally have terminated at this second till ridge opposite the Old Den, since the earliest maps, drawn in the late 16th and 17th centuries, show it to be considerably shorter, but it has lengthened since. There has been considerable growth in the last century, with 30m added to the end in the short period since 1997, possibly through increased erosion of the coast to the north and a resulting increase in the movement of sediments. The spit has, however, now reached the edge of the deepwater channel and is unlikely to extend much further (Scott Wilson 2009, 29). It is not impossible that the head will be separated from the mainland at some point as the neck continues to breach more frequently, just as it was in the mid 19th century.

In Holderness, artefactual and palaeoenvironmental evidence for the post-glacial landscape is to be found largely on the sites of former meres, channels and wetlands between the intertidal zone and the lowlying area of the lower Hull valley, and along the north bank of the Humber. On the coastline there are traces of former meres in Easington, Barmston, Skipsea, Withernsea and Roos parishes, while Hornsea Mere, which is now the only extant example of its type, was originally more extensive. A number of past records of observations and work undertaken at these locations have been listed in the English Heritage Coastal Peat Resource Database (Hazell 2008). Historically, peat deposits containing identifiable faunal remains were noted on the Holderness coast as early as the first half of the 19th century, locally known as 'Noah's Wood', presumably in the belief that the layer dated from the Biblical Flood (Poulson 1840). Several of these sites have been investigated, including work as part of the Humber Wetlands Project Holderness Survey (Van de Noort & Ellis 1995); a single core was for example taken at Sand-le-Mere, where a peat deposit of late Bronze Age–early Iron Age date exposed on the beach surface was recorded (ibid, 126). Work was also carried out at Withow Gap in 1993 by Fachtna McAvoy, Central Archaeology Service, English Heritage (McAvoy 1995), which included sampling two sequences of mere deposits and recovering timber samples (McHugh 1993; Carrott *et al* 1994; Usai 1994).

In addition to this work, published pollen records for inland sites in Holderness include Roos, Gransmoor and Hornsea Old Mere (Beckett 1981), Skipsea Withow Mere (Blackham & Flenley 1984), Brandesburton (Clark & Godwin 1956) and Skipsea Low and Bail Meres (Flenley 1984). Pollen records for Sproatley Bog (Robinson 1986) and Flaxmere (Barker 1987) have been the subject of unpublished undergraduate projects, with a detailed summary of the palynological evidence drawn together for a doctoral thesis (Tweddle 2000).

These pollen records, together with an examination of preserved wood from former wetland and foreshore exposures, have allowed the development of the post-glacial environment in the area to be reconstructed as a series of 'Regional Pollen Assemblage Zones' (Beckett 1981) and tentatively dated (Flenley 1991). Birch and Scots Pine dominated as the tundra-like conditions of the Loch Lomond Interstadial gave way to the early Holocene, with probably smaller areas of juniper and willow. As the climate ameliorated further, hazel and elm began to dominate, with alder also increasing, and ash, lime and oak also appearing, beginning to shade out hazel and some of the other 'pioneer' species. Elm and lime declined after c 3000 BC, the former probably as a result of disease, with hazel increasing in the lower temperatures. Oak and alder dominated until c 500 BC with other species such as beech and hornbeam present. From this period onwards there is a decline in the tree pollen record and it is apparent that woodland clearance and the spread of arable farming had a dramatic impact on the environment, with minerogenic deposits washing into the Holderness meres, representing eroding soils, although localised clearance is likely to have already begun during the Neolithic period.

Coastal erosion has meant that traces of wetlands extend to the coast in the low-lying area south of Kilnsea including Spurn, where the till dips to beach level and below. At Kilnsea Warren, an exposure of peat was sampled at the low tide mark in 1974 at TA 4235 1385 in the area to the east of the land surface exposure recorded during Phases 1 and 2 of the RCZAS (Site 8: EA353). The peat sealed clay containing marine bivalves, probably of common species of muddy estuarine and marine environments such as *Scrobicularia plana* and *Macoma balthica*, which may have been deposited towards the end of the period when Britain was finally severed from the Continent by rising sea levels, c 6500 BC. The woodland peat itself, with frequent birch twigs near the base at –2.40m OD, was previously ¹⁴C dated to 5490–4700 cal BC/6170±180 BP

(Hv3359) the later Mesolithic period (Van de Noort & Ellis 1995, 286). The presence of marine molluscs below the peat suggests a tidal regression and conditions had clearly been stable enough to allow trees to colonise an area close to the north shore of the Humber estuary.

A borehole drilled near the south end of Spurn is reported to have revealed the presence of a later Mesolithic peat deposit at -7m OD, dated 5490–5470 cal BC/6500 years BP (ABPmer 2007, 3), although the exact location of the borehole and details of the borehole data and dating process could not be confirmed at the time of writing. The peat overlay 10m of shelly gravel which continued down to the till surface, suggesting either that it formed on the shore of a partly infilled channel feeding the Humber, or that it marked the north shore of the estuary channel itself.

The dates of both samples lie centrally within the range of a sequence of Mesolithic peat deposits at a similar Ordnance Datum level recovered from the south side of the Humber at Union Dock, Grimsby (see below). Taken together, the sites represent the growth and eventual inundation of marginal woodland either side of the estuary.

A second exposure on the foreshore at Kilnsea Warren, comprising brown peat resting on poorly-sorted glacial till, was located north of the first sample at TA 4230 1470 and represents a rather later formation episode (Long *et al* 1998, 229–47). In this case the peat formed in the mid to late Neolithic period between 3390–3080 cal BC/4562 \pm 59 BP (UB-3900) (base at -1.29 to -1.32m OD) and 3120–2890 cal BC/4384 \pm 54 BP (UB-3901) (top at -1.19 to -1.22m OD). Pollen and diatom data suggested peat formation under saltmarsh conditions which was inundated as the sea level continued its gradual rise. Saltmarsh peats of this date on the south bank have been found to contain sea arrowgrass (*Triglochin maritima*), one of a number of plants common in the upper saltmarsh which form a second wave of colonisation after saltmarsh has already begun to form. The thin overlying silt clay contained marine bivalves, reflecting a return to muddy conditions along the northern shore of the Humber, suggesting that the rate of sea level rise became too rapid for the saltmarsh flora to adjust.

During the course of the RCZAS Phase 2 walkover survey of the area in 2009, an eroding alluvial silt clay shelf (Site 8: EA353) on a bed of glacial till was located on the North Sea foreshore near Kilnsea Warren, extending over an area at least c 50m north–south, 30m east–west, along the central beach southward from an area where late Bronze Age/early Iron Age cremations were excavated in 1957 (EA236). This exposure was considered likely to have formed part of a land surface contemporary with the cemetery, although it clearly included visible traces of fragmented organic material and estuarine faunal remains. The extent was mapped using a handheld GPS.

At a return visit in 2011 to record the remains of a post-medieval eeltrap (Site 9), further areas of the land surface were examined and the area was resurveyed. Visual inspection revealed substantial colonies of bivalves which largely appeared to be the burrowing species *Scrobicularia plana*, although other types may have been present. Many individuals were still intact, suggesting the colony had been buried rapidly and not subjected to subsequent turbulence or erosion.

As part of Phase 3 of the RCZAS, surface samples and borehole transects were undertaken in selected areas at Spurn to map the depth and extent of exposures of the former land surface, determine the stratigraphic sequence, and potentially identify and profile hidden prehistoric features.

A sample from the upper core extracted from BH1 at the north end of the main transect (Transect 5) included alder and probably hazel. A peat sample ^{14}C dated

previously in this area at TA 4230 1470 (Long *et al* 1998, 229–47) was of the mid to late Neolithic period, the date range ending just before that of a sample taken at the south end of Transect 5 in 2012 (BH18); although there is no clear evidence that these were all the same deposits, a date in the Neolithic is likely. The upper borehole column of BH18 contained scraps of twigs or roots among an indeterminate organic component, but also traces of fungal tissue of the woodland floor fungus *Cenococcum geophilum*. This would therefore appear to be the base of an eroded woodland horizon, formed directly on alluvial silts, presumably former mudflats. A section of indeterminate roundwood from close to BH18, referred to above, returned a late Neolithic ¹⁴C date of 2880–2570 cal BC (Wk-35947), contemporary with two samples from Cleethorpes, also dated as part of this project.

Soil-dwelling fungus *C geophilum* was also present in a sample from the east–west Transect 2 (BH4) crossing the northern exposure of the former land surface near the north end of Transect 5, together with nettle and examples of brackish/marine snail species. The presence of rush (*Juncus*) in BH1 together with goosefoot (Chenopodiaceae) combines to reflect a picture of a fluid, marginal environment, switching through a range of habitats from woodland to freshwater and brackish or marine wetland.

A similar picture emerges from samples recovered from Transect 3, located further south to examine the central area of former land surface. Here, a surface sample near BH1 contained *Juncus* remains and a single *Teucrium* nutlet, possibly from the common wood sage (*T scorodonia*) or the currently much rarer water germander (*T scordium*), as well as further traces of the woodland floor fungus *Cenococcum geophilum*. A ¹⁴C sample from an adjacent tree root or branch provided a date of 3640–3370 cal BC (Wk-35945), somewhat earlier in the Neolithic than the Transect 5 sample, but overlapping with the range of the second of the earlier samples referred to previously. Interestingly, BH2 revealed at least 2m of alluvial deposits, suggesting the presence of a channel or hollow. Further south at the site of the single borehole Transect 4, any woodland floor deposits had been truncated leaving the underlying alluvium exposed.

A significant discovery through coring were two broad depressions. These have been interpreted as two palaeochannels or possibly shallow meres, set c 100–150m apart, in an area where the truncated glacial till survived to between –1.62 and –2.26m OD. The northern depression was probably c 270m wide and at least 2.60m deep below at BH 8 (base below –3.89m OD); the full depth was not reached. The southern depression was c 330m wide and c 2.50m deep (base at –4.26m OD). A 1.3km transect of five boreholes drilled in March 2011 by the British Geological Survey parallel to the western shore of Spurn traced the level of the till in the north (BH1) at +1.46m OD (TA 42041 14652), falling in BH3 to –1.75m OD (TA 42075 14494) and progressively in BH7 to –5.41m OD (TA 4211 14199) and BH4 to –5.57m OD (TA 42083 13695) before rising again in BH5 to –4.45m OD (TA 41944 13350). The till was sealed in each case by sands and sandy silts, which in some instances at least lay below a grey/black upper silt containing shells, suggesting the existence of a depression or channel in this area, overlain by later intertidal alluvium. Fibrous peat was recorded above the alluvium in BH7 at c 1m depth (1.59m OD).

