

GUNFLEET SANDS 2 OFFSHORE WINDFARM, ESSEX

Archaeological recording of cores (Stage 2)



Oxford Archaeology North

DONG
energy

Gunfleet Sands
Offshore Wind Farm

May 2008

**Niras, on behalf of Dong
Energy**

Issue No: 2008-09/818
OA North Job No: L9932
NGR: TM 622200

CONTENTS

SUMMARY	2
1. INTRODUCTION	3
1.1 Circumstances of the Project.....	3
2. METHODOLOGY	5
2.1 Project Design	5
2.2 Stage 2; Coring and Recording.....	5
2.3 Archive.....	5
3. BACKGROUND	6
3.1 Location, Topography, Geology and Archaeology	6
4. ARCHAEOLOGICAL CORING AND RECORDING RESULTS	8
4.1 Introduction	8
4.2 Core Bhss	8
4.3 Core Bhf3	8
4.4 Core Bhf9	8
4.5 Interpretation of the Data	8
5. CONCLUSION	9
5.1 Discussion	9
5.2 Recommendations.....	9
6. BIBLIOGRAPHY	10
6.1 Primary and Cartographic Sources	10
6.2 Secondary Sources.....	10
6.3 Internet Sources	10
APPENDIX 1: PROJECT DESIGN	11

SUMMARY

Following proposals for the construction of an offshore windfarm at Gunfleet Sands, Essex (NGR centred TM 622200) by Gunfleet Sands Ltd, commissioned Oxford Archaeology North (OA North) to undertake an archaeological assessment of the marine deposits impacted upon by the second phase of development.

The assessment has been undertaken in a phased manner, each stage informing the work required for the next. An initial desk-based assessment was undertaken of three logs (OA North 2008) to identify their potential for further work, defined as Stage 2. The work in Stage 2 was undertaken in April 2008 and entailed detailed examination of remaining sediments from the three boreholes (BHF3, BHF9 and BHSS) provided by the geotechnical contractor, Structural Soils. The aim was to assess whether any land surfaces or peat deposits were represented that may contain material of archaeological significance, and to determine the palaeoenvironmental potential of the sediments for any further analysis.

The sediments recorded in all three boreholes represent bands of clays, silts, sands and gravels deposited under either fluvial or estuarine conditions. It is possible that the deposits recorded from Gunfleet Sands represent a seaward extension of the infilled drainage system of the former Thames-Medway Rivers and their tributaries.

A little amount of material remained of the three boreholes. Most were spot samples of disturbed material with a few short sections of cores (<30 cm long and not labelled with top or bottom). Only in BHSS was sediment with any organic content found, and this was a single spot sample from a depth of 31.9m. It did not represent a land surface or peat deposit, but could possibly be from a mudflat. Consequently, no further stages of the archaeological assessment are recommended.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 Gunfleet Sands 2 Ltd has been awarded an extension of the Gunfleet Sands 1 offshore wind farm, Essex (NGR centred at approximately TM 622200) known as the Gunfleet Sands 2. Gunfleet Sands 2 Limited requested that Oxford Archaeology North (OA North) submit a project design for an archaeological assessment of the marine deposits to be impacted upon by a second phase of development on the site. This phase of the development will consist of 18 wind turbines over an area of 7.5km².
- 1.1.2 The Gunfleet Sands project consists of an consented project Gunfleet I (GS1) (Fig 1), which has consent to construct up to 30 turbines, each of a maximum capacity of 3.6MW, thus yielding a total capacity of 108MW, and an extension known as Gunfleet Sands 2, which was consented 28 February 2008. Gunfleet Sands Ltd requested that OA North undertook an archaeological assessment of three geotechnical cores from the proposed development area of Gunfleet Sands 2 Offshore Wind Farm.
- 1.1.3 Gunfleet Sands Ltd has received a Coast Protection Act 1949 (CPA): Section 34 for Ground Investigations, and it has been requested that “*Geotechnical works should be analysed for archaeological interests*”. This should include “*In particular, analysis of the geotechnical survey data ...to determine the presence of deposits such as peat beds that may contain material of archaeological significance*”. The Archaeological Protocol for Gunfleet Sands 1 Offshore Windfarm, the first phase of the development, which was prepared by Wessex Archaeology, also recommends an archaeological assessment of the geotechnical data.
- 1.1.4 The project design submitted by OA North followed the Archaeological Protocol provided by the client, which stipulates that ‘the programme of work is to be taken in four stages: Stage 1, a desk-based assessment; Stage 2, Coring and recording; Stage 3, Sampling and assessment; and Stage 4, Analysis and dating’.
- 1.1.5 Stage 1, a desk-based assessment of the core logs from three locations provided by Structural Soils was undertaken and a report submitted by OA North in January 2008. The results suggested that, given the importance of the Pleistocene history of the Lower Thames Valley, and the similarity of the recorded deposits from the three cores with significant interglacial sites recorded nearer to the shore; Clacton-on-Sea (Pike and Godwin 1952, Bridgland *et al* 1999) and Cudmore Grove (Roe 1995) that the deposits were worthy of further investigation. It was recommended that Stage 2 should proceed: a detailed inspection of the remaining sediments and an evaluation made by a geoarchaeologist to determine whether there were any sediments which might contain material of archaeological significance and/or the potential for palaeoenvironmental analyses. The results would provide the

