East Anglia ONE North Offshore Windfarm

Chapter 16

Marine Archaeology and Cultural Heritage

Preliminary Environmental Information
Volume 1
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Chapter 16 Marine Archaeology and Cultural Heritage appendices are presented in **Volume 3: Appendices** and listed in the table below.

Appendix number	Title
16.1	East Anglia ONE North Offshore Windfarm Archaeological assessment of geophysical data
16.2	East Anglia ONE North and East Anglia TWO Offshore Windfarm Export Cable Route Archaeological assessment of geophysical data

Glossary of Acronyms

AEZ	Archaeological Exclusion Zones
BP	Before Present
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DML	Deemed Marine Licence
EPP	Evidence Plan Process
ETG	Expert Topic Group
GIS	Geographical Information Systems
HDD	Horizontal Directional Drilling
HSC	Historic Seascape Characterisation
MBES	Multibeam Echosounder
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MIS	Marine Isotope Stage
MMO	Marine Management Organisation
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NRHE	National Record of the Historic Environment
NSIPs	Nationally Significant Infrastructure Project
nT	nanoTesla
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
PEIR	Preliminary Environmental Information Report
RCZA	Rapid Coastal Zone Assessment
ROV	Remote Operated Vehicle
SBP	Sub-bottom profiler data
SSS	Side-scan sonar
UKHO	United Kingdom Hydrographic Office
WSI	Written Scheme of Investigation
ZEA	Zonal Environmental Appraisal

Glossary of Terminology

Applicant	East Anglia ONE North Limited
Construction operation and maintenance platform	A fixed offshore structure required for construction, operation, and maintenance personnel and activities
East Anglia ONE North project	The proposed project consisting of up to 60 wind turbines, up to four offshore electrical platforms, up to one offshore operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and the information required to support HRA.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Inter-array cables	Offshore cables which link the wind turbines to each other and the offshore electrical platforms, these cables will include fibre optic cables.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land, and connect to the onshore cables.
Natura 2000 site	A site forming part of the network of sites made up of Special Areas of Conservation and Special Protection Areas designated respectively under the Habitats Directive and Birds Directive.
Offshore cable corridor	This is the area which will contain the offshore export cable between offshore electrical platforms and landfall jointing bay.
Offshore development area	The East Anglia ONE North windfarm site and offshore cable corridor (up to Mean High Water Springs).
Offshore electrical platform	A fixed structure located within the windfarm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which would bring electricity from the offshore electrical platforms to the landfall, these cables will include fibre optic cables.
Offshore platform	A collective term for the offshore construction, operation and maintenance platform and the offshore electrical platforms.
Platform link cable	Electrical cable which links one or more offshore platforms, these cables will include fibre optic cables.
Safety zones	A marine area declared for the purposes of safety around a renewable energy installation or works / construction area under the Energy Act 2004.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water

16Marine Archaeology and Cultural Heritage

16.1 Introduction

1. This chapter of the Preliminary Environmental Information report (PEIR) summarises the existing baseline conditions for the marine archaeological and cultural heritage environment (the historic environment) within the offshore development area (including the landfall below Mean High Water Springs (MHWS)) of the proposed East Anglia ONE North project. It also assesses the potential impacts to offshore and intertidal archaeological receptors from the project and describes the embedded and additional mitigation proposed to prevent significant impact. This PEIR chapter has been prepared in line with a Method Statement previously produced for marine archaeology and cultural heritage and consulted on with Historic England[1].

2. Baseline conditions as set out in this PEIR chapter provide an account of the known archaeological and cultural heritage resource (including designated and non-designated heritage assets), a summary of the potential for currently unrecorded heritage assets and finds to exist within the offshore development area and a review of the Historic Seascape Character (HSC). The known and potential offshore and intertidal archaeological resource is identified with respect to:

   - Seabed prehistory (i.e. archaeological remains on the sea bed corresponding to the activities of prehistoric populations that may have inhabited what is now the sea bed when sea levels were lower);
   - Maritime archaeology (i.e. the remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities);
   - Aviation archaeology (i.e. the remains of crashed aircraft and archaeological material associated with historic aviation activities);
   - HSC (i.e. the attributes that contribute to the formation of the historic character of the seascape); and
   - Buried archaeology (including palaeoenvironmental deposits) within the intertidal zone below MHWS.

3. Baseline conditions within the East Anglia ONE North windfarm site and the offshore cable corridor have been established primarily through a review of

[1] The East Anglia ONE North Offshore Archaeology Assessment Method Statement was issued to Historic England on the 28/02/2017. A finalised version of the Method Statement is provided in Appendix 2.6 of the East Anglia ONE North Offshore Windfarm Scoping Report (SPR, 2017).

geophysical and geotechnical data undertaken by Wessex Archaeology. The technical reports authored by Wessex Archaeology which present the results of this work are provided in ***Appendix 16.1*** (East Anglia ONE North windfarm site) and ***Appendix 16.2*** (the offshore cable corridor). The assessment also draws upon the existing work undertaken for the Zonal Environmental Appraisal (ZEA) (East Anglia Offshore Wind, 2012a) and for East Anglia ONE and East Anglia THREE, including Desk Based Assessment (DBA) and the archaeological assessment of geophysical and geotechnical data (East Anglia Offshore Wind (2012b); East Anglia THREE Limited (2015)), supplemented by additional data sources (see ***section 16.4.2***).

4. This chapter has been prepared by Royal HaskoningDHV in consultation with Historic England (***section 16.2***) and in accordance with legislation, policy and industry standards and guidance documents relevant to the marine archaeological and cultural heritage (historic) environment (***section 16.4***), with specific reference to the relevant National Policy Statements (NPSs), the National Planning Policy Framework (NPPF) and the Marine Policy Statement.

5. Onshore archaeology and cultural heritage within the East Anglia ONE North indicative onshore development area, above Mean High Water Springs (MHWS) is assessed in ***Chapter 24 Archaeology and Cultural Heritage***. Although reported on separately, correlation between the assessment methodology utilised in the onshore and offshore and intertidal archaeological and cultural heritage chapters has been ensured, where relevant, in order to produce an integrated and coherent account of the historic environment and the degree to which the project may interact with the archaeological and cultural heritage resource as a whole.

16.2 Consultation

6. Consultation is a key driver of the Environmental Impact Assessment (EIA) process, and continues throughout the lifecycle of a project, from its initial stages through to consent and post-consent. Consultation specific to offshore archaeology and cultural heritage which has informed the preparation of this PEIR is detailed in

7. ***Table*** 16.1 and includes:

- Historic England's response (18th January 2017) to a letter (20th December 2016) outlining the planned approach to geophysical survey for the project;
- Historic England's response (10th March 2017) to the East Anglia ONE North and East Anglia TWO Offshore Archaeology Assessment Method Statement (28th February 2017);
- An update meeting with Historic England on 3rd May 2017 held at SPR's offices in Tudor Street, London; and

- The Planning Inspectorate Scoping Opinion to the East Anglia ONE North Scoping Report (10th December 2017) (SPR 2017).

8. Feedback received through this process has been considered in preparing incorporated into the PEIR where appropriate and this chapter will be updated following the next stage of consultation for the final assessment submitted with the Development Consent Order (DCO) application.

Table 16.1: Consultation Responses

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
Historic England	18/01/2017 East Anglia – SPR Future Projects: Geophysical Survey Strategy	Archaeological Assessment of Geophysical and Geotechnical Data used to support the East Anglia ONE windfarm application details that side scan sonar and sub-bottom profiling data was only considered to be of generally average quality, with some data "often affected by weather to a certain degree, increasing the difficulty of interpretation of some areas." (para. 28). This therefore suggests that existing datasets should only be used where it is adequate and appropriate to do so, and that this geophysical strategy should consider where existing survey data needs to be supplemented by the acquisition of new survey data.	This PEI chapter draws upon the archaeological assessment of existing geophysical survey data as well as the acquisition of new survey data as outlined in ***section 16.4.2.***
Historic England	18/01/2017 East Anglia – SPR Future Projects: Geophysical Survey Strategy	We note from section titled 'Offshore Archaeology Assessment to inform EIA' that "All areas of East Anglia ONE North and TWO which have not previously been surveyed, will be included within the 2017 geophysical survey (swath-bathymetric and side scan sonar)." In light of this statement we would suggest that you consider (with reference to your other windfarm projects), what necessary coverage and specification is required for magnetometer and sub-bottom profiling data acquisition in these areas to support an adequate assessment of impacts to the historic environment from the construction, operation and decommissioning from this proposed project.	No new magnetometer or sub-bottom profiler data have been acquired within the East Anglia ONE North windfarm site. This will be addressed as a requirement of consent secured through the DCO. An outline Written Scheme of Investigation (WSI) detailing the requirements for post-consent survey and archaeological assessment will be

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
			submitted with the DCO application.
Historic England	18/01/2017 East Anglia – SPR Future Projects: Geophysical Survey Strategy	We also recommend that you provide us with some further detail as to the specifications for all these surveys with regard to coverage (overlap) percentage and resolution, and the explanation for doing so.	Additional detail was provided through the Offshore Archaeology Assessment Method Statement (Appendix 2.6 of the East Anglia ONE North Offshore Windfarm Scoping Report, SPR 2017).
Historic England	18/01/2017 East Anglia – SPR Future Projects: Geophysical Survey Strategy	…we would like to have it clarified what measures will be taken to provide adequate and consistent levels of information for the Palaeogeographic assessment and deposit modelling, to address risks from the proposed project, without acquiring sub-bottom profiling data or geotechnical data the proposed project runs a great risk of not satisfying core principles of the EIA and consenting process as set out in section 5.8 of the Overarching National Policy Statement for Energy (EN-1) Planning (July 2011) document.	Additional detail was provided through the Offshore Archaeology Assessment Method Statement (ScottishPower Renewables 2017)
Historic England	10/03/2017 EA ONE North and TWO Offshore Archaeology Assessment Method Statement	HE recommended that further specific technical archaeological expertise is sought and review the guidance document Gribble, J. and Leather, S. for EMU Ltd. Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector, COWRIE Ltd, in consideration of the level of information held and whether it is adequate to support a palaeographic impact assessment included within the planned Environmental Statement.	An assessment of the paleogeography of the study area, and the potential for sea bed prehistory based upon existing data is presented in ***section 16.5.1.*** Further geotechnical data will be acquired post-consent and the approach to geoarchaeological assessment will be set out in the Outline WSI to be submitted as part of the DCO application.