Although the exact orientation of the possible channels could not be ascertained from the limited information available, they may well have been aligned broadly north-east to south-west, parallel to the northern section of the Kilnsea Fleet. This channel passed between the present villages of Easington and Kilnsea below what is now dry land north of Spurn to enter the Humber further west. Three cores taken by the British Geological Survey in May 2003 reached glacial till at depths of 18m in this

area and may therefore have passed through the fills of the Fleet, which was the easternmost known channel of a series which included Keyingham, Hedon and Winestead Fleets. During the early Bronze Age the Easington barrows and henge were constructed on the shore of the Kilnsea Fleet which had at least partly silted up, and traces of Neolithic occupation below show that this process had already begun, although it could theoretically have remained open until the eastern end was lost to erosion, possibly as late as the 9th century (Sheppard 1966): this was presumably also the fate of the two Spurn channels. The 2012 transect confirmed that the southern barrow, Easington Barrow 1 (Site 5: EA117) had been constructed on alluvium.

The late Bronze Age/early Iron Age Kilnsea cremation cemetery recorded in 1957 and the early Bronze Age circular structure (Site 10) recorded in 2010/2012 were established further south on the contemporary ground surface. The latter is a significant addition to the known prehistory of the area, dated to 2040–1880 cal BC by ¹⁴C analysis of two of the posts (Wk-35950, Wk-35946), a similar date to the Easington henge and barrows, and only slightly earlier than the Kilnsea sewn-plank boat. Further investigation of the site may reveal details of any internal features which would assist in confirming whether the structure was a domestic building or had a ritual/funerary function. It marks the southernmost recorded occupation site in this area, but the proximity of the cremation cemetery suggests that further structures are present and will be revealed as the area continues to erode, covering a date range which extends through the Bronze Age. In addition, the presence of earlier occupation may be revealed, as was the case with the Easington sites.

The main significance of the post-medieval eeltrap (Site 9), if *in situ*, is that it presumably marks the location of a former channel, although this may have been a simple runnel within an estuarine saltmarsh. It is likely to date from no earlier than the late 17th century if composed largely of rattan or a similar imported species, while Spurn must have moved over the site in the intervening period. As the adjacent section of the headland has moved relatively rapidly and breached in the mid 19th century, an 18th- or early 19th-century date seems the most likely.

Further north, the transect through Barmston Mere (Site 2) and the mapping of its extent have added some additional detail to the original form of the lake and the sedimentary sequence. Previous excavation by Smith, Varley and Humber Wetlands Project had revealed peat deposits and trace of Bronze Age settlement, but these were not encountered (Varley 1968; Head *et al* 1995; Fletcher & Van de Noort 2007).

The boreholes passed through a sequence of lacustrine alluvial silts at least 7m deep below the present ground surface (–2.74m OD), a similar level. A perched water table was encountered close to the ground level. Several boreholes closest to both edges of the mere (BH1–2 and BH6–10) reached an indurated gravel surface which in several instances was impenetrable; as this overlay till in BH7–10, this may represent a general basal deposit partly cemented by lime secretions from the stonewort *Chara*; the sequence above this included sand and gravel which in some instances formed discrete layers, in others formed bands within the lower alluvium.

The occurrence of stonewort and the water flea *Daphnia* in samples from BH4A is an indication of high water quality, although the presence of *Daphnia* resting bodies (ephippia) and the statoblasts of bryozoans may indicate periods of stress. This might have been the result of falling water levels, a reduction in the available food resources, or a decline in water quality. Some of these might be the result of rising temperatures or low rainfall, although human interference cannot be ruled out, in particular increased siltation following deforestation of the surrounding area to prepare it for agricultural use

(Gilbertson 1990). Birch pollen was present below 3.1m; as an early post-glacial coloniser its appearance is not unexpected, although the sequence as a whole could not be dated. As the late glacial peat deposits encountered by Varley and Humber Wetlands Project presumably overlay the basal gravel, either directly or over intervening layers, it is likely that the basal gravels were Late Devensian deposits laid down at the end of the Dimlington Stadial as water was released during the thaw, since the peat seems to have already begun to form during the tundra conditions of the Loch Lomond Stadial.

The beach section and core recorded at Withow Gap (Site 3) do not significantly add to the substantial body of palaeoenvironmental information already available as a decision was taken not to sample the deposits in view of the considerable amount of information retrieved and published from past interventions. The purpose of the Phase 3 record at this location was to provide further comparative data with regard to the overall stratigraphic sequence following a period of rapid erosion and collapse as the softer deposits recede inland along the line of the Gap. The rate of erosion at this point is apparently increasing, almost certainly as a result of more aggressive coastal erosion combined with runoff from a field drain which exits at this point, collecting and transporting water from the surrounding area. The recent tendency towards periods of dry weather alternating with very heavy rainfall has caused severe problems along the east coast from Holderness to North Yorkshire by weakening cliffs through cracking, allowing water to enter and cause areas to slide. This site is a finite resource which will clearly only remain available for future research in the short to medium term and although little new significant palaeoenvironmental information may be obtained, there remains the possibility that artefacts which throw light on early anthropogenic exploitation of the area will be exposed and can be retrieved.

South of the Humber, local awareness of the extensive palaeoenvironmental remains along the coastline of Lincolnshire has been high from a relatively early date, the earliest scientific reference being published at the end of the 18th century (Correa de Serra 1799). This is probably largely due to the presence of a chain of population centres along the coast, the extensive use of the foreshore for leisure use and fishing, and (until recently) active erosion along the low tide mark. Deposits, archaeological features and artefacts representing a wide date range have consequently been recorded between Immingham and Ingoldmells, continuing to the rear of the present sea defences below land reclaimed from the post-Roman period onwards as the result of continued siltation and embankment. By comparison Holderness is geographically remote and comparatively sparsely inhabited, with exposures of palaeoenvironmental significance restricted to a small number of defined sites, mainly centred on meres and palaeochannels.

During the prehistoric period, much of the Lincolnshire coast, at least in the north, was probably subject to the accretion of silts, protected from erosion by a series of small boulder clay islands, which were possibly part of a morainic deposit. The loss of these in the 13th/14th century allowed erosion to commence. Traces of the islands remain between Cleethorpes and Mablethorpe as the Saltfleet Overalls, and there is still accretion in the coastal area to the west between Donna Nook and Saltfleetby, where there are mudflats and stable saltmarshes up to 2km in width in front of the most recent seabanks. South of Skegness longshore drift of sand and shingle has allowed accretion to continue at Gibraltar Point, but between these two areas, erosion has progressed since the medieval period, contained now by hard defences and, since 1994, beach nourishment (deposition of dredged shingle). There is some evidence that the beaches in the Cleethorpes/Grimsby area north-west of Donna Nook are now affected by erosion, or at least by a reduction in the beach level, exposing post-medieval/early modern shipwrecks in the area on a more regular basis.

A combination of archaeological and geotechnical investigations, casual observations and the exposure of former land surfaces along the Lincolnshire coast has allowed the establishment of a broad sequence of post-glacial development (Ellis *et al* 2001).

A lower peat horizon, dated broadly to the middle Mesolithic (c 5500 cal BC) represents the presence of former land surfaces and forested areas as the sea level stabilised following a period of rapid rise. In Grimsby, core samples taken during rebuilding work on Union Dock (Long *et al* 1988, 229–47) yielded mid to late Mesolithic formation dates between 7320–7060 cal BC/8170±45 BP (SRR-4747) to 5640–5480 cal BC/6645±45 BP (SRR-4746) for a thin sandy amorphous basal peat which rested on sandy clay; it contained rootlets and tree pollen, suggesting a woodland origin. The peat was sealed by thick clay containing a brown intercalated (layered) amorphous saltmarsh peat with *Phragmites*, which was dated to the later Mesolithic, 4860–4680 cal BC/5900±45 BP (SRR-4745) to 4620–4360 cal BC/(5665±45 BP (SRR-4744). These deposits lay below –7.68m OD and were clearly much lower and earlier than the upper peats exposed at beach level in the Cleethorpes area, presumably forming on the southern bank of the Humber at a period when the sea level was much lower than at present. The central date and level are broadly the same as those obtained from peat recovered from a core at the south end of Spurn which may mark the former line of the northern shore.

An exposure of eroding glacial till representing a former land surface was identified during the RCZAS Phase 1 walkover at Cleethorpes. Extensive areas of surface biogenic deposits and tree roots have also been found previously in the Grimsby/Cleethorpes area and their existence is well known locally. The remains include an area of eroding peat on the foreshore at the north end of Cleethorpes near TA 3043 0973 where a partly embedded axe-hammer was recovered on the surface in 1979 (Leahy 1986). An exposed tree stump from the same area was dated by ¹⁴C to 2920–2290 cal BC/4090±120 BP (OxA-132), the late Neolithic/early Bronze Age. This is somewhat later than the date obtained from the Kilnsea tree root (3640–3370 cal BC Wk-35945).

The date obtained for the partly preserved handle of the axe-hammer itself was later still, 1940–1490 cal BC (3390±100 BP OxA-130) and can therefore be assigned to the early Bronze Age, indicating that the tool was intrusive, perhaps discarded or lost in a later (now eroded) horizon during a period relating to clearance of the treescape and its replacement by agriculture. The extremely rare preservation of the handle, however, suggests that the axe-hammer was deposited in waterlogged conditions and may have been a deliberate votive offering in a pool or marsh. The tool was contemporary with the Kilnsea 'roundhouse' (Site 10) and both represent activity within what became an intertidal zone during the ensuing Iron Age.

This area of former forest was targeted for further limited sampling as part of the Phase 3 programme with the assistance and advice of Hugh Winfield, Archaeologist for North-East Lincolnshire Council and with the intention of obtaining new calibrated ¹⁴C dates. A series of branch fragments were obtained whilst coring was being undertaken, including parts of what appeared to be a structure, with a series of drilled holes. After being recorded, two pieces were selected for ¹⁴C dating. One fragment returned a radiocarbon date of 2880–2500 cal BC (Wk-35948). A branch from the same area, possibly from the same structure, returned a similar date range of 2910–2670 cal BC (Wk-35949). Both of these results place the possible structure in the later Neolithic period, broadly contemporary with the previous date obtained for the tree stump and for a branch recovered at Easington near the south end of Transect 5.