basis on which any further work (i.e. Stages 3 and 4) would be recommended. OA North was subsequently commissioned to undertake the work.

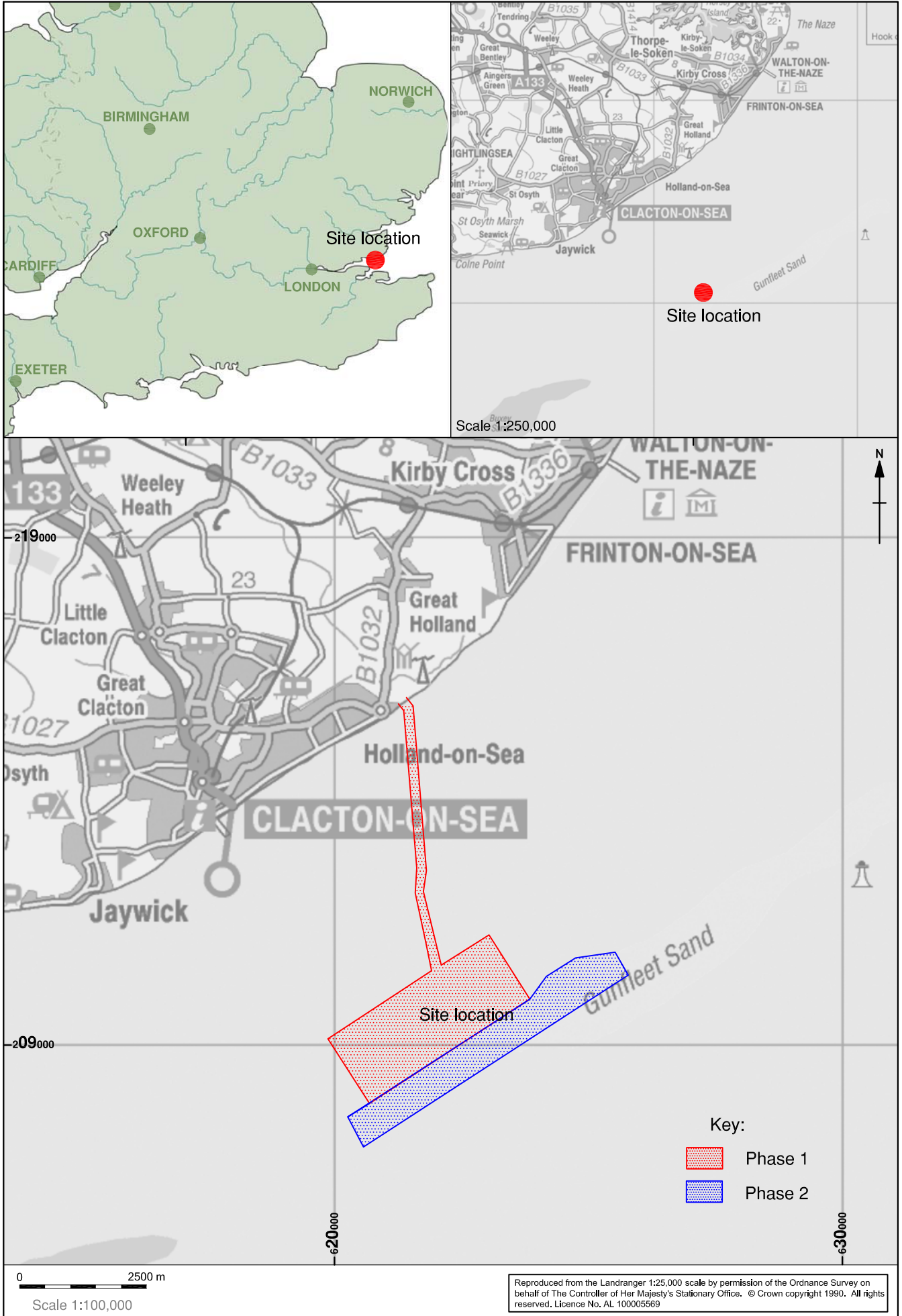


Figure 1: Location map of Gunfleet Sands Phases 1 and 2

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 The project design, submitted by OA North (*Appendix 1*), followed the Archaeological Protocol, updated with a Written Scheme of Investigation, March 2008, which was prepared by Wessex Archaeology, and provided by the client. The methodology for Stage 2, outlined in the project design, was adhered to.

2.2 STAGE 2; CORING AND RECORDING

2.2.1 A geoarchaeological/palaeoenvironmental specialist made a detailed inspection of all extant material from the three boreholes at Structural Soils, Bristol. The extant material was examined visually and the sediments types identified and recorded. Particular care was taken to record the presence of any organic material.

2.3 ARCHIVE

2.3.1 A full archive has been prepared to a professional standard in accordance with current United Kingdom Institute for Conservation (UKIC 1990) and English Heritage guidelines (English Heritage 1991).

3. BACKGROUND

3.1 LOCATION, TOPOGRAPHY, GEOLOGY AND ARCHAEOLOGY

- 3.1.1 The following section was provided in the Stage 1 report (OA North 2008) and has been repeated here to provide a context for the Stage 2 results.
- 3.1.2 The site of the proposed development lies roughly 7km south-east of Clacton-on-Sea, Essex (NGR centred at TM 622200), situated on one of many sand bars, which are a prevalent feature of the marine-dominated outer estuary of the Lower Thames Valley (Bates and Whittaker 2004).
- 3.1.3 The Thames Valley is one of the most significant regions in British Pleistocene geology, and its terrace sequence, with surviving deposits of interglacial sediments, has provided the basis for a British Palaeolithic sequence of palaeoenvironmental changes in relation to climatic and sea level fluctuations. Reconstruction of the Pleistocene drainage evolution of the lower Thames (Bridgland *et al* 1995) has shown that prior to the Anglian glaciation (*c* 480,000-375,000 BP) the course of the Thames was further north, and its convergence with the River Medway was near to Clacton-on-Sea. During the Anglian period, the Thames was blocked by ice and diverted southwards near to its current position.
- 3.1.4 Although the northward alignment of the former post-diversion route of the Thames is no longer evident, its drowned extension and tributaries now lie offshore, submerged by the Holocene marine transgression. Several major climatic episodes and marine fluctuations have affected the area since the Anglian glaciation, leading to the development of a complex sequence of estuarine and fluvial deposits. The number of glacial and interglacial episodes represented in the sequence is still open to debate, and crucial to this understanding are the thick channel infills present on the coast and further offshore. Upper Pleistocene freshwater sediments have been recorded at -35m OD (Ordnance Datum) in the Channel (West 1972), and interglacial channel fills have been exposed at Cudmore Grove (NGR TM 067144; Roe 1995) and at Clacton-on-Sea (Pike and Godwin 1952; Bridgland *et al* 1999).
- 3.1.5 The deposits of clays and silts recorded at both Clacton-on-Sea and Cudmore Grove contain rich assemblages of vertebrate remains, molluscs, and ostracods (Roe 1995; Bridgland *et al* 1999). In addition, the organic clays recorded at both sites contain well-preserved pollen (Pike and Godwin 1952; Roe 1995). Both channel fills contain fauna and flora interpreted as being Hoxnian in age (dated to *c* 424,000-380,000 BP).
- 3.1.6 The Lower Thames Valley is also renowned for its important archaeological sites and associated Clactonian-type palaeolithic industry, which is fundamental to the understanding of both Britain's and Europe's earliest populations. Although few sites with *in situ* archaeological material have been discovered in the Lower Thames Valley, the importance of the buried deposits, with or without cultural material, in providing a broader

