



Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Geoarchaeological Method Statement

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Prepared by:	
Royal HaskoningDHV	
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Table of Contents

1	Background	6
2	Marine Geotechnical Surveys	6
2.1	Geotechnical Vibrocore Survey 2021.....	6
2.2	Geotechnical Borehole Survey 2022.....	7
2.3	Geotechnical Vibrocore Survey 2023.....	8
2.4	Selection of archaeological vibrocore locations	8
3	Approach to Further Geoarchaeological Assessment	9
4	Potential Impacts and Mitigation	10
	References	12

Table of Tables

Table 1	Archaeological vibrocore requirements	9
Table 2	Wessex Archaeology’s staged approach to geoarchaeological investigations	10

Glossary of Acronyms

AEZ	Archaeological Exclusion Zones
BH	Borehole
DCO	Development Consent Order
DEL	Dudgeon Extension Limited
DEP	Dudgeon Offshore Wind Farm Extension Project
DOW	Dudgeon Offshore Wind Farm
EIA	Environmental Impact Assessment
ES	Environmental Statement
ETG	Expert Topic Group
GIS	Geographic Information System
NGI	Norwegian Geotechnical Institute
NSIP	Nationally Significant Infrastructure Project
OASIS	Online Access to the Index of archaeological investigations
OS	Ordnance Survey
OSS	Offshore Sub-stations
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
OWF	Offshore Wind Farm
OWSI	Outline Written Scheme of Investigation
RHDHV	Royal HaskoningDHV
SEL	Scira Extension Limited
SEP	Sheringham Offshore Wind Farm Extension Project
SNC	South Norfolk Council
SNS	Southern North Sea
SOW	Sheringham Shoal Offshore Wind Farm
UK	United Kingdom

Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP offshore site	The Dudgeon Offshore Wind Farm Extension consisting of the DEP wind farm site, interlink cable corridors and offshore export cable corridor (up to mean high water springs).
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP offshore site	Sheringham Shoal Offshore Wind Farm Extension consisting of the SEP wind farm site and offshore export cable corridor (up to mean high water springs).
SEP wind farm site	The offshore area of SEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area.
The Applicant	Equinor New Energy Limited. As the owners of SEP and DEP, Scira Extension Limited and Dudgeon Extension Limited are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.

1 Background

1. This document has been prepared as an addendum to the **Outline Written Scheme of Investigation (Offshore) (OWSI)** [APP-298] to set out the approach to integrating archaeological objectives within planned geotechnical surveys undertaken to support SEP and DEP, building on the baseline geoarchaeological assessment undertaken to support Environmental Statement (ES) **Chapter 14 Offshore Archaeology and Cultural Heritage** [APP-100].
2. This Method Statement is informed by:
 - Outline Written Scheme of Investigation (Offshore) [APP-298];
 - ES **Chapter 14 Offshore Archaeology and Cultural Heritage** [APP-100];
 - ES **Appendix 14.3 – Stage 1 Geoarchaeological Assessment of Geotechnical Data** [APP-201]’
 - ES **Appendix 14.1 – Archaeological Assessment of Geophysical Data** [APP-199].
 - ES **Appendix 14.2 Archaeological Assessment of Geophysical Data - Addendum** [APP-200].
3. This method statement, therefore, sets out the confirmed scope of offshore geotechnical surveys undertaken in 2022 and an upcoming survey planned to take place in May 2023, and the proposed approach to geoarchaeological assessment.