A single borehole was drilled to examine the adjacent soil horizon. The sample mainly revealed the remains of marine shellfish as well as brackish/marine snails such as *Hydrobia ulvae*, which may have been introduced when the area was still affected by estuarine influences. Significantly, traces of fungal hyphae were also present, although it is not clear if these were the forest floor species *Cenococcum geophilum*.

Where the upper part of the sequence survives behind the present sea defences, these early deposits are deeply buried below grey marine silts deposited during the pre-Roman Iron Age when the coastline lay considerably further west than at present, containing large numbers of shells of peppery furrow shells (*Scrobicularia plana*). The situation stabilised sufficiently in the Roman period during another short regression or standstill for occupation to expand beyond its Iron Age limits, but rising sea level and the resultant deposition of silt deposition from the late Roman or early post-Roman period led to the creation of large areas of marshes east of the Iron Age/Roman shoreline; useful for grazing, later post-medieval and early modern drainage eventually made this land available for agriculture.

As mentioned earlier, the natural deposition of silts continues in front of the present sea defences in some areas, particularly in north-eastern Lincolnshire either side of the short headland of Donna Nook. Saltmarsh growth at Cleethorpes, for example, threatens the tourist beach, although the coastline further south is being eroded and has been protected by beach nourishment. The shore to the west of Cleethorpes shows some evidence that it is alternating between accretion and depletion. This is apparent by studying the condition of the wrecks in the area, several of which have been recorded previously. Wreck CL118 had previously been briefly examined by John Buglass in 1999 (Buglass 2002), and represented a two masted wooden carvel-built 19th-century fishing vessel. Nearby was a similar but more deeply buried vessel which could not be examined in any detail at the time and its location was not recorded. To the south-west of this site there were two further (probable) post-medieval wrecks (CL131, CL133). Wreck CL133 appeared to be that of a barge.

A brief site reconnaissance was carried out for Phase 1 of the RCZAS in May 2007 in the area of wreck CL118. The remains of the vessel were now standing almost completely clear of the surrounding sand. Internally the vessel had been clear long enough for a covering of sea weed to develop. Externally the wreck had deep scours on its northern side which had undercut the remains, assisting the start of a break up. Several areas of significant damage were visible at both the bow and stern with numerous loose planks and large, detached but otherwise intact sections of structure in the immediate vicinity. It was the author's view that unless the wreck was covered by the sand in the near future it would probably break up completely within a year to 18 months.

The reduction in level of the beach sand exposed a second wreck c 100m to the south of CL118. Less of this vessel was exposed with 37 frames visible on the southern side and 25 on the northern but the keelson remained buried. It appears to be 15–30m long and about 7m wide. The remains were of a wooden, carvel built fishing vessel slightly smaller than CL118. It was also possible to clearly see the remains of wrecks CL131 and CL133 though the tide was not sufficiently low to be able to carry out any form of inspection.

At a return visit for Phase 2 in 2010, the whole area was covered by beach sand, with none of the vessels visible, but an inspection by Hugh Winfield (North-East Lincolnshire Council) in 2012 (section 4.2) revealed that most of wrecks were again exposed, although CL131 (NELHER 1000/21/0) was apparently buried by a sand

bank. CL118 (NELHER 1000/33/0) showed clear signs of deterioration, particularly the starboard side, with hull and ceiling planks loosened and the exposed ribs decayed. CL133 (NELHER 1000/20/0) was in a state of collapse, with clear signs of shipworm damage. Two other wreck sites had been revealed, one of these (NELHER 1000/33/1) was identifiable with a site identified but not recorded in 2007. The second (NELHER 1000/33/20) consisted mainly of fragments of timber and ballast. The instability of the area does suggest that these wrecks will break up in the short to medium term; how soon will depend on the length and frequency of exposure.

In summary, the intertidal zone is dynamic and affected by a number of external factors, including sea level fluctuations, changes in climate, and the erosion or restoration of natural and man-made defences. The palaeoenvironmental potential of the coastal area itself covers a broad range of disparate elements. These extend over a long timescale from the post-glacial to post-medieval/early modern periods. The majority of features in this report have already been modified or damaged by the cycle of erosion and deposition affecting the coasts of Holderness and Lincolnshire. These processes will continue to have an impact on archaeological and palaeoenvironmental assets, but will also reveal new locations.

7.2 Recommendations

The Holderness and Lincolnshire coastlines form an extensive area of study. In defining the level of future archaeological intervention, with limited resources available, a balance should be reached between occasional monitoring and targeted intervention, avoiding the repetition of existing work where the returns are likely to be of diminishing value. The targets set for Phase 3 of the Rapid Coastal Zone Assessment Survey of the area already represent the investigation of a small, highly selective number of sites identified as being of significance in Phases 1 and 2. Severe storm damage in recent years, including that of December 2013, has emphasised the fragility of the coastal area. With this in mind, the following recommendations are made:

- No further specific work is recommended at Earl's Dike (Site 1), Barmston Mere (Site 2), Withow Gap (Site 3) or Sand le Mere (Site 4). It is highly likely that local interest groups and educational establishments will continue to carry out and publish the results of recording and sampling programmes;
- Arrangements could be made for the area surrounding Easington Barrow 1 and the underlying Neolithic occupation site (Sites 5 and 6) to be monitored, possibly as a partnership between the Humber Sites & Monuments Record (local HER) and East Riding Archaeological Society, which has undertaken much of the previous fieldwork in this area. Although the sites have been excavated, coastal erosion may reveal further features in the vicinity and the opportunity could also be taken to sample and map the Kilnsea Fleet which appears to underlie this area by means of borehole transects;
- Future consideration could be given to a more intensive programme of work at Spurn Point, including transects along both shorelines, incorporating the Humber foreshore at the north end of the peninsula (Site 7) to establish the course of the possible palaeochannels identified at Kilnsea Warren (Site 8) and the presence of any further features or deposits of palaeoenvironmental significance. The transects could be extended to the tip of Spurn. Further samples should be taken for more detailed microfossil analysis;

- No further work is recommended on soil samples from the eeltrap (Site 9); the structure itself has been adequately recorded and discarded;
- The area of the circular timber structure at Kilnsea Warren (Site 10) and its immediate surroundings should be considered for evaluation by site clearance to recover the complete plan, accompanied by trial trenching to elucidate its function, the presence or absence of internal features and determine whether earlier horizons survive. The condition of the timbers suggests that any surviving related organic remains will be well preserved. The current status of the monument following the December 2013 storm surge in the area is unclear, but the site is clearly at extremely high risk from further natural events as well as ongoing changes to the beach profile;
- Examination of the site of the Neolithic structure located during sampling at Cleethorpes (Site 11) is recommended to determine a possible function and recover any further structural remains. No specific further work is recommended on the forest beds or recent shipwrecks: the area is actively monitored by the local authority's archaeological officer, and HER records are routinely updated;
- New or updated data arising from Phase 3 will be added to the existing project archive. Selected aspects (including ¹⁴C dates) will continue to be disseminated in appropriate forums.