understanding of the chronological sequence of events in relation to climate change and early human occupation cannot be underestimated.

4. ARCHAEOLOGICAL CORING AND RECORDING RESULTS

4.1 INTRODUCTION

- 4.1.1 The core logs obtained from Gunfleet Sands 2, provided by Structural Soils, and the desk-based assessed in Stage 1, suggested that there might be some sediments with an organic component that would warrant further palaeoenvironmental investigation.
- 4.1.2 Much of the material from the three boreholes was known to have been used previously for geotechnical analyses by Structural Soils. Consequently, on inspection, it was found that very little remained: a few bags of disturbed sediment and of unknown volume, many only spot samples, and a few very small lengths of bagged core (< 30cm) without any indication of top or bottom. These were inspected.

4.2 CORE BHSS

- 4.2.1 Six bags of disturbed sediment and of unknown volume and one short core were examined. Only one bag (31.90m depth) of disturbed material from a spot sample had any discernible organic content. This came from sediment recorded between depths of 30.6m and 32.4m in the borehole log, as being a slightly sandy calcareous clay with occasional black peat/organic silt inclusions. There was no evidence of a land surface or peat deposit, but it could possibly represent a mudflat.

4.3 CORE BHF3

- 4.3.1 This core was originally recorded as BHFS in the Stage 1 Report. Three bags of disturbed sediment and unknown volume and one short bagged core segment were examined. No organic content was discernible in these.

4.4 CORE BHF9

- 4.4.1 Five bags of disturbed sediment and one short bagged core segment remained. There was no evidence of any organic content.

4.5 INTERPRETATION OF THE DATA

- 4.5.1 Only a small amount of material from the boreholes remained to make any possible interpretations. Only material from one borehole, BHSS, had any indication of organic material and this was only from a spot sample at a depth of 31.9m. It was not consistent with the occurrence of a land surface or peat, but may represent a mudflat.

5. CONCLUSION

5.1 DISCUSSION

- 5.1.1 The remaining sediments from the three boreholes are insufficient to provide any interpretation of the sediments and whether they have any archaeological significance or represent any land surfaces or peat beds. It is possible that a mudflat was represented in disturbed sediment from a depth of 31.9m in borehole BHSS.

5.2 RECOMMENDATIONS

- 5.2.1 No further work on the remaining sediments from the three boreholes is recommended.