2 Marine Geotechnical Surveys

2.1 Geotechnical Vibrocore Survey 2021

4. A geotechnical vibrocore survey was undertaken in 2021 and the data was provided to Royal HaskoningDHV (RHDHV) (the Retained Archaeologist) and Wessex Archaeology (the geoarchaeological contractor) to undertake a Stage 1 Geoarchaeological Assessment provided within **Appendix 14.3 – Stage 1 Geoarchaeological Assessment of Geotechnical Data** [APP-201], the results of which are summarised below.
5. A total of 51 geotechnical vibrocore logs were reviewed to identify deposits with geoarchaeological potential, assigning high, medium and low status accordingly. Identified deposits of archaeological interest include tidally influenced and fluvial minerogenic alluvium, which were assigned medium potential status due to their potential to preserve inorganic palaeoenvironmental remains and record a transition from a sub-aerially exposed southern North Sea to increasing marine conditions under the influence of rising sea levels. Organic clay and peats were also identified and assigned high potential status due to their potential to preserve palaeoenvironmental remains and dating material that could provide a landscape context to human activity.
6. It was recommended that samples containing alluvium, peat and organic clay be recorded by a geoarchaeologist to determine their suitability for further palaeoenvironmental assessment to improve current understanding of age, environment and vegetation history. Representative samples of these deposits were

selected for retention in consultation with the geoarchaeology contractor and shipped to Wessex Archaeology where they have been retained for future assessment and analysis.

2.2 Geotechnical Borehole Survey 2022

7. A geotechnical borehole survey was undertaken between September and November 2022 within the SEP and DEP wind farm sites to characterise ground conditions to inform the design of wind turbine foundations. A total of 56 boreholes were acquired across 28 locations. Target depth was 60m below seafloor, but some boreholes were terminated at shallower depths due to operational constraints.
8. An intermittent coring/sampling strategy was adopted to ensure sufficient and representative sample coverage from all geological units. This methodology does not provide a full continuous record of the deposits. However, the downhole strategy was planned to ensure gaps between samples were typically <0.5m and no more than 0.75m ensuring a near complete record was sampled.
9. Sampling was performed as piston coring or rotary coring using barrels 2.75m in length. Samples were extruded offshore for description (including photographs) and preliminary testing. If the sample was uncohesive (e.g. sand or gravel), due to its nature it became disturbed during extrusion and was therefore stored in a bag. If a sample was cohesive, and relatively undisturbed, it was sealed offshore as either a tube or wax sample. Upon completion of the survey, all samples were transported to the onshore testing laboratory at the Norwegian Geotechnical Institute (NGI).
10. As part of the pre-commencement geotechnical survey planning, all borehole locations and the coring/sampling strategy were shared by the Applicant with RHDHV (the Retained Archaeologist) and Wessex Archaeology (the geoarchaeological contractor).
11. The planned locations were mapped against the locations of known heritage assets and geophysical anomalies of potential archaeological interest using GIS. Through this exercise it was confirmed that none of the planned borehole locations were located within Archaeological Exclusion Zones (AEZs) recommended for SEP and DEP, nor in the vicinity of previously identified seabed geophysical anomalies of possible archaeological interest.
12. The planned locations were also mapped against the locations of previously identified palaeogeographic features and deposits with the potential to contain prehistoric archaeology and palaeoenvironmental remains. Many of the proposed borehole locations intercepted palaeogeographic features of interest providing an opportunity to ground truth these features without the need for relocating existing boreholes or acquiring new boreholes. The results from this geotechnical survey provided preliminary information on the stratigraphy and geoarchaeological significance of the deposits to inform geoarchaeological requirements in future geotechnical surveys, as summarised below.
13. It is recommended a Stage 1 geoarchaeological assessment of these data is undertaken and provisions made to secure any samples of archaeological interest for future analysis.