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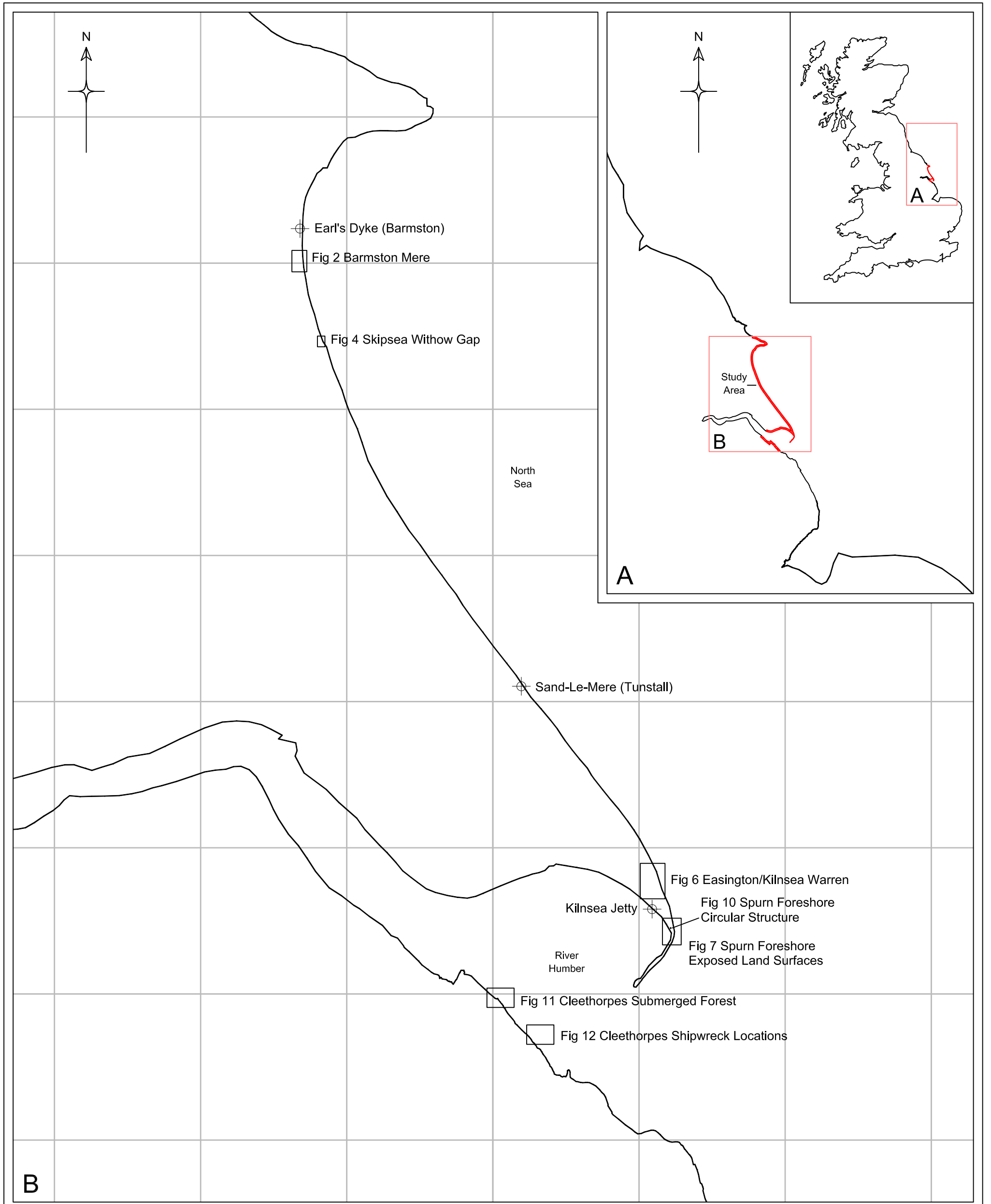
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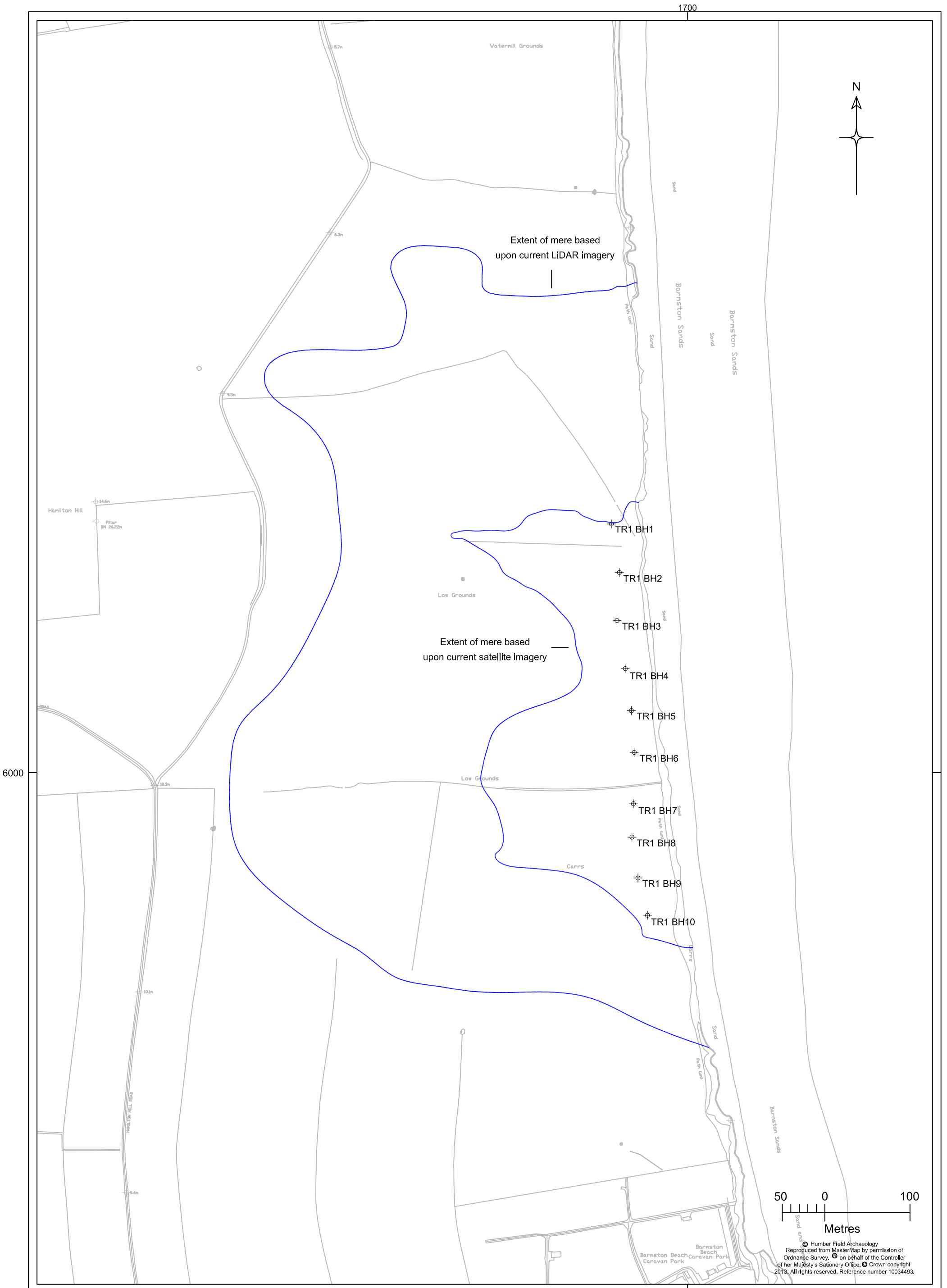
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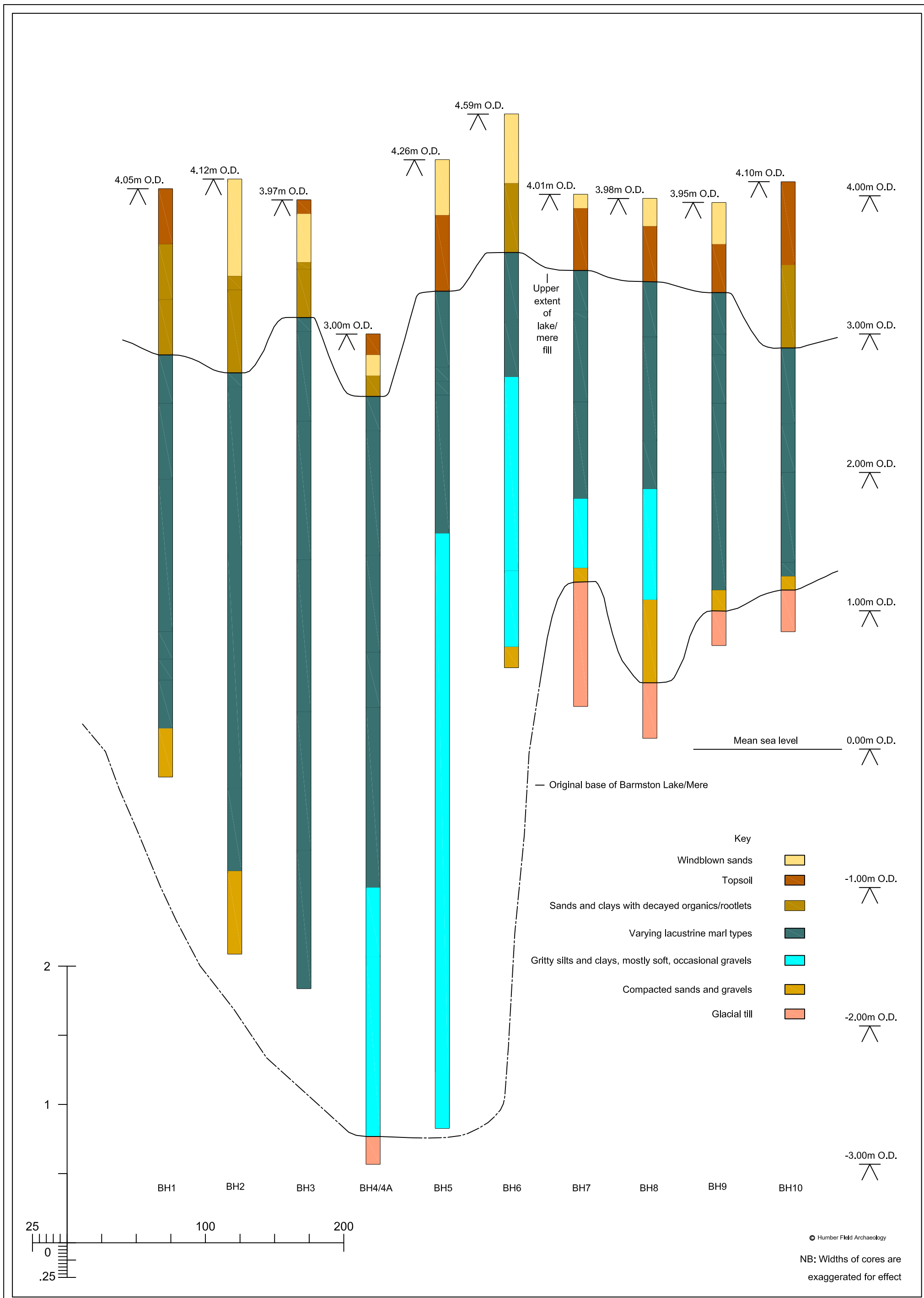
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Figure 1 Site locations and sites not investigated further