6. BIBLIOGRAPHY

6.1 PRIMARY AND CARTOGRAPHIC SOURCES

Ordnance Survey, 1972, 1:25 000, Sheet TM 11/21, Pathfinder 1101

6.2 SECONDARY SOURCES

Bates, M, and Whittaker, K, 2004 Landscape evolution in the Lower Thames Valley: implications for the archaeology of earlier Holocene period. (pp 50-65) in J Cotton, and D Field (eds), *Towards a New Stone Age: aspects of the Neolithic in south-east England*. CBA Research Report **137**

Bridgland, DR, Allen, P, and Haggart, BA (eds) 1995 *The Quaternary of the Lower Reaches of the Thames, Field Guide*. Quaternary Research Association

Bridgland, DR, Field, MH, Holmes, JA, McNabb, J, Preece, RC, Selby, I, Wymer, JJ, Boreham, S, Irving, BG, Parfitt, SA, and Stuart, AJ, 1999 Middle Pleistocene interglacial Thames-Medway deposits at Clacton-on-Sea, England: Reconsideration of the biostratigraphical and environmental context of the Clactonian Palaeolithic industry. *Quaternary Science Reviews* **18**, 109-146

English Heritage, 1991 *Management of Archaeological Projects*, second edition, London

Pike, K, and Godwin, H, 1952 The Interglacial at Clacton-on-Sea. *Quarterly Journal of the Geological Society*, 108, 261-272

Roe, HM, 1995 The Cudmore Grove Channel Site (TM 067144) (pp 258-269) in DR Bridgland, P Allen, and BA Haggart (eds), *The Quaternary of the Lower Reaches of the Thames, Field Guide*. Quaternary Research Association

UKIC, 1990 *Guidelines for the Preparation of Archives for Long-Term Storage*, London

West, RG, 1972, Relative land-sea-level changes in southeastern England during the Pleistocene. *Philosophical Transactions of the Royal Society, London, A*, **272**, 87-98

6.3 INTERNET SOURCES

<http://www.gunfleetsands.co.uk/front+page.htm>

APPENDIX 1: PROJECT DESIGN

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 NIRAS, Denmark (hereafter the 'client') has requested that Oxford Archaeology North (OA North) submit proposals for an Archaeological Assessment of three bore cores from a Marine Geotechnical Survey ahead of the construction of Gunfleet Sands 2 Offshore Windfarm, Essex, being planned by DONG Energy (UK) Ltd, a subsidiary of Danish Oil and Natural Gas (DONG). The site of Gunfleet Sands 2, lies 7km south east of Clacton-on-Sea, Essex.

1.2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

1.2.1 Gunfleet Sands Ltd has received a Coast Protection Act 1949 (CPA): Section 34 for Ground Investigations at Gunfleet Sands Ltd Two Offshore Windfarm and it has been requested that "*Geotechnical works should be analysed for archaeological interests*". The Archaeological Protocol for Gunfleet Sands 1 Offshore Windfarm, which was prepared by Wessex Archaeology, recommends an archaeological assessment of the geotechnical data. The Scope of work for marine archaeology was submitted to OA North by NIRAS and will not be repeated here.

1.3 OXFORD ARCHAEOLOGY NORTH

1.3.1 The company, both as Oxford Archaeology North, and under the former guise of Lancaster University Archaeological Unit (LUAU), has considerable experience of sites of all periods, having undertaken a great number of small and large scale projects throughout Northern England during the past 25 years and latterly in Southern England. Evaluations, assessments, watching briefs and excavations have taken place within the planning process, to fulfil the requirements of clients and planning authorities, to very rigorous timetables.

1.3.2 OA North has the professional expertise and resources to undertake the project detailed below to a high level of quality and efficiency. OA North is an Institute of Field Archaeologists (IFA) registered organisation, registration number 17, and all its members of staff operate subject to the IFA Code of Conduct.

2 OBJECTIVES

2.1 The following programme has been designed following the Archaeological Protocol provided by NIRAS and will be undertaken in 4 stages.

- Stage 1: Desk-based assessment
- Stage 2: Coring and recording
- Stage 3: Sampling and assessment
- Stage 4: Analysis and dating

2.2 **Stage 1: Desk-based assessment:** Desk-based Archaeological assessment of three core logs already generated by Geotechnical contractors. This assessment will establish the likely presence of horizons of archaeological interest and broadly characterise them, as a basis for deciding if any Stage 2 recording is required. A written report detailing the results of Stage 1 will be produced.