2.3 Geotechnical Vibrocore Survey 2023

14. The primary objective of the 2023 geotechnical site investigation is to provide good quality geotechnical data to facilitate the detailed design and routing of the inter-array/interlink cables, and to inform the further development and calibration of the existing ground model.
15. Offshore geotechnical site investigation will be undertaken by GEO in May 2023, and comprise:
 - Up to 47 shallow cone penetration tests (CPTs) and vibrocores to 6m depth
16. The locations for all planned vibrocores were provided by the Applicant to RHDHV (the Retained Archaeologist) for review.
17. The planned locations were mapped against the locations of known heritage assets and geophysical anomalies of potential archaeological interest using GIS. Through this exercise it has been confirmed that none of the planned locations are within AEZs recommended for SEP and DEP, nor in the vicinity of previously identified geophysical anomalies of possible archaeological interest.
18. Preliminary logs from the 2022 geotechnical borehole survey were reviewed to provide an outline stratigraphy/deposit model for SEP and DEP (see [Section 2.2](#)) which was used to ground truth previously identified palaeogeographic features and inform understanding of archaeological potential. After reviewing the planned locations of vibrocores against the palaeogeographic features, recommendations were made to acquire additional vibrocores for geoarchaeological purposes as detailed in [Section 2.4](#)).

2.4 Selection of archaeological vibrocore locations

19. Upon review of the 2022 geotechnical borehole data, peat was recorded in five boreholes (EQ22454-BH_DSE_01, EQ22454-BH_DSE_04, EQ22454-BH_SS_04, EQ22454-BH_SS_06, EQ22454-BH_SS_12). Intact samples were available from three boreholes (EQ22454-BH_SS_04, EQ22454-BH_SS_12, EQ22454-BH_SS_06) but due to the intermittent nature of coring, continuous recovery across the entire sequence was not achieved.
20. To secure continuous, undisturbed samples for palaeoenvironmental analysis from known peat sequences, provisions have been made to acquire 6m vibrocores during the 2023 geotechnical vibrocore survey. Given the maximum target depth of vibrocores (6m), the sequences in EQ22454-BH_SS_06 and EQ22454-BH_SS_12 were not targeted as they were located at depths greater than the maximum penetration depth of the vibrocore (6m). Peat in EQ22454-BH_DSE_04 was located at shallow depth (<0.4m), and while it is possible to sample this deposit with the vibrocorer, there is high potential the deposit would be reworked given its proximity to the modern seabed. Furthermore, any sequence recovered would be relatively thin when compared with sequences in other boreholes. Therefore, this sequence has not been targeted.
21. The peat in EQ22454-BH_DSE_01 and EQ22454-BH_SS_04 were present at depths <6m, providing an opportunity to acquire continuous sequences of these deposits and associated over/underlying alluvium. Recommendations were made

to acquire two vibrocores to a target depth of 6m at each of these locations as outlined in **Table 3-3**.

- 22. A review of geotechnical sampling locations against paleogeographic features identified through archaeological analysis of geophysical data [APP-200; APP-201] was undertaken to ensure a representative coverage of features would be ground truthed. A series of channel features were mapped across the wind farm sites and export cable corridor and many of these have already been sampled by boreholes or vibrocores from previous geotechnical surveys.

One feature within the export cable corridor connecting the SEP and DEP wind farm sites correlates to the Southern River, which is palaeochannel system that preserves known prehistoric archaeology (Missien et al. 2021). A review of 2021 geotechnical vibrocores located within this channel feature indicates laminated silt and clay with occasional organic partings and frequent shell fragments is preserved. The deposits have been interpreted as alluvium and record the transition from a fluvial to estuarine environment during post-glacial sea-level rise. Vibrocore samples have been retained from three locations within and adjacent to the Southern River palaeochannel and are stored at Wessex Archaeology for potential further palaeoenvironmental assessment.

Table 1 Archaeological vibrocore requirements

ID	x	y	Justification	Priority
DSE_01_Arch	399125	5896310	Sample peat between 4-5 m identified in 2022 borehole but no intact samples recovered	High
SS_04_Arch	370352	5895745.5	Sample peat at 4.75-5.70 m identified in 2022 borehole.	Medium