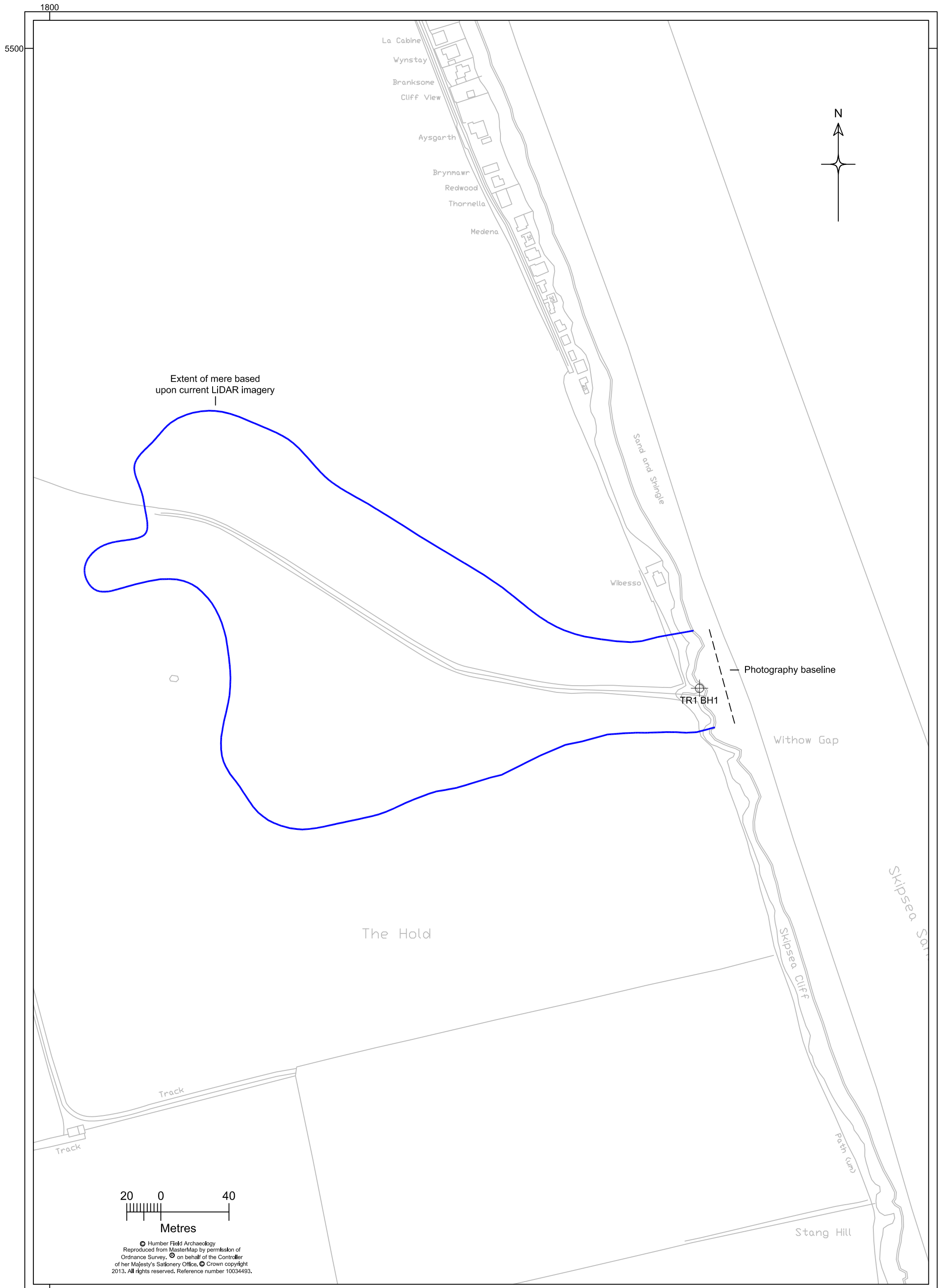
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Figure 2 Site 2 Barmston Mere; coring positions and mere extents



scale 1:2500 (horizontal) and 1:25 (vertical) @ A3

Figure 3 Site 2 Barmston Mere; Transect 1, Cores 1-10



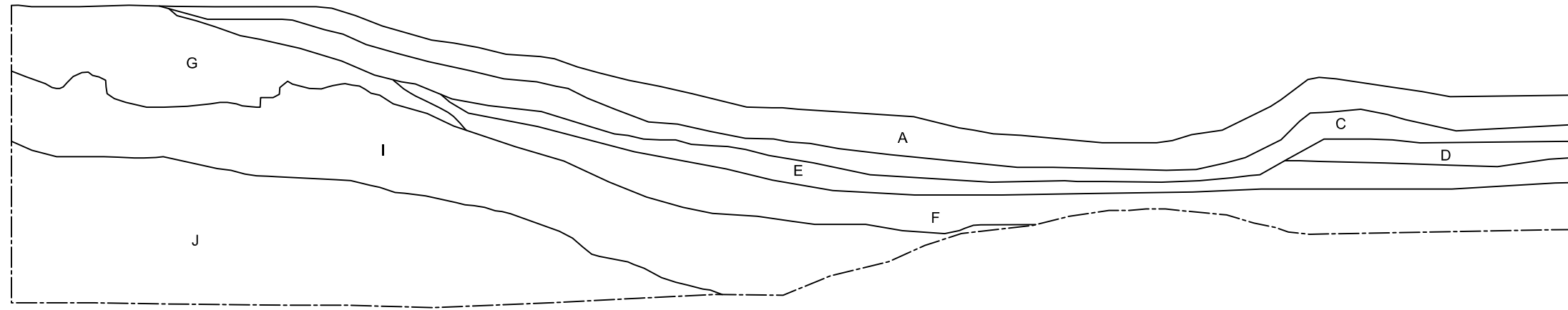
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Figure 4 Site 3 Without Gap; core position, mere extents and rectified photography line

8.19m O.D.

South

North



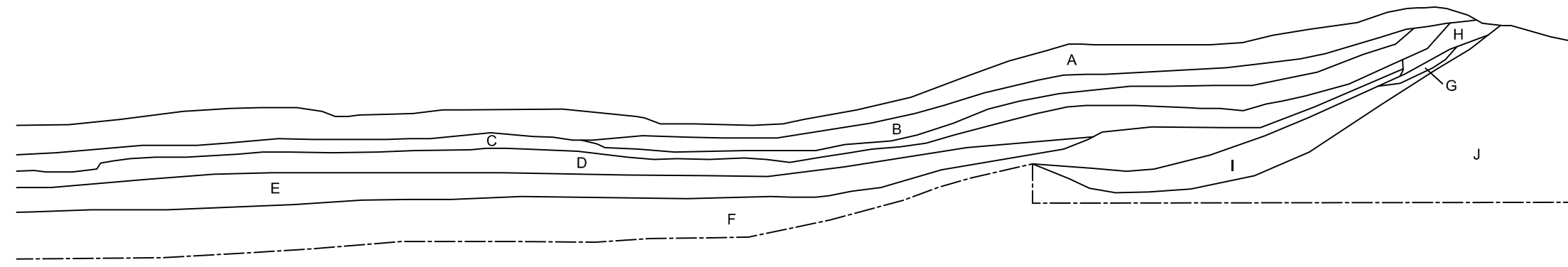
5.68m O.D.

South

North

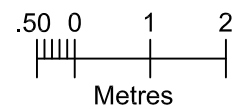
5.68m O.D.

8.85m O.D.



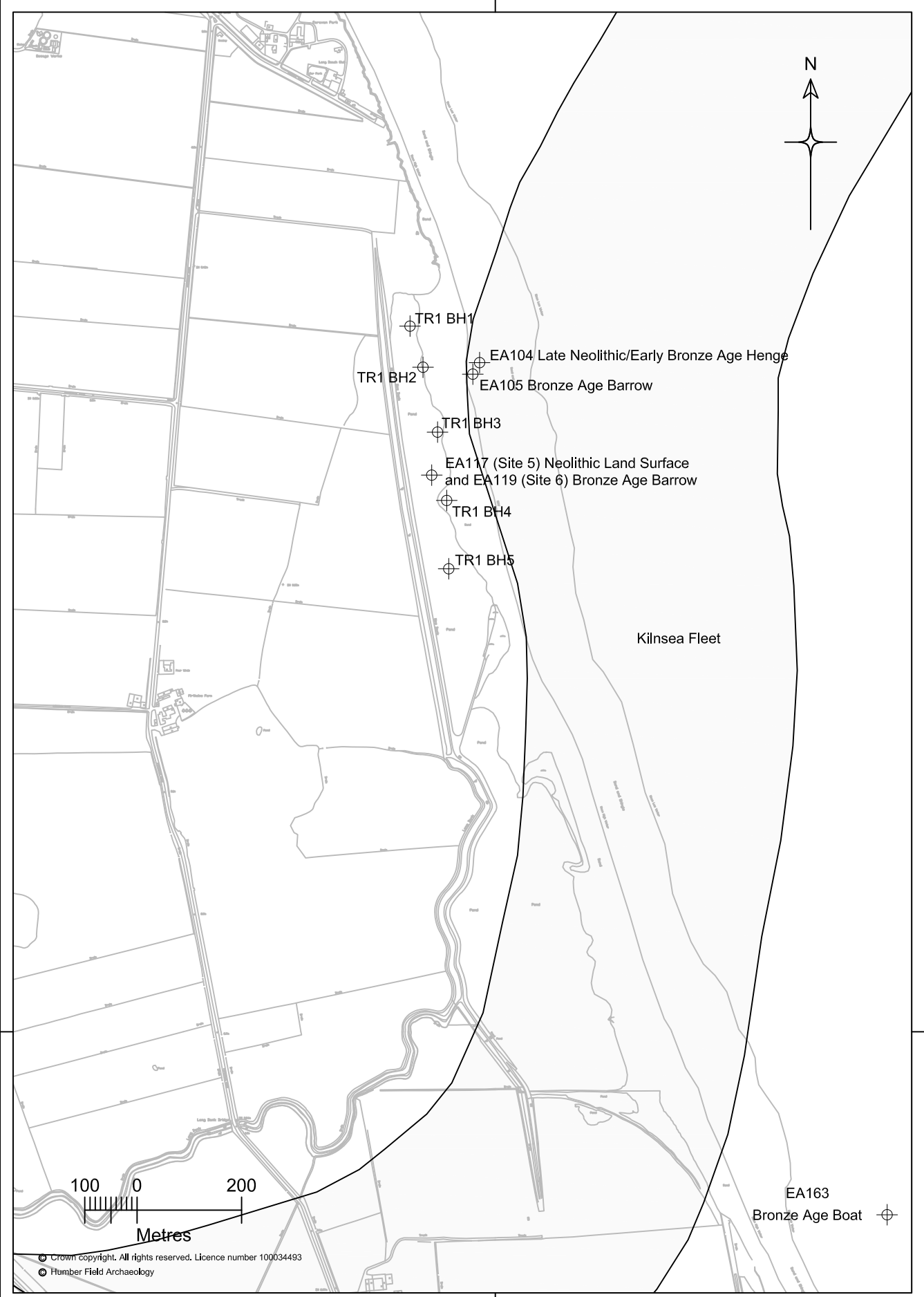
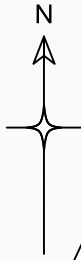
Key

- A Topsoil
- B Mid brown sandy clays
- C Buff grey mottled silty clays
- D Dark brown silty organic clays
- E Mid to dark brown silty organic clays
- F Mid to dark brown smooth silty organic clays
- G Laminated buff orange sands and gravels
- H Pale brown clays
- I Pale firm grey silty sands and clays
- J Glacial till

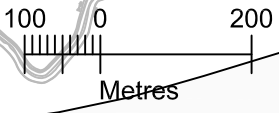




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4100



1700



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scale 1: 10 000 @ A4 Figure 6 Sites 5 and 6 Easington; coring positions and position of Kilnsea Fleet