2.3 **Stage 2: Coring and recording:** Archaeological recording of selected retained or new cores. Again, a written report will be produced, which will indicate if any Stage 3 work is warranted.

- 2.4 **Stage 3:** Sampling and assessment: To assess the palaeoenvironmental potential of the selected core(s) for further analysis. A written report will be produced giving the results of the assessment, an outline of the archaeological implications of the combined work and an indication if any Stage 4 work is warranted.
- 2.5 **Stage 4:** analysis and Dating: This stage will comprise full analysis of pollen, diatoms and/or foraminifera and it will be supported by a programme of scientific dating. An account of successive environments within the coring area, a model of environmental change over time and an outline of archaeological implications will be given.
- 2.6 **Report and archive:** a written report will be produced at each stage to assess the significance of the data generated by the programme within a local and regional context. It will present the results of the assessments from each stage.

3 METHOD STATEMENT

3.1 ARCHAEOLOGICAL ASSESSMENT

- 3.1.1 **Stage 1:** desk-based assessment. The three core logs generated by the geotechnical contractors will be assessed to establish whether there are horizons of archaeological interest for example buried land surfaces. These will be broadly characterised. This data will be the basis as to whether it is necessary to proceed to Stage 2 of the archaeological recording. The results of this exercise will be summarised in a written report.
- 3.1.2 **Stage 2:** coring and recording. Selected cores, either those from the initial geotechnical work or new ones will be split, and half the core will be cleaned and recorded on *pro-forma* sheets following the English Heritage guidelines for Geoarchaeology (English Heritage 2004). The data will be used to produce lithology diagrams and a written report, which will include the methodology, results, interpretation, and potential of the cores for further analysis with appropriate diagrams and maps.
- 3.1.3 **Stage 3:** sampling and assessment. One half of the selected core(s) will be subsampled and samples taken for environmental assessment (pollen, diatoms and/or foraminifers) and scientific dating. The subsamples will be assessed in the laboratory for pollen, diatoms and/or foraminifera either by the OA North in house specialist (pollen) or sent to the appropriate specialists.
- 3.1.4 **Pollen:** The pollen in the sediment will be assessed to help understand the nature and processes of accumulation of the waterlogged deposits and also the local environment. The pollen assessment method to be used is in the following paragraph.
- 3.1.5 Sub-samples, 10-20ml in volume, will prepared for pollen analysis using a standard chemical procedure (method B of Berglund & Ralska – Jasiewiczowa (1986), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles > 170 microns, silicates, and cellulose, respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000 cs silicone oil. Slides will be examined at a magnification of 400x (1000x for critical examination) by equally-spaced traverses across at least two slides to reduce the possible effects of differential dispersal on the slide (Brooks & Thomas, 1967). For the assessment a pollen count for each sample of at least 100 land pollen and spores will be reached. *Lycopodium* tablets (Stockmarr, 1971) will be added to a known volume of sediment at the beginning of the preparation so that pollen concentrations could be calculated. Pollen identification will be made using the keys of Moore *et al.* (1991), Faegri & Iversen (1989), and a small modern pollen reference collection. Andersen (1979) will be followed for identification of cereal-type grains. Indeterminable grains will also be recorded as an indication of the state of the pollen preservation. Plant nomenclature will follow Stace, 1997.
- 3.1.6 The data will be presented in tables as either percentage values or actual numbers of pollen grains and spores. The interpretation of the data may help in our understanding of the nature in which the waterlogged deposits accumulated and also of the local environment.