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
Historic England	08/12/2017 Scoping Response	All aspects of the historic environment are valued, however the particular remit of Historic England in relation to this project would be the impact upon the intertidal and fully marine historic environments and the terrestrial historic environment in regard to the highly graded designated heritage assets (scheduled monuments, grade I and II* listed buildings and registered park and gardens and Conservation Areas). Above the Mean High Water mark, the undesignated terrestrial archaeology would more properly be the province of the Suffolk County Council's Archaeological Service (SCCAS). We recommend the applicant consult with them at the earliest opportunity. Similarly, the conservation and landscape officers in the local planning authorities and the county council would need to be consulted regarding impacts upon the setting of listed building and parks and gardens, including those listed at grade II, as well as conservation areas and other undesignated heritage assets within their remit. We are also aware of the landscape designation that makes this area an AONB.	Details of consultation with the SCAAS and further consultation with regard to settings assessment is included in the onshore archaeology chapter (***Chapter 24 Archaeology and Cultural Heritage***).
Historic England	08/12/2017 Scoping Response	Interestingly we note the proposed assessment of impacts (as detailed within table 1.8) against beneficial outcomes. As such (although it is not directly referenced) this would appear to accord the National Policy Statement EN-3 for Renewable Energy Infrastructure (2011) and we request that this matrix is more broadly considered in regard to the known and potential heritage assets situated within the proposed area of development, and the forthcoming schemes of investigation.	The approach to assessing beneficial effects is described in ***section 28.***
Historic England	08/12/2017 Scoping Response	We note that the Scoping Report gives a number of options suggested for the wind turbine foundations, the platform foundations and the met mast and that a	A worst case scenario approach to impact assessment has been

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
		combination of the suggested options may be used depending on the site conditions. The impact that each option will have on any near surface or buried archaeological remains/deposits needs to be considered. The same comments also apply to the installation methods for the different foundation types, cable installation methods, scour protection, cable protection, and cable crossings.	taken as described in ***section 16.3.2.***
Historic England	08/12/2017 Scoping Response	We note that the Scoping Report indicates a number of landfall installation methods which may be used. The impact that each of these options would have on the historic environment would also need to be determined in order to mitigate any damage. We are aware from previous schemes that there is the potential for the bentonite slurry used in the HDD process to breakout and spread into and coat archaeological deposits, features and materials under which the drill would pass. Information would therefore need to be provided regarding the chemistry, pH and composition of the drilling fluid used and any impacts defined and considered.	The potential impacts associated with bentonite slurry breakout are discussed in ***section 16.6.1.5.***
Historic England	08/12/2017 Scoping Response	We accept that the future assessment of impacts will (in accordance with the 2017 EIA Regulations) describe the measures predicted to avoid, prevent, reduce or (where possible) offset any significant adverse effects on the historic environment. We therefore recommend where possible that embedded mitigation strategies, such as archaeological exclusion zones, are set out and established.	Embedded mitigation including the application archaeological exclusion zones is set out in ***section 16.6.1.***
Historic England	08/12/2017 Scoping Response	It is worth considering the issues of potential cumulative direct impacts. In particular, where cumulative impacts could exist and where the collective heritage value of many individual assets may be impacted, through “multiple impacts upon similar assets”.	Potential cumulative impacts are described in ***section 16.7.***

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
		Furthermore it may be possible for multiple developments to affect the larger-scale archaeological features such as palaeo-landscapes and to affect the setting of heritage assets and historic landscapes/seascapes. Similarly, there is often a connection between the sea bed area and the site of some First and Second World War shipping casualties. Therefore given the need to include extensive sea bed coverage using geophysical survey techniques and other more prescriptive methods it may be possible to illuminate special features within a wider battlefield context.	
Historic England	08/12/2017 Scoping Response	We consider the following level of information to be appropriate to inform the archaeological desk based assessment for the application process: All existing and applicable survey data (as above). Sidescan sonar and swath bathymetry survey within the East Anglia ONE North windfarm site and area of the offshore export cable corridor Area of Search previously surveyed as part of the ZEA surveys. Completed to 100% coverage of the sea bed in summer 2017. Swath bathymetry, side scan sonar, magnetometer and sub-bottom profile data will be collected from all areas of the offshore export cable corridors not previously surveyed. The survey is scheduled for spring 2018. Use of available overlapping and relevant geotechnical data and core samples from East Anglia ONE and East Anglia THREE.	Assessment has been undertaken in accordance with this approach as set out in the Offshore Archaeology Assessment Method Statement. The results are presented in ***Appendix 16.1*** and summarised in ***section 16.5.***
Historic England	08/12/2017 Scoping Response	It is important to consider the potential age of archaeological deposits present, and therefore how any deposits/remains would be scientifically dated. The choice of techniques may require cores to be	Further geotechnical data will be acquired post-consent. The approach to geoarchaeological

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
		collected and stored in a certain way, as is the case for the luminescence dating techniques, which will need to be considered as part of the sampling strategy.	assessment including the approach to dating will be set out in the Outline WSI to be submitted as part of the DCO application.
Historic England	08/12/2017 Scoping Response	Although the post-consent site investigation works currently being carried out will contribute to the understanding of the geological units of greatest archaeological potential, it may also be useful to discuss the development area with a North Sea landscape and/or Palaeolithic specialist. The specialist would potentially enhance the discussions and identification of areas of archaeological potential, as well as aid the development of strategies required to locate and investigate these areas where necessary.	Consultation with a North Sea landscape and/or Palaeolithic specialist will be included for consideration in the Outline WSI as part of the approach to post-consent assessment of geophysical and geotechnical data.
Historic England	08/12/2017 Scoping Response	It would be important to consider the percentage coverage, quality and resolution of geophysical surveys that will be carried out to ensure that features can be identified from the data and so that confidence can be held in any conclusions that are drawn about the presence/absence of features within a given area.	Additional data on the coverage, quality and resolution of existing geophysical data is included in ***Appendix 16.1.*** This will be included for further consideration during the planning of post-consent surveys as part of the approach set out in the Outline WSI.
The Planning Inspectorate	20/12/2017 Scoping Response	The Inspectorate expects early communication and collaboration in respect of the need for and scope of geotechnical and geo-archaeological assessments.	Early communication with Historic England, and other specialists as necessary, during the planning of post-consent surveys will be included in the approach set out in the Outline WSI.

Consultee	Date/ Document	Comment	Response / where addressed in PEIR
The Planning Inspectorate	20/12/2017 Scoping Response	The PEI should clearly identify the guidance used in the assessment.	The guidance used in the assessment is set out in ***section 16.4***.
Historic England	27/02/2018 Development Area update	Historic England were provided with an update outlining minor updates made to the offshore cable corridor following consultation with The Crown Estate. Historic England provided no further comment.	Changes to the offshore cable corridor were incorporated into the geophysical survey and reported in this Chapter.

9. Ongoing public consultation has been conducted through a series of Public Information Days (PIDs) and Public Meetings. PIDs have been held throughout Suffolk in November 2017, March 2018, and June / July 2018 with further events planned in 2019. A series of stakeholder engagement events were also undertaken in October 2018 as part of consultation phase 3.5. These events were held to inform the public of potential changes to the onshore substation location. This consultation aims to ensure that community concerns are well understood and that site specific issues can be taken into account, where practicable. Consultation phases are explained further in ***Chapter 5 EIA Methodology***. Full details of the proposed East Anglia ONE North project consultation process will be presented in the Consultation Report, which will be submitted as part of the DCO application.

10. No public consultation feedback specific to marine archaeology and cultural heritage have been raised during the public consultation undertaken to date. Full details of the proposed East Anglia ONE North project consultation process will be presented in the Consultation Report, which will be submitted as part of the DCO application.

16.3 Scope

16.3.1 Study Area

11. The study area established for this assessment comprises the East Anglia ONE North windfarm site and the offshore cable corridor (including the landfall up to MHWS) (***Chapter 6 Project Description***, ***Figure 6.1***).