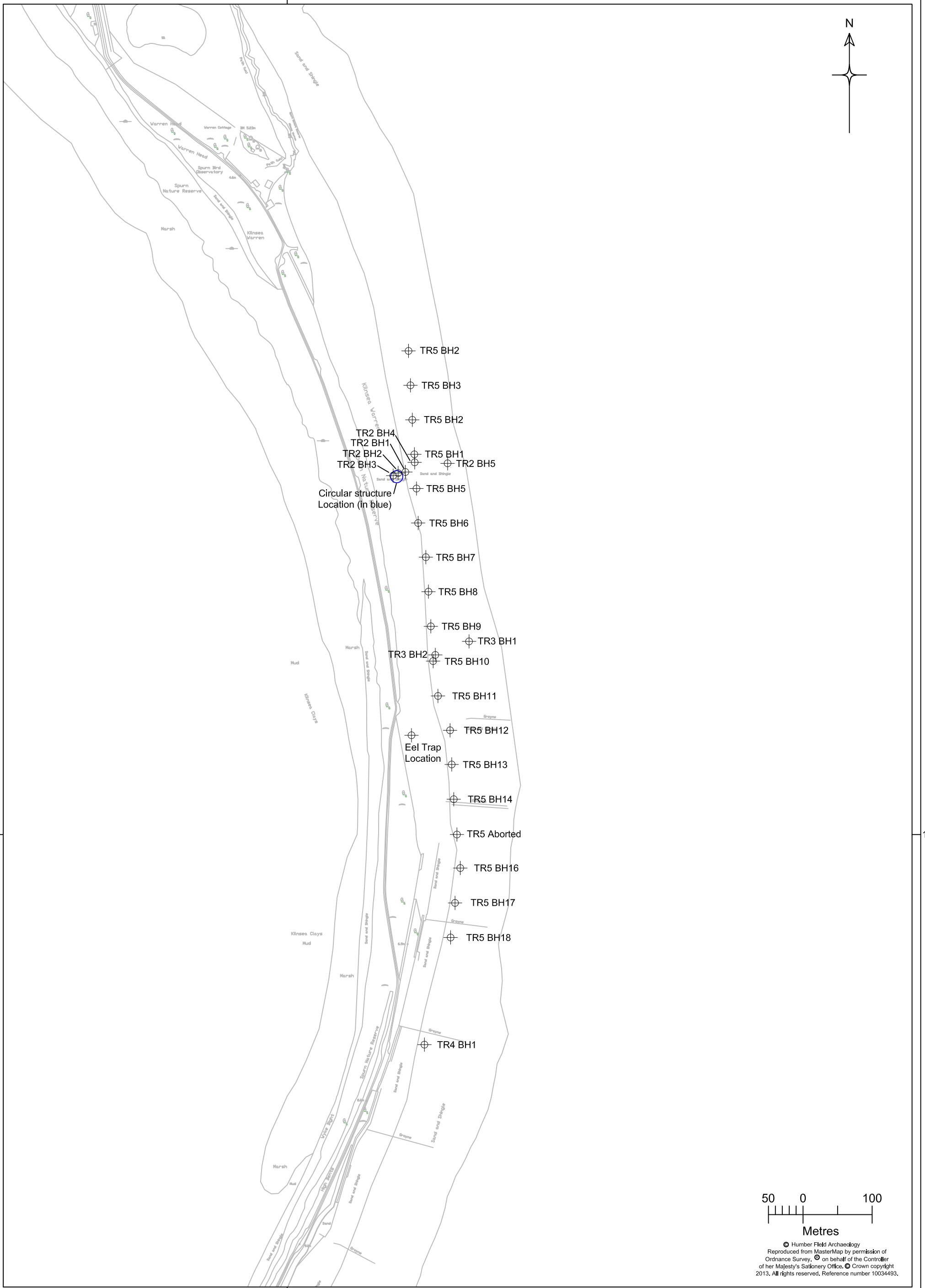
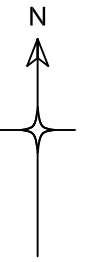
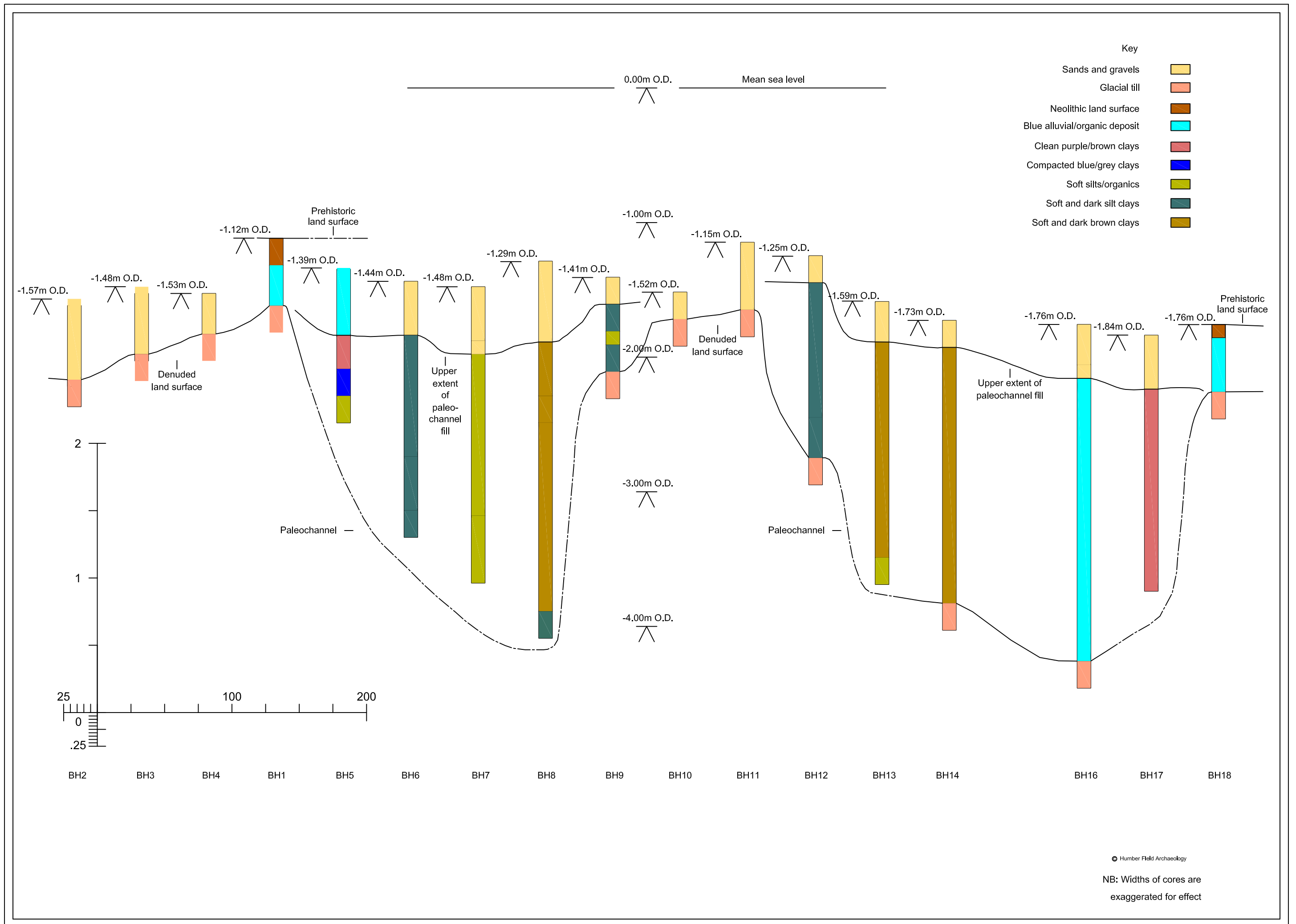
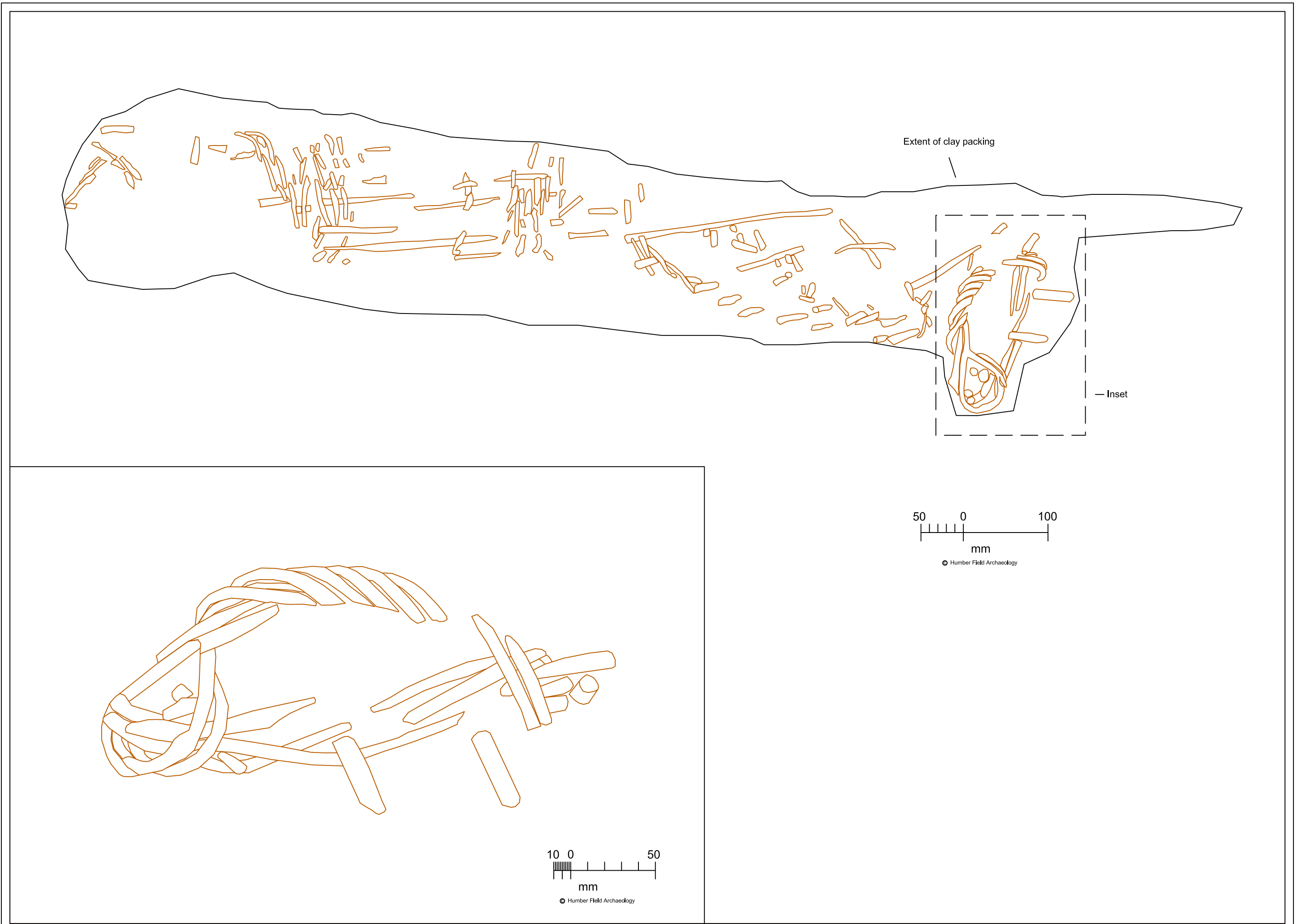