- 3.1.7 **Diatoms:** The sediments will be assessed for the presence and absence of diatoms. If present the diatoms will be identified and quantified. Small sub-samples of the sediment samples will be submitted to the relevant specialists (Drs Philip Barker and Lydia King), who will prepare 10ml samples following the standard hydrogen peroxide and hydrochloric acid procedure (Batterbee 1986).
- 3.1.8 Diatoms are freshwater or marine algae with a silica frustule or chamber, which is resistant to decay. They are habitat specific and are therefore a good indicators of such characteristics as salinity and water quality (English Heritage, 2002).
- 3.1.9 **Foraminifera:** The samples will be assessed in the first instance for the presence or absence of foraminifera by Dr John Whittaker of the Natural History Museum. Subsamples will be prepared as follows. They will be placed in a ceramic bowl and dried in an oven at a low temperature, then a teaspoon of sodium bicarbonate will be added (to assist clay breakdown), hot water will poured on and the samples left to soak overnight. Each will then washed through a 75 micron sieve with hot water, the residue being decanted back into the bowl and left, again, to dry in the oven. The dried samples were then put into labelled plastic bags.
- 3.1.10 Sorting will be carried out under a binocular microscope, the sample being first dried sieved through a nest of sieves (>500 microns, >250 microns, >150microns, and pan), and then a portion of each sieve-size, one at a time, being sprinkled onto a grid-lined picking-tray. Microfossils will be picked out with a small brush onto a 3x1" faunal slide for reference purposes. At this assessment stage recording was merely on a presence/absence basis. Other organic matter of interest (plant debris, seeds, insects, ostracods and diatoms) will also noted.
- 3.1.11 The data from the pollen, diatom and foraminifera assessment will be presented in a written report with an outline of the archaeological implications. Proposals will be made for further analysis if warranted and the methodology for this analysis will also be included.
- 3.1.12 **Stage 4:** analysis and dating. If the environmental assessment demonstrates the potential for further research of the pollen, and/or diatom and foraminifera, a programme of full analysis from all or part of the borehole sequence will be undertaken. The details of the methodology will be outlined in the Stage 3 report. This programme of analysis will supported by a programme of scientific dating and the advice of the English Heritage dating team will be sort because of the possible influence of old carbon in marine sediment. It may be necessary to consider using some other dating techniques instead of radiocarbon.

3.2 REPORT AND ARCHIVE

- 3.2.1 **Report:** one bound and one unbound copy of the final report will be submitted to the client within three weeks of the completion of stages 1-3 of the project. Three copies of the final report will be submitted to the client on completion of the project. The report will include:
- a site location plan related to the national grid;
 - a front cover to include the planning application number and the NGR;
 - the dates on which each phase of the programme of work was undertaken;
 - a concise, non-technical summary of the results;
 - an explanation to any agreed variations to the brief, including any justification for any analyses not undertaken;
 - a description of the methodology employed, work undertaken and results obtained;
 - a description of the sediments in the borehole selected for all stages of the project;
 - a list of scientific dates;

- a description of any environmental or other specialist work undertaken and the results obtained;
 - a summary of the impact of the development on any archaeological remains and, where possible, a model of potential archaeological deposits within as-yet unexplored areas of the development site;
 - a copy of this project design, and indications of any agreed departure from that design;
 - the report will also include a complete bibliography of sources from which data has been derived.
- 3.2.2 This report will be in the same basic format as this project design; a copy of the report can be provided on CD, if required. Recommendations concerning any subsequent mitigation strategies and/or further archaeological work following the results of the field evaluation will be provided in a separate communication.
- 3.2.3 **Confidentiality:** all internal reports to the client are designed as documents for the specific use of the client, for the particular purpose as defined in the project brief and project design, and should be treated as such. They are not suitable for publication as academic documents or otherwise without amendment or revision.
- 3.2.4 **Archive:** the results of all archaeological work carried out will form the basis for a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of Archaeological Projects*, 2nd edition, 1991, English Heritage Guidelines for Geoarchaeology, 2004 and The English heritage Guidelines for Environmental Archaeology, 2002). The project archive will include summary processing and analysis of all features, finds, or palaeoenvironmental data recovered during fieldwork, which will be catalogued by context.
- 3.2.5 The deposition of a properly ordered and indexed project archive in an appropriate repository is essential and archive will be provided in the English Heritage Centre for Archaeology format and a synthesis will be submitted to the Lancashire HER (the index to the archive and a copy of the report). OA North practice is to deposit the original record archive of projects with the appropriate Record Office.
- 3.2.6 All artefacts will be processed to MAP2 standards and will be assessed by our in-house finds specialists. The deposition and disposal of any artefacts recovered in the evaluation will be agreed with the legal owner and an appropriate recipient museum. Discussion regarding the museum's requirement for the transfer and storage of finds will be conducted prior to the commencement of the project, and Lancashire HER will be notified of the arrangements made.
4. HEALTH AND SAFETY
- 4.1 OA North provides a Health and Safety Statement for all projects and maintains a Unit Safety policy. All site procedures are in accordance with the guidance set out in the Health and Safety Manual compiled by the Standing Conference of Archaeological Unit Managers (1997). A written risk assessment will be undertaken in advance of project commencement and copies will be made available on request to all interested parties.
- 4.2 Full regard will, of course, be given to all constraints (services etc) during the fieldwork as well as to all Health and Safety considerations.
5. PROJECT MONITORING
- 5.1 Whilst the work is undertaken for the client, Essex HER will be kept fully informed of the work and its results, and will be notified a week in advance of the commencement of the