12. Geophysical survey data, archaeologically assessed by Wessex Archaeology, covers the entire East Anglia ONE North windfarm site (208km^2) and offshore cable corridor (133km^2). These assessments also draw upon the archaeological assessment of geophysical and geotechnical data undertaken for the ZEA and for East Anglia ONE and East Anglia THREE, where relevant. The archaeological assessment of this combination of both existing and newly acquired survey data ensures that the assessed geophysical and geotechnical data are adequate to

support sufficient consideration of the expected impacts to archaeology and the historic environment within the parameters of the study area from the construction, operation and decommissioning of the project.

16.3.2 Worst Case

13. The design of the proposed East Anglia ONE North project (including number of wind turbines, layout configuration, requirement for scour protection, electrical design, etc.) is not yet fully determined, and may not be known until sometime after the DCO has been granted. Therefore, in accordance with the requirements of the Project Design Envelope (also known as the Rochdale Envelope) approach to EIA (Planning Inspectorate 2018) (as discussed in section ***Chapter 5 EIA Methodology***), realistic worst case scenarios in terms of potential effects upon marine archaeology and cultural heritage are adopted to undertake a precautionary and robust impact assessment.

14. Post-consent, the final detailed design of the proposed East Anglia ONE North project will refine the worst-case impacts assessed in the ES. Any required monitoring or management / mitigation will be refined and agreed with the relevant authorities at that time. As part of the DCO submission a suite of outline documents providing indicative monitoring and management measures will be provided.

15. The worst case scenario for archaeology below MHWS is based upon the general assumption that the greatest potential footprint for the proposed East Anglia ONE North project represents the greatest potential for direct impacts (e.g. damage / destruction) to surviving archaeological material. This equates to:

- The greatest potential area of direct contact with the sea bed/landfall zone;
- The maximum number of locations at which direct contact may occur (e.g. maximum number of foundations, cables, jack up feet or anchors); and
- The greatest volume of disturbed sea bed sediments and intertidal deposits.

16. The realistic worst case scenario for indirect impacts equates to those aspects of the proposed East Anglia ONE North project which result in the greatest potential for increased scour and sediment stripping across an area as a result of changes to physical processes. Conversely, those aspects of the proposed East Anglia ONE North project which result in the greatest increase in sediment deposition also represent the greatest potential effect in terms of the beneficial impact of increased protection for archaeology.

17. The worst case scenario for the disturbance of setting and character equates to the maximum intrusive effect (e.g. number and type of new infrastructure elements, height of infrastructure) for the longest duration.

18. By identifying and tabulating project parameters (by potential impacts) considered to represent the worst case scenario (from those described in ***Chapter 6 Project Description***), the results of this assessment can be considered as representing the worst case effect upon the offshore archaeological and cultural heritage resource within the study area. The implementation of embedded and additional mitigation measures (see ***section 16.3.3***) will ensure the application of appropriate levels of protection or further investigation for archaeological receptors (heritage assets) once the project design is finalised.

19. As the embedded mitigation includes the avoidance of known heritage assets (through Archaeological Exclusion Zones (AEZs) or through micro-siting) where possible, impacts to known heritage assets arising from the project layout would only become relevant if known heritage assets could not be avoided. The worst-case layout will be that which corresponds to the most number of known heritage assets which cannot be avoided. As this is location specific, this cannot be known until after the layout is defined. For this reason, the worst case for the proposed East Anglia ONE North project as a whole (i.e. the maximum overall potential disturbance of the sea bed from individual parameters across the project) is considered in ***Table 16.2***.

Table 16.2 Realistic Worst case scenarios

Impact	Parameter / Activity	Rationale
Construction		
Impact (1) Direct Impact to known heritage assets	Seabed preparation	Direct impacts to known heritage assets are not anticipated to occur due to the application of embedded mitigation, as follows: AEZs around A1 and certain A3 anomalies prohibiting development activities within their boundaries; and Micro-siting by design to avoid A2 and certain A3 anomalies.
	Installation of foundations	
	Installation of offshore cabling	
	Seabed contact by legs of jack-up vessels and / or anchors (installation)	
	Cable installation at the landfall	
Impact (2) Direct impact to potential heritage assets	Seabed preparation	Maximum area of sea bed preparation: Maximum total wind turbines prepared sea bed area (based on worst case of 67 x 4 leg jacket on

Impact	Parameter / Activity	Rationale
		suction caisson): 465,490.88m^2 (6,947.63m^2 per wind turbine) Maximum depth of sea bed preparation for Gravity Base Structure (GBS) foundations: 7m Maximum prepared sea bed area for total offshore platform (based on worse case of a maximum 4 platforms using jacket on suction caisson foundations): 149,248m^2 Maximum prepared sea bed area for accommodation platform (based on worse case of a maximum 1 platform using jacket on suction caissons): 37,312m^2 Array cable sand wave excavation: 400,000m^3 Platform link cable sand wave excavation: 150,000m^3 Offshore export cable sand wave excavation: 800,000m^3 Pre-grapnel run / sweeping (boulder clearance): 20m maximum width along cables
	Installation of wind turbine foundations	Maximum number of wind turbine foundations: 67 Maximum footprint for total wind turbines (including foundation structure) (based on worst case scenario of 67 wind turbines using Gravity Base Structure (GBS) foundations): 1,330,328.61m^2
	Installation of ancillary infrastructure	Maximum number of met masts: 1 Maximum total met mast footprint with scour protection (based on worst case scenario of 1 met mast using a GBS foundation): 2,827.43m^2

Impact	Parameter / Activity	Rationale
		Maximum number of anchored buoys: 20 Maximum buoy anchor footprint: 80m^2 (4m^2 / buoy) Maximum number of offshore platforms: 4 Maximum total footprint of offshore platforms including scour protection (based on worse case scenario of 4 platforms using jacket on suction caissons foundations): 61,104m^2 (15,276m^2/platform) Maximum number of construction, operations and maintenance platforms: 1 Maximum total footprint of construction, operation and maintenance platforms including scour protection (based on worst case scenario of 1 platform using jacket on suction caissons foundations): 15,276m^2
	Installation of offshore cabling	Inter array cables – maximum area of sea bed disturbance: 4,000,000m^2 Inter array cable – maximum burial depth: 5m Maximum number of platform link cables: 7 Maximum number of trenches for platform link cables: 7 Platform link cables - maximum area of sea bed disturbance: 1,500,000m^2 Maximum number of offshore export cables: 2 Maximum number of installation corridors for offshore export cables: 2

Impact	Parameter / Activity	Rationale
		Offshore export cables – maximum area of sea bed disturbance: 3,040,000m^2 Total volume of sand removed during trenching works: 800,000m^3
	Seabed contact by legs of jack-up vessels, construction vessel anchors or monitoring buoy anchors (installation)	Jack-up vessel - total spud cans footprint: 3,000m^2 Construction vessel anchor footprint: the number and location of anchoring points cannot be predicted until the pre-construction geophysical surveys are undertaken and the final cable routes and foundation locations are determined. Monitoring buoy anchor footprint: 4m^2
	Cable installation at the landfall	Landfall to be achieved via HDD - no beach access required. Maximum HDD length: 2000m Maximum number of drills: 4 (includes one spare drill to allow for any HDD failures)
Impact (3) Indirect impact to heritage assets from changes to physical processes	Changes in suspended sediment concentrations due to foundation installation	The worst case for archaeology equates to the worst case for marine physical processes (see ***Chapter 7 Marine Geology, Oceanography and Physical Processes***)
	Changes in sea- bed levels due to foundation installation	
	Changes in suspended sediment concentrations during inter-array cable and platform link cable installation	
	Changes in sea-bed level due to inter-array cable and platform link cable installation	
	Changes in suspended sediment concentrations during offshore export cable installation	

Impact	Parameter / Activity	Rationale
	Changes in sea-bed level due to offshore export cable installation	
	Indentations on the sea bed due to installation vessels	
	Changes to suspended sediment concentrations and coastal morphology at the offshore export cable landfall	
Impact (4) Impacts to the setting of heritage assets and historic seascape character	Activities associated with construction	Maximum offshore construction duration: 27 months Total number of vessel trips: 3,335 Maximum number of all types of vessels operating during construction simultaneously: 74 (under construction strategy Option 1)
Impact (5) Impacts to site preservation conditions from drilling fluid breakout	Activities associated with HDD	See construction impact (2): cable installation at the landfall
Operation		
Impact (1) Direct Impact to known heritage assets	With the application of the embedded mitigation (see ***section 16.3.3***), and the retention of AEZs throughout the project lifespan, it is anticipated that all direct impacts to known heritage assets will be avoided.	
Impact (2) Direct impact to potential heritage assets	Routine operation and maintenance in the East Anglia ONE North windfarm site	Annual number of operations and maintenance vessels required within windfarm site during operation: 2 Annual number of vessels round trips required for routine operational and planned maintenance activities: 647 Annual number of maintenance activities requiring the use of a jack-up vessel: 0.5 Jack-up vessel – total spud cans footprint: 3,000m^2