3 Approach to Further Geoarchaeological Assessment

- 23. All preliminary core logs will be provided by the Applicant, or their geotechnical contractor (GEO), to RHDHV and their preferred geoarchaeological contractor so that all logs can be reviewed and integrated with the results of the existing, pre-consent geoarchaeological and palaeogeographic assessments. If cores are identified as having potential for further geoarchaeological assessment and analysis, guided by specific research questions, then the Applicant will ensure that cores/samples are retained and made available for further Stage 2 recording as advised by the geoarchaeological contractor.
- 24. Based on preliminary geoarchaeological and geophysical assessments, the archaeological potential across SEP and DEP is high and it is anticipated any future geoarchaeological work will encompass all five stages of the assessment process, culminating at Stage 5 (see **Table 3-1** for summary of staged process). This will comprise the publication of the results of the pre-consent Stage 1-4 works, integrated with the results of any subsequent post-consent geoarchaeological assessment of geotechnical surveys, for submission in a peer reviewed journal, book or monograph, depending on the archaeological significance of the work. The scope and location of the final publication will be agreed in consultation with the Applicant and Historic England, as advised by Wessex Archaeology.

25. In accordance with Section 1.8.2 (Data Management) of the **OWSI** [APP-298], the Applicant has committed to submitting a Historic England OASIS (Online Access to the Index of archaeological investigations’) form with a digital copy of the report following completion of construction of the authorised scheme.

Table 2 Wessex Archaeology’s staged approach to geoarchaeological investigations

Stage	Description
Stage 1: Geoarchaeological Review	Desk-based review of geotechnical and geological data. Establish likely presence/ absence/ distribution of archaeologically relevant deposits. Identify deposits or samples for Stage 2 works.
Stage 2: Geoarchaeological Recording	Target deposits or samples identified in Stage 1. Describe the sequences recovered and undertake deposit modelling (if suitable). Interpret depositional environment (if possible). Identify if suitable deposits are present for Stage 3 works.
Stage 3: Palaeoenvironmental Assessment	Sub-sample deposits of archaeological interest for palaeoenvironmental assessment (e.g. pollen, plant macrofossils, foraminifera, ostracod and diatoms) and associated scientific dating. Provide an outline interpretation of the archaeological and palaeoenvironmental context. Any recommendations for Stage 4 works will depend on the potential for further analysis and the project research objectives.
Stage 4 Palaeoenvironmental Analysis	Full analysis of samples and additional scientific dating as specified in Stage 3, together with a detailed synthesis of the results, in their local, regional or wider archaeological and palaeoenvironmental context. Publication would usually follow from a Stage 4 report.
Stage 5: Publication	Publication of the results of Stage 1-4 works for submission in a peer reviewed journal, book or monograph, depending on the archaeological significance of the work. The scope and location of the final publication will be agreed in consultation with the client and regulatory bodies where appropriate.

4 Potential Impacts and Mitigation

26. Following review of the planned geotechnical locations, it has been confirmed that the proposed locations do not coincide with any previously identified geophysical anomalies of archaeological potential nor AEZs. As such, direct impacts to known heritage assets will not occur.
27. The primary mitigation for potential impacts to previously unknown archaeological sites which may be encountered during the works is adherence to the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) (The Crown Estate, 2014). This will establish whether the objects are of archaeological interest and recommend appropriate mitigation measures where necessary.
28. The Applicant will be responsible for ensuring that all staff and contractors are aware of their responsibilities under the protocol. Contractors will be informed by the Applicant of their responsibilities to support the delivery of archaeological objectives (as set out within the note) as part of project toolbox talks held at mobilisation.
29. Provision will be made by the Applicant, in accordance with ORPAD, for the prompt reporting/recording to Historic England of archaeological remains encountered or

suspected during works. If the find is a wreck within the meaning of the Merchant Shipping Act (1996) then a report will also be made to the Receiver of Wreck. If the find is treasure within the meaning of the Treasure Act (1996) then a report will also be made to the Coroner.

30. Following completion of the survey phase, a report will be prepared presenting the results of the ORPAD implementation during activities. In the event that no discoveries are made, a nil discoveries report will be compiled in order to demonstrate adherence to the scheme.

References

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