fieldwork. Any proposed changes to the project design will be agreed with Essex HER in consultation with the client.

6 STAFFING

6.1 The project will be under the direct management of an OA North Project Manager.

6.2 All environmental sampling and assessment will be undertaken under the auspices of **Elizabeth Huckerby** (OA North Environmental Manager) who has unparalleled experience of palaeoenvironmental work in the North West and who heads a team of environmental archaeologists. **Denise Druce**, who has considerable experience of working in the North West and also on the Severn estuary, will describe the sediments and assess their geoarchaeological potential. **Lucy Verrill and Sylvia Peglar**, who are both experienced as pollen analysts, may also assist with the project. **Sylvia** has previously analysed samples for pollen from East Anglia and has experience of marine cores taken in advance of the construction of the channel tunnel.

6.3 All diatom work will be undertaken under the supervision of Dr Philip Barker and Dr Lydia King of the Geography Department of the University of Lancaster.

6.4 Dr John Whittaker of the Natural History Museum, London, will examine the foraminifera

7 INSURANCE

7.1 OA North has a professional indemnity cover to a value of £2,000,000; proof of which can be supplied as required.

8 REFERENCES

Andersen, S Th, (1979), Identification of wild grasses and cereal pollen. *Danm Geol Unders*, **1978**

Battarbee, R W, 1986, Diatom analysis in BE Berglund (ed), *Handbook of Holocene Palaeoecology and Palaeohydrology*, Chichester

B E and Ralska-Jasiewiczowa, M, (1986) Pollen analysis and pollen diagrams, in Berglund, B E (ed) *Handbook of Holocene Palaeoecology and Palaeohydrology*, Chichester

Brooks, D & Thomas, K W (1967) The distribution of pollen grains on microscope slides. The non randomness of the distribution, *Pollen Spores*, **9**, 621-629.

English Heritage, 1991 *Management of Archaeological Projects*, 2nd edition, London

English Heritage, 2002, *Environmental Archaeology*, London

English Heritage, 2004, *Geoarchaeology; Using earth sciences to understand the archaeological record*, London

Faegri, K and Iversen, J (1989) *Textbook of modern pollen analysis* 4th ed, Chichester

Grimm, E C, (1991) TiliaGraph 2.0.b.5. Illinois State Museum, Research and Collections Center, Springfield, Illinois.

Moore, P D, Webb, J A and Collinson, M E, (1991) *Pollen analysis*, Oxford

SCAUM (Standing Conference of Archaeological Unit Managers), 1997 *Health and Safety Manual*, Poole

Stace, C (1997) *New Flora of the British Isles* Cambridge

Stockmarr, J (1972) Tablets with spores used in absolute pollen analysis. *Pollen et Spores* **13**, 615-621.

UKIC, 1990 *Guidelines for the Preparation of Archives for Long-Term Storage*, London

UKIC, 1998 *First Aid for Finds*, London