Impact	Parameter / Activity	Rationale
		Annual number of maintenance activities requiring the use of a cable laying vessel: 5
Impact (3) Indirect impact to heritage assets from changes to physical processes	Changes to the tidal regime due to the presence of foundation structures	The worst case for archaeology equates to the worst case for marine physical processes (see ***Chapter 7 Marine Geology, Oceanography and Physical Processes***)
	Changes to the wave regime due to the presence of foundation structures	
	Changes to the sediment transport regime due to the presence of foundation structures	
	Changes in suspended sediment concentrations due to scour around foundation structures	
	Changes to the sea bed morphology due to the footprint of the foundation structures	
	Morphological and sediment transport effects due to cable protection measures for inter-array cables and platform link cables	
	Morphological and sediment transport effects due to cable protection measures for offshore export cables	
	Morphological effects due to cable protection measures at the offshore export cable landfall	
Impact (4) Impacts to the setting of heritage assets and historic seascape character	Presence of windfarm infrastructure. Activities associated with operations and maintenance	Maximum number of wind turbine foundations: 67 Maximum blade tip height above LAT: 300m Annual number of vessels round trips required for routine operational and planned maintenance activities: 647

Impact	Parameter / Activity	Rationale
		(accounts for all vessels and all maintenance and operation activities)
Impact (5) Impacts to site preservation conditions from heat loss from installed cables	Heat generated by underground cables (dissipation of heat through the soil)	Maximum number of offshore export cables: 2 Maximum length of offshore export cable: 76km (per cable)
Decommissioning		
No decision has been made regarding the final decommissioning policy, as it is recognised that industry best practice, rules and legislation change over time. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the project so as to be in line with latest and current guidance, policy and legislation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees.		
Impact (1) Direct Impact to known heritage assets	With the application of the embedded mitigation (see ***section 16.3.3***), and the retention of AEZs throughout the project lifespan, it is anticipated that all direct impacts to known heritage assets will be avoided.	
Impact (2) Direct impact to potential heritage assets	Removal of foundations and associated infrastructure	Decommissioning offshore would most likely involve removal of all of the wind turbine components, part of the foundations (those above sea bed level) and the sections of the inter-array cables close to the offshore structures, as well as sections of the offshore export cables. Impacts anticipated to be no greater than during the construction phase.
	Seabed contact by legs of jack-up vessels and / or anchors on vessels during installation	No greater than construction
Impact (3) Indirect impact to heritage assets from changes to physical processes	Changes in suspended sediment concentrations due to foundation removal	The worst case for archaeology equates to the worst case for marine physical processes (see ***Chapter 7 Marine Geology, Oceanography and Physical Processes***)
	Changes in sea bed levels due to foundation removal	
	Changes in suspended sediment concentrations due to removal of	

Impact	Parameter / Activity	Rationale
	parts of the inter-array and platform link cables	
	Changes in sea bed levels due to removal of parts of the inter-array and platform link cables	
	Changes in suspended sediment concentrations due to removal of parts of the offshore export cable	
	Changes in sea bed levels due to removal of parts of the offshore export cable	
	Indentations on the sea bed due to decommissioning vessels	
	Changes to suspended sediment concentrations and coastal morphology at the offshore cable corridor landfall due to removal of the offshore export cable	
Impact (4) Impacts to the setting of heritage assets and historic seascape character	Complete removal of wind farm and infrastructure	Impacts anticipated to be no greater than during the construction phase. Maximum change to historic seascape character.

16.3.3 Embedded Mitigation

20. Embedded mitigation measures for offshore and intertidal archaeology are set out in ***Table 16.3***. These measures have been embedded in the project design and will be secured through a written scheme of investigation that will later be set out in the Deemed Marine Licence(s) (DML). The impact assessment presented in ***sections 16.6.1*** to ***16.6.3*** takes into account this mitigation embedded into the project.

Table 16.3 Embedded mitigation for offshore and intertidal archaeology and cultural heritage

Parameter	Embedded mitigation measures relevant to the historic environment
Geophysical survey data acquisition relating to the assessment of maritime and	Any geophysical data acquired for the project prior to construction will be archaeologically assessed. The planned surveys will result in full coverage of the final windfarm layout and cable route with sidescan sonar and swath bathymetry. The results of the archaeological assessment of the sidescan sonar and bathymetry data have been integrated with the existing magnetometer data

Parameter	Embedded mitigation measures relevant to the historic environment
aviation archaeology (pre-construction).	and wider research to ensure that the extent of the impact of the proposed project on the significance of any maritime or aviation heritage assets is adequately understood. Any further geophysical survey data will also be subject to archaeological assessment.
Geophysical and geotechnical data acquisition relating to sea bed prehistory (pre-construction).	The level of existing geophysical and geotechnical data allows the applicant to provide a description of the significance of potential prehistoric heritage assets which could be affected by the proposed project. Although no further geotechnical surveys will be carried out prior to consent, the existing data will be used to prepare an initial deposit model which will inform a phased and targeted approach to further assessment to be carried out post-consent. A deposit model, as necessary to both inform the assessment of, and provide mitigation for, potential impacts, is the result of a phased programme of analysis relative to the complexity of the palaeoenvironmental sedimentary sequences encountered within any given project area. Any geophysical and geotechnical data acquired for the project prior to construction will also be archaeologically assessed. There will be archaeological input into any future sampling programmes.
Avoidance and Micro-siting	Archaeological Exclusion Zones (AEZs) are to be implemented around the extents of known wreck sites and anomalies of archaeological interest (A1s) and the recorded point locations of previously recorded sites that have not been seen in the geophysical data (A3s) but at which archaeological material is likely to be present (possibly buried). No project related activities will take place within the established parameters of the AEZs. The avoidance of identified anomalies (A2s) and previously recorded sites that have not been seen in the geophysical data (A3s) and at which the presence of surviving material is considered unlikely (although it cannot be entirely discounted) will be achieved by micro-siting the project design, where possible and within the confines of engineering and other environmental constraints.
Further investigation where avoidance isn't possible	Any identified anomalies (A2s) and previously recorded sites (A3s) that cannot be avoided by micro-siting of design will be subject to further investigation so that their character, nature and extent can be more fully understood and appropriate mitigation measures to reduce or off-set impacts can be determined.
Protocol for Archaeological Discoveries	In the event of impact to potential sites, the establishment of a formal protocol to ensure that any finds are promptly reported, archaeological advice is obtained, and any recovered material is stabilised, recorded and conserved.
Watching Briefs	Watching briefs will be undertaken, as and where appropriate, where sea bed material is brought to the surface (e.g. during pre-lay grapnel runs) and for any intrusive works carried out in the intertidal zone (e.g. HDD).
Draft (outline) WSI	The project will submit a project-specific draft (outline) WSI as part of the final ES to accompany the DCO application, prepared in agreement with HE, which will outline methodological approach to post-consent survey and archaeological

Parameter	Embedded mitigation measures relevant to the historic environment
	assessment of acquired data, alongside the mitigation measures for agreement with Historic England including embedded mitigation.

21. With regard to potential *in situ* prehistoric sites, submerged landscape features and palaeoenvironmental evidence, any available pre-construction geotechnical data (e.g. samples / geotechnical logs acquired as part of engineering-led ground investigation works) will be subject to geoarchaeological assessment during the post-consent stages of the project. As part of this process, an archaeological contractor will also be consulted to advise on potential samples to be acquired specifically for archaeological purposes, particularly from the interpreted dune features and other identified units of archaeological interest identified within the data. Should *in situ* prehistoric sites be identified as a result of such work, appropriate mitigation measures to record and / or protect such sites (if and where present) would be agreed in consultation with Historic England.

22. The geoarchaeological examination of potential prehistoric deposits through the assessment of pre-construction geotechnical and geophysical data, where available, may also be regarded as contributing to the body of scientific data available for the study of sea bed prehistory within the wider East Coast region. This may be realised as a positive public benefit (and beneficial effect) as part of an overall accumulation and is discussed further under cumulative impacts in ***section 16.7***.

23. With regard to potential wrecks and aircraft, a pre-construction mitigation requirement of the project is to archaeologically assess further geophysical survey data (as relevant and where available) to further identify and understand the nature of sea bed features which may represent previously unidentified maritime or aviation heritage assets. Should previously unrecorded wreck or aircraft remains be encountered as a result of such work, mitigation strategies to safeguard such heritage assets (in a manner appropriate and proportionate to the remains present) will be developed and agreed in consultation with Historic England.

24. The primary means of preventing direct impacts to known heritage assets is avoidance. AEZs may be reduced, enlarged or removed in agreement with Historic England if further relevant information becomes available. However, unless modified by agreement, it is important that AEZs are retained throughout the project lifetime and monitoring of AEZs may be required by the regulator and Historic England to ensure adherence both during construction and in the future operation of the windfarm.

25. If anomalies cannot be avoided then additional work may be required to further investigate the nature and extent of anomalies, to establish the archaeological

interest and to record them prior to removal and/or relocation. The methodology for such works will be set out post-consent in a WSI in accordance with the outline WSI and agreed with Historic England prior to works commencing. Historic England will also be consulted on the scope of all further post-consent geophysical and geotechnical surveys undertaken for the project in order to ensure that the data generated are sufficiently robust to enable professional archaeological interpretation and analysis.