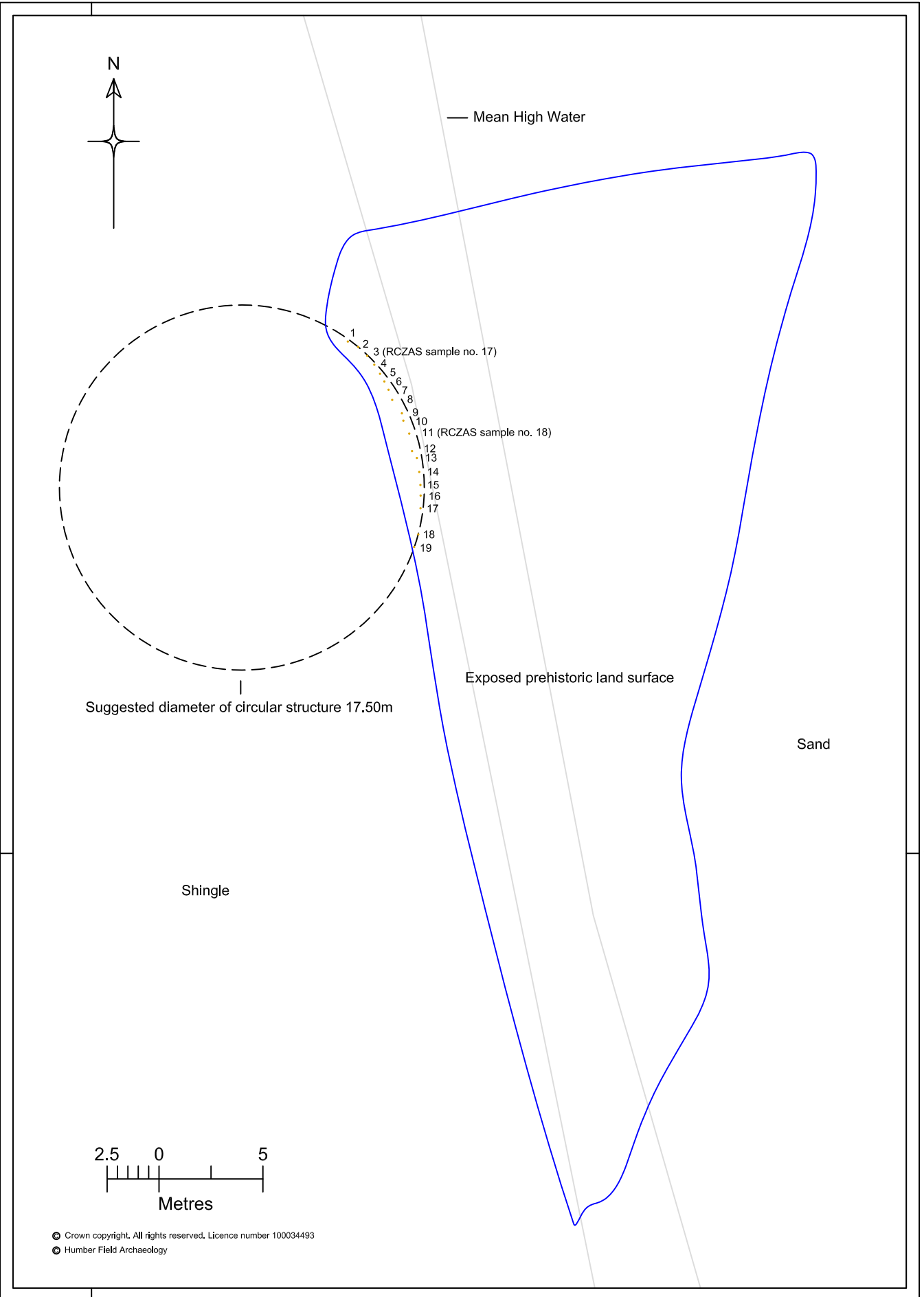
Figure 7 Sites 8, 9 and 10 Spurn Foreshore transect and borehole, circular structure and eel trap locations

50 0 100
Metres

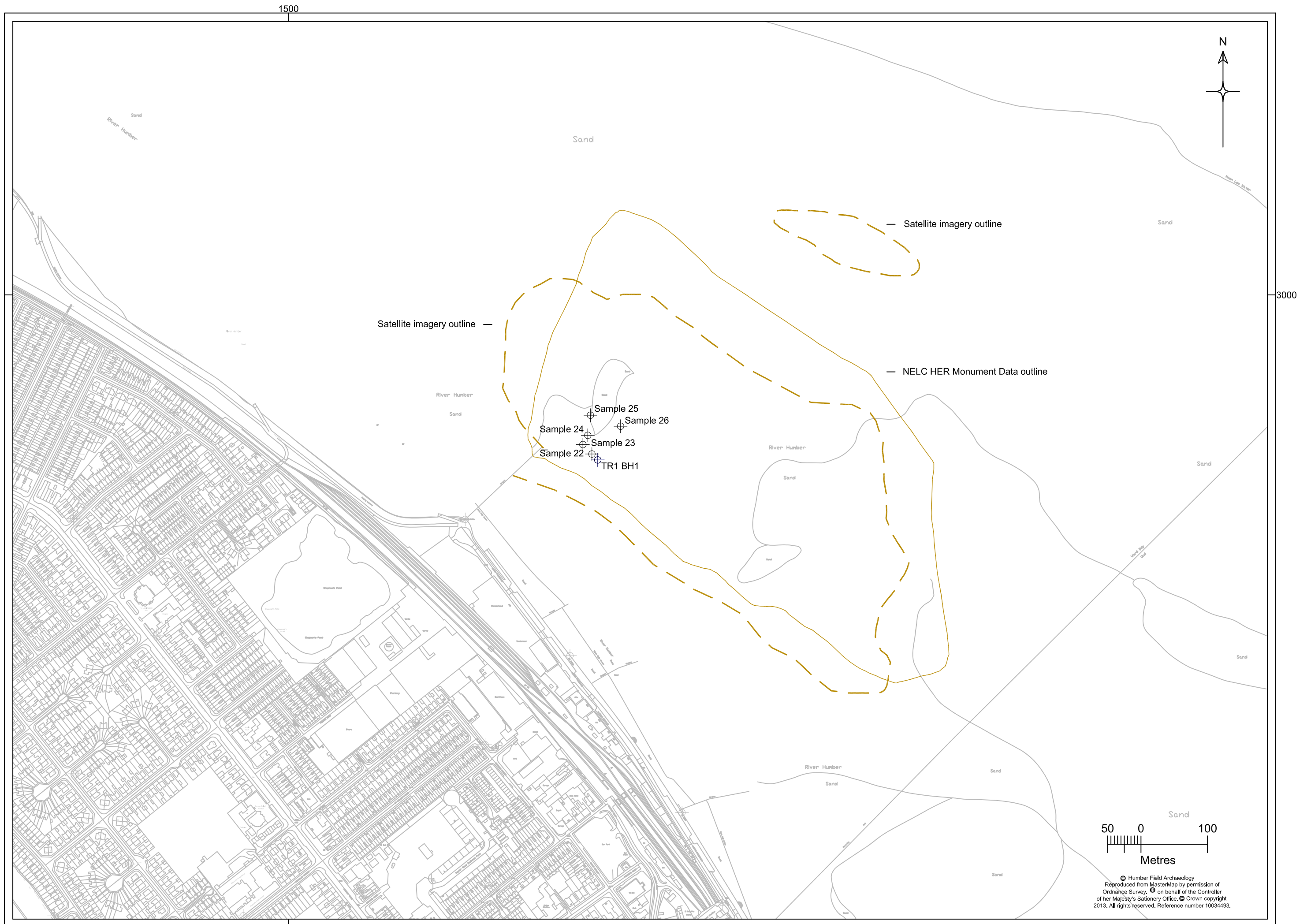
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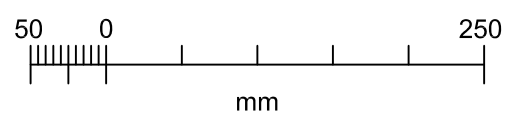
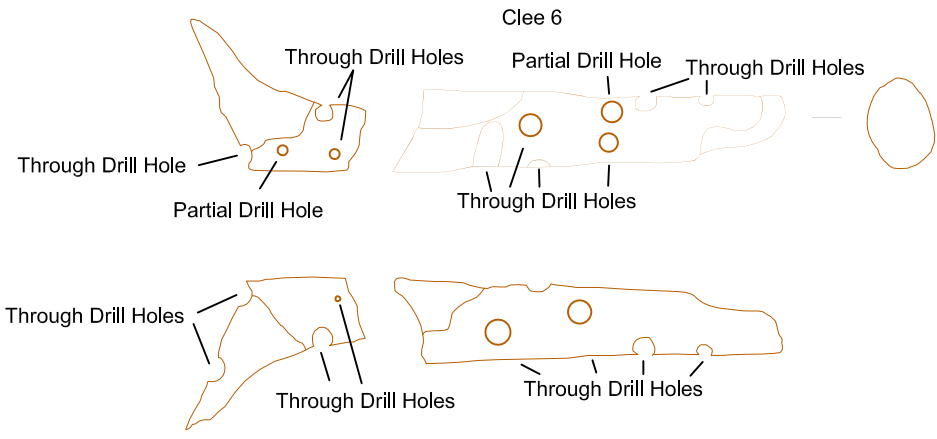
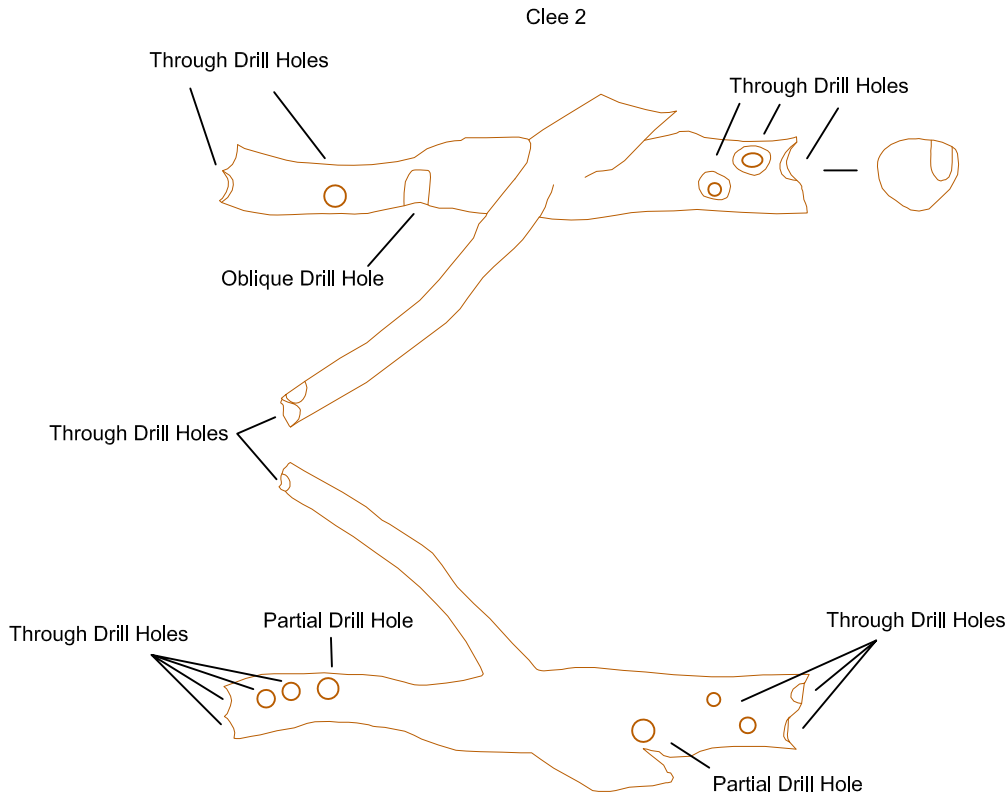