26. In order to account for unexpected discoveries of archaeological material during construction, operation and decommissioning, a formal protocol will be established. In 2015, SPR issued an offshore windfarms archaeological protocol explaining the procedures and processes which must be followed by all contractors and sub-contractors working on an offshore project for SPR in the event of an archaeological discovery (SPR 2015). It is recommended that if any objects of possible archaeological interest are encountered, that they should be reported using the established SPR protocol which is based upon The Crown Estate's Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate 2014) (ORPAD). This will establish whether the objects are of archaeological interest and recommend appropriate mitigation measures where necessary.

27. A draft Outline WSI setting out the methodology for all proposed embedded mitigation will be prepared for consultation with Historic England for submission alongside the DCO application for the proposed East Anglia ONE North project. The WSI takes account of the standards and guidance presented in Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate, 2010). The draft WSI will be finalised as a point in time document in consultation with Historic England post-consent. Specific methodological requirements and any required revisions (e.g. to the nature and extent of AEZs) will be addressed through method statements, as required, to underpin the delivery of the commitments of the WSI.

16.3.4 Monitoring

28. Post-consent, the final detailed design of the proposed East Anglia ONE North project and the development of the relevant management plan(s) will refine the worst-case parameters assessed in the EIA. It is recognised that monitoring is an important element in the management and verification of the impacts of the proposed East Anglia ONE North project. Outline management plans, across a number of environmental topics, will be submitted with the DCO application. These outline management plans will contain key principles that provide the framework for any monitoring that could be required. The requirement for and final appropriate design and scope of monitoring will be agreed with the relevant stakeholders and

included within the relevant management plan(s), submitted for approval, prior to construction works commencing. Assessment Methodology

29. The following sections set out the assessment methodology used to establish baseline conditions for offshore archaeology and cultural heritage within the study area and the approach to identifying and evaluating potential impacts upon the historic environment (within offshore and intertidal contexts, up to MHWS) arising as a result of the project.

16.4 Assessment Methodology

16.4.1 Legislation, Policy and Guidance

30. The NPSs (the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs)), of relevance to the project are:

- Overarching NPS for Energy (EN-1) (July 2011); and
- NPS for Renewable Energy Infrastructure (EN-3) (July 2011).

31. ***Table 16.4*** sets out how specific policies relevant to the historic environment are addressed within this chapter.

Table 16.4 NPS Guidance for the Historic Environment

NPS Requirement	NPS Reference	PEIR Reference
EN-1 Overarching NPS for Energy		
"As part of the ES the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset."	Paragraph 5.8.8	The heritage importance of the archaeological and cultural heritage receptors considered in this chapter of the PEIR, including the contribution of setting to that significance, is detailed in ***section 16.5.5.*** Potential impacts arising as a result of the project upon the setting of marine heritage assets are considered in ***section 16.6.*** Issues relating to the setting of onshore heritage assets have been considered as part of ***Chapter 24 Archaeology and Cultural Heritage***.
"Where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where	Paragraph 5.8.9	This chapter of the PEIR draws upon existing archaeological assessment work undertaken for the ZEA and for East Anglia ONE and THREE and has been undertaken based on the results of the archaeological assessment of both existing and project-specific geophysical survey data acquired for the offshore

NPS Requirement	NPS Reference	PEIR Reference
proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact."		development area (see **section 16.5** and ***Appendix 16.1***).
"The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets affected can be adequately understood from the application and supporting documents."	Paragraph 5.8.10	This chapter has been informed by the results of the archaeological assessment of geophysical survey data for the offshore development area (***Appendix 16.1***). This chapter of the PEIR provides an account of the potential impacts of the project upon heritage assets and their significance (***section 16.6***).
EN-3 NPS for Renewable Energy Infrastructure		
"Consultation with the relevant statutory consultees (including English Heritage or Cadw) should be undertaken by the applicants at an early stage of the development."	Paragraph 2.6.140	Consultation has been undertaken with relevant statutory consultees, as outlined in ***section 16.2***. Consultation will be on going throughout the development process. Such
"Assessment should be undertaken as set out in section 5.8 of EN-1. Desk-based studies should take into account any geotechnical or geophysical surveys that have been undertaken to aid the windfarm design."	Paragraph 2.6.141	The assessment has been undertaken in accordance with section 5.8 of EN-1, as detailed above. Geophysical and geotechnical studies have underpinned the assessment ***(section 16.5 and Appendix 16.1)***.
"The assessment should also include the identification of any beneficial effects on the historic marine environment, for example through improved access or the contribution to new knowledge that arises from investigation."	Paragraph 2.6.142	Any beneficial effects to the offshore archaeology and cultural heritage resource resulting from the proposed project have been identified and incorporated as part of ***section 16.6***.
"Where elements of an application (whether offshore or onshore) interact with features of historic maritime significance that are located onshore, the effects should be assessed in accordance with the policy at section 5.8 of EN-1."	Paragraph 2.6.143	Potential impacts of the proposed project upon onshore heritage assets have been considered in ***Chapter 24 Archaeology and Cultural Heritage.***

32. This assessment has also been undertaken in a manner consistent with the NPPF, a revised version of which was published by the Ministry of Housing, Communities and Local Government (MHCLG) in July 2018, replacing the original policy from

March 2012. Provision for the historic environment is principally given in section 16: Conserving and enhancing the historic environment of the NPPF, which directs local authorities to set out "*a positive strategy for the conservation and enjoyment of the historic environment, including heritage assets most at risk through neglect, decay or other threats*". Local planning authorities should recognise that heritage assets are "*an irreplaceable resource, and should be conserved in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of existing and future generations*" (MHCLG, 2018).

33. The aim of NPPF section 16 is to ensure that Regional Planning Bodies and local authorities, developers and owners of heritage assets adopt a consistent and holistic approach to their conservation and to reduce complexity in planning policy relating to proposals that affect them.

34. To summarise, UK government guidance provides a framework which:

- Recognises that heritage assets are an irreplaceable resource;
- Requires applicants to provide a level of detail that is proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance;
- Takes into account the desirability of sustaining and enhancing the significance of heritage assets, including any contribution made by their setting, and putting them to viable uses consistent with their conservation;
- Places weight on the conservation of designated heritage assets (which include world heritage sites, scheduled monuments, listed buildings, protected wreck sites, registered parks and gardens, registered battlefields or conservation areas), with any anticipated substantial harm weighed against the public benefits of the proposal;
- Requires applicants to include a consideration of the effect of an application on the significance of non-designated heritage assets, giving regard to the scale of any harm or loss and the significance of the heritage asset;
- Regard proposals that preserve those elements of the setting that make a positive contribution to the asset (or which better reveal its significance) favourably; and
- Requires developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and impact, and to make this evidence (and any archive generated) publicly accessible.

35. The NPPF's associated PPG 'Conserving and enhancing the historic environment' (DCLG, 2014) includes further information and guidance on how national planning policy is to be interpreted and applied locally. Although the PPG is an important

and relevant consideration in respect to this project, EN-1 (the Overarching NPS for Energy) is the key decision making document.

36. This assessment also takes account of the UK Marine Policy Statement (MPS) (HM Government, 2011). The MPS sets out high level objectives for marine planning, which have directed development of the Plan at a local level. Marine Plans must be in accordance with other relevant national policy and are intended to contribute to the achievement of sustainable development in the UK marine area. Those relevant to this project are the East Marine Plans; comprising the East Inshore and East Offshore Marine Plans (DEFRA 2014), which outline the objective "*to conserve heritage assets, nationally protected landscapes and ensure the decisions consider the seascape of the local area*". This objective recognises the need to consider whether developments are appropriate to the area they will be located in and have an influence upon, and seeks to ensure that, as far as possible, the value of such assets and characteristics are not compromised. Policies specific to heritage assets are outlined in ***Table 16.5***.

Table 16.5 Summary of East Inshore and East Offshore Marine Plans

Plan policies specific to heritage assets	PEIR Reference
Policy SOC2: Proposals that may affect heritage assets should demonstrate, in order of preference: • That they will not compromise or harm elements which contribute to the significance of the heritage asset • How, if there is compromise or harm to a heritage asset, this will be minimised • How, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against or • The public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset	The primary method of mitigation when dealing with the archaeological resource as set out in this chapter is the precautionary principle, based on the prevention of damage to receptors by putting in place protective measures rather than attempting to repair damage. Avoidance by means of Archaeological Exclusion Zones (AEZ) will serve to ensure that such assets will not be compromised. Potential archaeological receptors are safeguarded or the effects upon them minimised by means of mitigation measures outlined in ***section 16.3.3.***

37. In demonstrating adherence to industry good practice, this chapter has been compiled in accordance with the following relevant standards and guidance:

- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Second Edition) (Historic England, 2017);
- Chartered Institute for Archaeologists' Standard and Guidance for Historic Environment Desk-Based Assessments (2014a) and Code of Conduct (2014b);
- Marine Geophysical Data Acquisition, Processing and Interpretation – guidance notes (Historic England, 2013);

- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011);
- Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology, 2008);
- Historic Environment Guidance for the Offshore Renewable Energy Sector. Guidance (Wessex Archaeology, 2007);
- Code for Practice for Seabed Development (Joint Nautical Archaeology Policy Committee (JNAPC), 2006); and
- Conservation Principles: For the Sustainable Management of the Historic Environment (Consultation Draft 10th November 2017, Historic England 2017a).

16.4.2 Data Sources

38. The assessment of the existing environment presented in ***section 16.5*** is informed by the results of the work undertaken by Wessex Archaeology, as presented in the following technical reports:

- ***Appendix 16.1:*** East Anglia ONE North Offshore Windfarm Archaeological assessment of geophysical data; and
- ***Appendix 16.2***: East Anglia ONE North and East Anglia TWO Offshore Windfarm Export Cable Route Archaeological assessment of geophysical data.

39. The geophysical data assessed in order to inform the technical report for the East Anglia ONE North windfarm site (as presented in ***Appendix 16.1***) comprises sidescan sonar (SSS), multibeam echosounder (MBES), magnetometer and sub-bottom profiler data (SBP) acquired by Gardline Geosurvey Limited (Gardline) between 2010 and 2017, as detailed in ***Table 16.6.***

Table 16.6 Acquired Geophysical Survey Data within the East Anglia ONE North Offshore Windfarm

Data	Year	Coverage	Confidence	Notes
Magnetometer	2010	1000m line spacing	Data rated as 'Good'	Occasional spiking on some lines assessment
SBP	2010	1000m line spacing	Data rated as 'Variable	Some lines affected slightly by weather but still considered suitable for archaeological assessment.
SSS	2017	75m line spacing	Data rated as 'Variable'	Some lines affected by sea state with strong currents affecting positional accuracy of lines but in general data considered suitable for archaeological assessment

MBES	2017	75m line spacing	Data rated as 'Good'	Suitable for archaeological assessment of objects and debris over 0.5 m in size

40. The geophysical data assessed in order to inform the technical report for the offshore cable corridor (as presented in ***Appendix 16.2***) comprises SSS, MBES, magnetometer and SBP data acquired by Gardline in 2010 and 2017, and Bibby Hydromap Limited (Bibby) in 2018, as detailed in ***Table 16.7***. The coverage of the 2018 data varied, in terms of line spacing and orientiation, depending on the water depth and tidal currents.

Table 16.7 Acquired Geophysical Survey Data within the East Anglia ONE North Offshore Cable Corridor

Data	Year	Coverage	Confidence	Notes
Magnetometer	2018	Variable	Data rated as 'Good'	Minor spiking on a couple of lines and influenced slightly by background geology, but data considered suitable for archaeological assessment.
	2010	1000m line spacing	Data rated as 'Good'	
SBP	2018	Variable	Data rated as 'Variable'	Occasional blanking, likely due to weather and sea state, and interference and limited penetration due to the hard substrate in the area, but in general data considered suitable for archaeological assessment.
	2010	1000m line spacing	Data rated as 'Good'	
SSS	2018	Variable	Data rated as 'Variable'	A few lines were more affected by sea state and strong currents, but in general considered as suitable for archaeological assessment.
	2017	75m line spacing		
MBES	2018	Variable	Data rated as 'Average	Minor artefacts in a few cases, but suitable for archaeological assessment of objects and debris over 1 m in size.
	2017	75m line spacing		

41. As agreed with Historic England (see ***section 16.2***) no new geotechnical data has been acquired for the purposes of this PEIR although existing geoarchaeological assessments undertaken for the ZEA, East Anglia ONE and East Anglia THREE have been reviewed and the results incorporated as relevant to the assessment of palaeogeography within the study area. Borehole logs acquired by GEMS in 2010 were consulted during the archaeological assessment of geophysical survey data (***Appendix 16.1***).

42. In addition to the acquistion and archaeological assessment of project-specific geophysical survey data, this assessment also draws upon the archaeological assessment of existing survey work and desk-based studies undertaken for the ZEA and for East Anglia ONE and THREE (e.g. Wessex Archaeology 2011, 2012 and 2014). This has been supplemented by additional data sources, as presented in ***Table 16.8.***

Table 16.8 Desk-Based Data Sources to Inform the Assessment

Data	Source
Recorded wrecks and obstructions	United Kingdom Hydrographic Office (UKHO)
Records of heritage assets and documented losses of wrecks and aircraft (for areas within 12nm)	National Record of the Historic Environment (NRHE)
Records of non-designated heritage assets below MHWS	Suffolk Historic Environment Record
Designated heritage assets (including sites protected under the Protection of Military Remains Act 1986 and the Protection of Wrecks Act 1973)	National Heritage List online maintained by Historic England.
Historic Seascape Character (HSC) consolidated national GIS dataset	Historic England
Background geological information	British Geological Society
Admiralty Charts	UKHO
Archaeological studies and published sources, where relevant to the East Anglia ONE North windfarm site	Various

16.4.3 Impact Assessment Methodology

43. The general method for impact assessment is set out in ***Chapter 5 EIA Methodology.*** The specific approach to the assessment of impacts for offshore and intertidal archaeology and cultural heritage are detailed below. In the absence of an industry standard methodology for heritage impact assessment within the framework of EIA, the impact assessment methodology adopted will take account of overarching principles presented in policy and guidance:

- NPPF (MHCLG, 2018);
- Marine Policy Statement (HM Government 2011);
- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Historic England 2015); and

- Conservation Principles: For the Sustainable Management of the Historic Environment (Consultation Draft 10th November 2017, Historic England 2017a).

44. The impact assessment methodology adopted for offshore and intertidal archaeology will define heritage assets, and their settings, likely to be impacted by the proposed scheme and assess the level of any resulting benefit, harm or loss to their significance. The assessment is not limited to direct (physical) impacts, but also assesses possible indirect (physical) impacts upon heritage assets which may arise as a result of changes to hydrodynamic and sedimentary processes and indirect (non-physical) impacts upon the setting of heritage assets, whether visually, or in the form of noise, dust and vibration, spatial associations and a consideration of historic relationships between places and the historic seascape character.

45. More specifically, the impact assessment will present:

- The importance of any heritage assets identified as being affected;
- The anticipated magnitude of effect (change) upon those assets and their settings;
- The significance of any identified impacts upon those assets and their settings; and
- The level of any harm (or benefit) and loss of heritage significance (importance).

46. The impact assessment will also consider the extent to which the accumulation of archaeologically interpreted geophysical and geotechnical data, together with information provided by chance discoveries during the assessment and investigation process, represents a beneficial effect.

47. The assessment of the significance of any identified impact is largely a product of the heritage significance (importance) of an asset and the perceived magnitude of the effect on it, assessed and qualified by expert judgement.

48. An assessment of effects on an asset involves an understanding of the heritage significance of the asset and in the case of an effect on the setting of that asset, the contribution that the setting makes to the heritage significance of the asset. Policy sets out that the level of detail should be proportionate to the significance of the heritage asset and no more than is sufficient to understand the potential impact of the proposed project (NPPF paragraph 189, 2018).

49. The standardised EIA matrices provide a useful framework for the identification and appropriate responses to identified impacts, however, when analysing impacts upon heritage setting and heritage significance, the outcomes of the matrix-based

approach are qualified through expert judgement and further comments/arguments based upon the heritage specific legislation, policy and guidance documents available, and using the fundamental concepts from the NPPF of benefit, harm and loss.

16.4.3.1 Sensitivity (Heritage Importance)

50. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. However, while impacts to a heritage asset's setting or character can be temporary, impacts which result in damage or destruction of the assets themselves, or their relationship with their wider environment and context, are permanent. Once destroyed an asset cannot recover. On this basis, the assessment of the significance of any identified impact is largely a product of the heritage importance of an asset (rather than its sensitivity) and the perceived magnitude of the effect on it, assessed and qualified by professional judgement.

51. The importance of a heritage asset is a function of a range of factors. The Marine Policy Statement (HM Government 2011) states that the value of heritage assets to this and future generations lies in their heritage interest, which may be archaeological, architectural, artistic or historic.

52. In accordance with this definition, the importance of heritage assets is assessed by examining the asset's age, type, rarity, survival and condition, fragility and vulnerability, group value, documentation, associations, scientific potential and outreach potential. These factors help to characterise a heritage asset and to assess how representative it is in comparison to other similar archaeological, architectural, artistic or historic heritage assets. In the majority of cases, statutory protection is only provided to a site or feature judged to be an above average example in regard to these factors. The criteria used for assessing the importance of intertidal and offshore archaeology are specified in ***Table 16.9.***

Table 16.9 Criteria for determining heritage importance

Heritage Importance	Definitions/Example Assets
High (perceived International/National Importance)	Assets of acknowledged international/national importance (e.g. World Heritage Sites, Scheduled Monuments, Protected Wreck Sites and currently non-designated assets (including previously unrecorded assets) of the quality and importance to be designated under national and international legislation). Assets that can contribute significantly to acknowledged international/national research objectives.
Medium (perceived Regional Importance)	Assets that contribute to regional research objectives. Assets with regional importance, educational interest or cultural appreciation.

Heritage Importance	Definitions/Example Assets
Low (perceived Local Importance)	Assets that contribute to local research objectives. Assets with local importance, educational interest or cultural appreciation. Assets that may be heavily compromised by poor preservation and/or poor contextual associations.
Negligible	Assets with no significant importance or archaeological/historical interest.
Unknown	The importance/existence/level of survival of the asset has not been ascertained (or fully ascertained/understood) from available evidence.