scale 1: 250 @ A4 Figure 10 Site 10 circular structure, Spurn Foreshore dated 2040-1880 cal BC







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Plate 3 Eroding edge of post-glacial Barmston Mere (BA182), 2009



Plate 4 View across former Barmston Mere (BA182), 2009



Plate 5 Barmston Mere, coring underway, 2012



Plate 6 Barmston Mere, coring transect



Plate 7 Withow Gap, Skipsea (SK19), overall view of exposure of post-glacial mere deposits, 2009



Plate 8 Withow Gap, Skipsea, overall view of exposure, 2012



Plate 9 Withow Gap, south side of mere, showing edge gravels (left) below lacustrine silts (1.8m scale)



Plate 10 Withow Gap, slope of mere bed and lacustrine deposits near south side extending below upper beach (2 x 1.8m scales)



Plate 11 Withow Gap, continuation of south side deposit sequence, showing level of modern upper beach (2 x 1.8m scales)



Plate 12 Withow Gap, central lacustrine deposits and exit of drain channel (3 x 1.8m scales)



Plate 13 Withow Gap, central lacustrine deposits on north side of drain (3 x 1.8m scales)



Plate 14 Withow Gap, lacustrine deposits rising to north behind eroded spur of till marking 2009 cliffline (2 x 1.8m scales)



Plate 15 Withow Gap, base of mere and lacustrine deposits rising at north edge (1.8m scale)

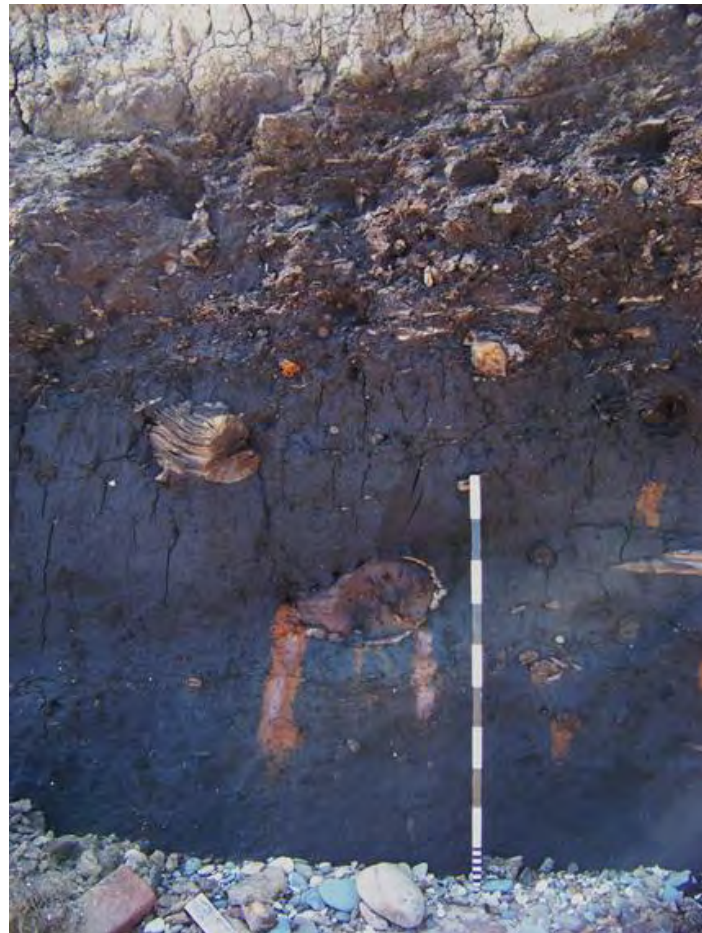


Plate 16 Withow Gap, detail of timbers exposed in section of lacustrine deposits (1m scale)



Plate 17 Site of excavated Bronze Age round barrow EA117 marked by darker circle of vegetation in front of sea bank, Easington, 2009



Plate 18 General view of low cliffs south of Easington, 2009



Plate 19 Northern exposure of eroding Neolithic forest surface EA353, North Sea shore of Spurn, Kilnsea Warren, 2009



Plate 20 Initial test coring, northern Neolithic forest bed exposure, Kilnsea Warren



Plate 21 Eroding Neolithic surface, northern exposure, Kilnsea Warren



Plate 22 Neolithic land surface, northern exposure, Kilnsea Warren (Transect 2)



Plate 23 Detail of eroded Neolithic land surface, northern exposure, Kilnsea Warren, showing remains of forest floor overlying grey alluvial silt and brown glacial till



Plate 24 Coring underway on eroded Neolithic land surface, central exposure, Kilnsea Warren (Transect 3)



Plate 25 Land surface with early Neolithic tree root or branch (circled), ^{14}C sample 5 near Transect 3, borehole 1, Kilnsea Warren



Plate 26 Neolithic tree root at south end of Transect 5 near Borehole 18, ^{14}C sample 19, Kilnsea Warren



Plate 27 Circular Bronze Age post structure emerging from edge of temporarily absent upper beach shingle, Kilnsea Warren, 2011 (British Geological Society)



Plate 28 Detail of two posts of Bronze Age circular structure, Kilnsea Warren, 2011 (British Geological Society)



Plate 29 Eroded Neolithic land surface and former estuary mudflats in vicinity of post-medieval eeltrap, Kilnsea Warren, 2011



Plate 30 General view of post-medieval eeltrap during excavation, Kilnsea Warren, 2011



Plate 31 Detail of post-medieval eeltrap, showing entrance loop



Plate 32 Cleaning the post-medieval Kilnsea eeltrap



Plate 33 Top of Kilnsea eeltrap showing construction of cut canes and twisted withies



Plate 34 Twisted basketry entrance loop, Kilnsea eeltrap



Plate 35 Eroding till platform north of Cleethorpes, 2007 (0.5m scale)



Plate 36 Eroding Neolithic forest beds, Cleethorpes



Plate 37 Tree stump, Neolithic forest beds, Cleethorpes



Plate 38 Neolithic forest floor with tree stump (left) and worked timbers from late Neolithic structure, Cleethorpes, including ^{14}C sample 22 (right foreground)



Plate 39 Eroding Neolithic land surface with structural timbers and later gravel cover



Plate 40 Partially worked timber from Neolithic structure in forest beds, ¹⁴C sample 22, Cleethorpes



Plate 41 Worked timber from Neolithic structure, Cleethorpes



Plate 42 Wreck CL118 (NELHER 1000/30/0), Cleethorpes, almost fully exposed, 2007



Plate 43 Wreck CL118 (NELHER 1000/30/0), Cleethorpes, exposed again in 2012 (Hugh Winfield)



Plate 44 Wreck exposed after 1999 (NELHER 1000/33/1), Cleethorpes, 2007



Plate 45 The newly-exposed wreck (NELHER 1000/33/1), Cleethorpes, 2012 (Hugh Winfield)



Plate 46 Detail of side planking and frame of wreck NELHER 1000/33/1, Cleethorpes, 2012 (Hugh Winfield)



Plate 47 Shipwreck NELHER 1000/20/0, Cleethorpes, 2012 (Hugh Winfield)



Plate 48 Stone cluster, possibly the remains of ballast (NELHER 1000/33/2), Cleethorpes, 2007



Plate 49 Stone cluster, exposed further and seen to include ship timbers (NELHER 1000/33/2), Cleethorpes, 2012 (Hugh Winfield)



Plate 50 Area of fish traps at extreme low water beyond wreck NELHER 1000/33/1, Cleethorpes (Hugh Winfield)



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