53. The criteria in ***Table 16.9*** provide a guide to the assessment of perceived heritage importance, which is to be based upon professional judgement. However, due to the nature of the archaeological record, it is often the case that information regarding individual assets may, at times, be limited. As such, the categories and definitions of heritage importance do not necessarily reflect a definitive level of importance of an asset. Instead they should be regarded as providing a preliminary or likely heritage importance based on information available to date. The heritage importance of an asset can therefore be amended or revised as more information comes to light. Archaeological assessments that may alter the perceived heritage importance of an asset may be undertaken pre- and post-consent and can include the archaeological assessment of further geophysical and geotechnical data, ground truthing using Remote Operated Vehicles (ROVs) or divers or further desk-based research (e.g. on individual historic wrecks).

54. Where uncertainty occurs, the precautionary approach is to assign high importance (and hence high sensitivity). This precautionary approach represents good practice in archaeological impact assessment and reduces the potential for impacts to be under-estimated.

55. It is crucial that for each asset there is a narrative accompanying the assessment which clearly sets out the reasoning (in accordance with the above factors) and the measure of professional judgment employed in assessing the importance of that asset. This can act as a modifier for the sensitivity assigned to the receptor.

16.4.3.2 Magnitude

56. The classification of the magnitude of effect on heritage assets takes account of such factors as:

- The physical scale and nature of the anticipated disturbance; and
- Whether specific features or evidence would be lost which are fundamental to the historic character and integrity of a given asset, including its understanding and appreciation.

57. Both direct physical and indirect non-physical (e.g. visual, setting) impacts on heritage assets are considered relevant. Impacts may be adverse or beneficial. Depending on the nature of the impact and the duration of development, impacts can also be temporary and / or reversible or permanent and/or irreversible.

58. The finite nature of archaeological remains means that direct physical impacts (e.g. those arising as a result of intrusive groundworks) are almost always adverse, permanent and irreversible; the 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed. By contrast, indirect non-physical effects upon the setting of heritage assets will depend upon the scale and longevity of the project and the sensitivity with which the landscape is re-instated subsequent to decommissioning, if applicable. Similarly, indirect physical impacts (e.g. increased burial or exposure of heritage assets arising as a by-product of changes to hydrodynamic and sedimentary regimes resulting from a project) may also depend upon scale and longevity.

59. The indicative criteria used for assessing the magnitude of adverse effect with regard to archaeology and cultural heritage are presented in ***Table 16.10***.

Table 16.10 Indicative criteria for assessing adverse magnitude of effect

Magnitude	Definition
High	Total loss of or substantial harm to an asset. Complete and permanent loss of, or change to, those characteristics of an asset's setting which contribute to its significance, such as could be caused by its disassociation with its historical setting.
Medium	Partial loss of, harm to or alteration of an asset which will affect its significance. Substantial change to the key characteristics of an asset's setting, which falls short of being a total disassociation with the historical context, or a more total loss which is temporary and/or reversible.
Low	Minor loss of or alteration to an asset which leaves its current significance largely intact. Minor and/or short-term changes to setting which do not affect the key characteristics and in which the historical context remains substantially intact.
Negligible	Minor alteration to an asset which does not affect its significance in any notable way. Minor and short term, or very minor and reversible, changes to its setting which do not affect the key characteristics of the asset's significance.
None / Nil	No alteration to an asset.

60. There is the potential for impacts to archaeology to be considered beneficial. Benefits may correspond directly to the project itself where a project will enhance

the historic environment (e.g. through measures which will improve the setting of a heritage asset or public access to it, or through indirect impacts which provide additional protection to an exposed site on the sea bed through increased sediment cover) or will enhance public understanding by adding to the archaeological record (e.g. through the accumulation of publicly available data).

61. The magnitude of beneficial effect with regard to archaeology and cultural heritage directly relates to the level of public value associated with an individual effect. The measure of beneficial effect (high/medium/low) is therefore necessarily situational and specific to a given site, area or subject. For this reason, magnitude of beneficial impact is discussed within the narrative of the assessment according to criteria defined on a case by case basis, and not defined by overarching criteria as for adverse magnitude of effect in ***Table 16.10***.

16.4.3.3 Impact Significance

62. An initial indication of impact significance is gained by combining the predicted magnitude of effect and heritage significance (importance) in accordance with the impact assessment matrix provided in ***Table 16.11.***

Table 16.11 Impact Significance Matrix

Heritage Importance	Magnitude				
	High	**Medium**	**Low**	**Negligible**	**No change**
High	Major	Major	Moderate	Minor	No change
Medium	Major	Moderate	Minor	Negligible	No change
Low	Moderate	Minor	Minor	Negligible	No change
Negligible	Minor	Negligible	Negligible	Negligible	No change

63. As with the definitions of magnitude and heritage importance, the matrix used is clearly defined by the expert assessor within the context of that assessment. The impact significance categories are divided as shown in ***Table 16.12.***

Table 16.12 Adverse Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor (asset) condition, both adverse or beneficial, which are likely to be important considerations at an international, national, regional or district level because they contribute to achieving international, national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.

Impact Significance	Definition
	Possible scenario: May equate to substantial harm or total loss of the value of a designated heritage asset (or asset potentially worthy of designation) such that development may not be consented unless substantial public benefit is delivered by the project. Effective/acceptable mitigation options are still likely to be possible, to offset and/or reduce residual impacts to satisfactory levels.
Moderate	Intermediate change in receptor (asset) condition, which are likely to be important considerations at a local level. Possible scenario: Less than substantial harm to the significance of a designated heritage asset (or asset potentially worthy of designation) such that the harm should be weighed against the public benefit delivered by the development to determine consent. Effective/acceptable mitigation options are likely to be possible, to offset and/or reduce residual impacts to satisfactory levels.
Minor	Small change in receptor (asset) condition, which may be raised as local issues but are unlikely to be important in the decision making process. Possible scenario: Harm to a designated or non-designated heritage asset that can be adequately compensated through the implementation of a programme of industry standard mitigation measures.
Negligible	No discernible change in receptor (asset) condition. Impact that is nil, imperceptible and not significant.
No change	No change, therefore no impact in receptor (asset) condition.

64. For the purposes of EIA, ‘major’ and ‘moderate’ impacts are generally deemed to be significant (in EIA terms). In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively or through interactions between heritage assets or elements of the historic environment (historic landscape / seascape).

65. Where uncertainty occurs, a precautionary approach will be taken to ensure that impacts are not under assessed. Where the extent of harm is uncertain, either because an asset is not fully understood (i.e. if further investigation is required to establish the significance of an asset) or the magnitude of the impact is unclear (i.e. because the design is not yet finalised) the precautionary approach is to assume the potential for major (substantial) harm.

66. Following initial assessment, if the impact does not require additional mitigation (or none is possible) the residual impact will remain the same. If however, additional mitigation is proposed required there will should be an assessment of the post-mitigation residual impact.

16.4.4 Historic Seascape Character

67. The approach to the assessment of HSC differs to that outlined above for heritage assets.

68. The historic character of the seascape is described in terms of ability to accommodate change. A key aspect of this ability is how that character is perceived by the public. For this reason, an approach is required which recognises the dynamic nature of seascape and how all aspects of the seascape, no matter how modern or fragmentary, can form part of the character of that seascape.

69. It is not meaningful, therefore, to assign a level of heritage importance to these perceptions of character, which are by nature subjective, nor to assign a measure of magnitude in order to understand the nature of the potential changes. Rather, this change is expressed as a narrative description of the seascape character, how it is perceived by the public and how these perceptions could be affected by the proposed East Anglia ONE North project, which may or may not be perceived as important from a historic perspective. In this respect, while damage to, or destruction of, a heritage asset is considered permanent and irreversible, impacts to HSC are dynamic, and may be temporary and reversible.

16.4.5 Cumulative Impact Assessment

70. The general method for cumulative impact assessment is set out in ***Chapter 5 EIA Methodology***.

71. Cumulative impacts may occur where archaeological receptors also have the potential to be impacted by other existing, consented and/or proposed developments or activities. This includes consideration of the extent of influence of changes to marine physical processes (see ***Chapter 7 Marine Geology, Oceanography and Physical Processes***) arising from the proposed project alone and those arising from the proposed East Anglia ONE North project cumulatively or with other offshore windfarm projects.

72. The cumulative impact assessment has been carried out in accordance with the document Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy issued by COWRIE (Oxford Archaeology 2008).

16.4.6 Transboundary Impact Assessment

73. Due to the localised nature of disturbance there is a limited pathway for impacts on transboundary assets. As such, transboundary impacts upon marine and inter-tidal archaeology and cultural heritage are scoped out of any further assessment (SPR 2017).

16.5 Existing Environment

74. The following sections provide a summary of the known and potential offshore and intertidal archaeological and cultural heritage resource within the study area (seawards of the MHWS) using the survey data and data sources outlined in ***section 16.4.2.*** All receptors landwards of MHWS are included within the onshore archaeology and cultural heritage assessment (***Chapter 24 Archaeology and Cultural Heritage***).

16.5.1 Seabed Prehistory

75. There are no known sea bed prehistory sites within the study area.

76. There is, however, the potential for previously undiscovered prehistoric sites and deposits of palaeoenvironmental interest to be present within the study area. This potential is primarily associated with surviving terrestrial features and deposits corresponding to times when sea levels were lower and hence prehistoric hominin populations may have inhabited what is now the sea bed. Archaeological material may also be present within secondary contexts, as isolated finds within deposits, this may comprise material from terrestrial phases that may have been reworked by marine or glacial processes, for example.

77. The shallow geology of the study area comprises a series of Pleistocene and Holocene deposits deposited in a range of environments, from terrestrial to marine. Terrestrial sediments, deposited during periods of low relative sea level, are of the highest archaeological potential. This potential is discussed in detail in ***Appendix 16.1*** and ***Appendix 16.2*** and summarised below. A full list of paleogeographic features interpreted from the sub-bottom profiler and multibeam bathymetry data by Wessex Archaeology for the windfarm site are included in the gazetteer in Appendix 1 of ***Appendix 16.1***. and Appendix 1 of ***Appendix 16.2***. The locations of these features are illustrated on ***Figure 16.1*** and ***Figure 16.2***.

78. The geology within the study area has been divided by Wessex Archaeology into five phases as summarised in ***Table 16.13***.

Table 16.13 Shallow stratigraphy of the study area identified by Wessex Archaeology (Appendix 16.1, Table 7, Appendix 16.2, Table 7) with broad date ranged stated according to Marine Isotope Stage (MIS)

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
8	Holocene Seabed Sediments (post-transgression) (Marine Isotope Stage (MIS) 1)	Generally observed as a veneer or thickening into large sand wave and bank features. Boundary between surficial sediments and	Gravelly sand with shell fragments, sand waves and ripples indicate sediment is mobile.	Considered of low potential in itself, but possibly contains reworked artefacts and can cover wreck sites and other cultural heritage.

Unit	Unit Name	Geophysical Characteristics [1]	Sediment Type [2]	Archaeological Potential
		underlying units not always discernible.		
7	Holocene Sediments (pre-transgression) (MIS 2 to 1)	Small shallow infilled channels with either seismically transparent fill, or fill characterised by subparallel internal reflectors. Can contain high amplitude reflectors or areas of acoustic blanking which may indicate organic matter such as peat.	Fluvial, estuarine and terrestrial.	Potential to *contain in situ* and derived archaeological material, and palaeoenvironmental material.
6	Brown Bank Formation (Late Ipswichian to Lower Devensian) (MIS 5d to 3)	Observed largely as a deposit infilling hollows or channels; however on occasion seen as broad blanket deposit, Fill is generally either acoustically transparent or characterised by subhorizontal layered reflectors.	Clayey silty sand deposited in an intertidal / lagoon environment.	*In situ* Lower Palaeolithic artefacts may be protected. Middle Palaeolithic *in situ* and derived artefacts may be associated dependent on the age of the fill. Palaeoenvironmental information. Basal contact may cover old land surfaces.
5	Lower Brown Bank (Lower Devensian) (MIS 5e to 5d)	Observed at the base of the BNB formation. Characterised by low relief basal and either an acoustically transparent or well-layered fill.	Silty sand and sandy silt, possible fluvial, intertidal or shallow marine deposits.	*In situ* Lower Palaeolithic artefacts may be protected. Middle Palaeolithic in situ and derived artefacts may be associated particularly with channel edges dependent on the age of the fill. Palaeoenvironmental information. Basal contact may cover old land surfaces.
4	Yarmouth Roads Formation (Lower to	Thick unit characterised by layered sub-parallel internal reflectors.	Silty sand with occasional layers of clay. Generally becoming silty,	Possibility of in situ finds in later part of formation if not eroded.

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
	Middle Pleistocene) (MIS 62 to 13)	Top of unit generally a well-defined regional erosion surface.	lagoonal clay with depth. Sediments deposited as part of delta complex.	Contemporaneous with terrestrial Cromer Forest Bed Formation (Pakefield and Happisburgh). Has been found to contain plant debris, wood and peat in some areas of possible palaeoenvironmental importance. Potential greatest where associated with river valleys.
3	Smith's Knoll Formation (Lower Pleistocene) (MIS 95 to 63)	Acoustically unstructured unit with some faint subparallel reflectors.	Fine grained, glauconitic marine sand with some silty clay.	Pre-Earliest occupation of the UK
2	Westkapelle Ground Formation (Lower Pleistocene) (MIS 103 to 63)	Acoustically unstructured unit with a generally faint basal reflector.	Deltaic silty clays and sands.	Pre-earliest occupation of the UK
1	Red Crag Formation (Late Pliocene)	Acoustically unstructured unit with some parallel internal reflectors.	Glauconitic marine sands.	Pre-earliest occupation of the UK
(1) Based on geophysical data (2) Based on borehole data and Cameron et al., (1992)				

79. The stratigraphy set out in ***Table 16.13*** is a combination of the all the interpreted shallow geological units from across the combined study areas for East Anglia ONE North, East Anglia TWO and the East Anglia ONE North and East Anglia TWO offshore cable corridors. The entire stratigraphy was not identified in any one single study area. Only the geology as relevant to understanding seabed prehistory within the East Anglia ONE North and the East Anglia One North offshore cable corridor study area is discussed below.

80. Units 1, 2 and 3 pre-date the earliest known occupation of Britain and are not considered to be of archaeological interest. Unit 3 is seen in the windfarm site only and Units 1 and 2 have been identified within the offshore cable corridor but not the windfarm site.

81. The earliest direct evidence for hominin activity in Britain has been identified from the Lower Palaeolithic (*c.* 970,000 to 300,000 BP, >MIS 9) at the sites of Happisburgh, on the Norfolk coast, and Pakefield, on the Suffolk coast, which date from c. 900,000 and 700,000 BP respectively (Parfitt et al. 2005; 2010). Within the study area, however, the earliest identified sediment correlating to phases of known human presence is Unit 4. Towards the east of the site, a blanket deposit of Yarmouth Roads formation (Unit 4) is present exposed on the seabed or beneath a veneer of modern marine sediments. This unit is interpreted as a delta top deposit with fluvial, estuarine and shallow marine components, extensive throughout the southern North Sea (Cameron et al. 1992). Unit 4 is not seen in the offshore cable corridor.

82. The upper layers of Yarmouth Roads are contemporaneous with the Cromer Forest Beds of North Norfolk and the Palaeolithic sites at Pakefield and Happisburgh. This indicates that the upper layers of Yarmouth Roads formation, which have been known to contain wood and peat remains, are of potential archaeological and palaeoenvironmental interest. However, due to the erosion caused by the subsequent Anglian glaciation, it is possible that few of these layers survive offshore. The delta / beach deposits of the Yarmouth Roads formation have also been identified two of the existing boreholes logs from the windfarm site (Borehole EA10-1-013 and Borehole EA10-1-009). In Borehole EA10-1-009, this underlies deposits interpreted as Brown Bank Formation (Unit 6).

83. Brown Bank Formation (Unit 6), which dates to the Middle Palaeolithic (300,000 to 40,000 BP) and was deposited during the late Ipswichian to Lower Devensian, is seen in both the offshore cable corridor and windfarm site. There is potential for both in situ and derived artefacts from the Middle Palaeolithic associated with this unit, although Lower Palaeolithic artefacts and land surfaces may also be preserved in situ beneath Unit 6.

84. Within the windfarm site Unit 6 is seen as a blanket deposit across the centre of the site, overlying both Unit 1 and Unit 2. At the base of the unit, several channel features are identified (75604, 75606, 75612-3, 75615 and 75617-8) possibly representing an eroded channel system, infilled with lower Brown Bank formation sediments (Unit 5), or an early phase of the Brown Bank formation (Unit 6). Two simple cut and fill features are also identified below Unit 6 (75602 and 75610) both with a single phase of acoustically unstructured fill (Unit 3). It is possible that these features are part of the same remnant of eroded palaeochannel system but, as their nature is less certain, they are considered of lower archaeological potential.

85. Brown Bank Formation is generally interpreted as a lagoon deposit although the number of internal reflectors seen in the geophysical data suggests that this may have a much more complex history including changes of sediment input and potential periods of drying out / terrestrial exposure. Within the offshore cable

corridor, a complex channel (780022), infilled during multiple phases of deposition, and incorporating possible relict dune features (780023) indicative of a significant period of aerial exposure and potentially protecting a buried land surface, (***Figure 16.2***). Unit 6 is also apparent either directly at the seabed, or beneath a veneer of modern sediments, in two areas (780024, 780025) close to the northern extent of East Anglia TWO (***Figure 16.2***).

86. Where there are Brown Bank formation channel features (Unit 5), the archaeological and palaeoenvironmental potential of the deposit is considered higher as these may indicate a former terrestrial landscape, and the areas immediately around the channel edges could have formed the focus for past human activity. Several other channels are identified across the windfarm site (74494-5, 75597-8, 75614, 75161, 75608 and 780053), either identified directly at the seabed, or beneath a veneer of modern marine seabed sediments. Three channels were reported as having high amplitude internal or basal reflectors in the 2014 data assessment (75597-8 and 75608). It is possible that this is indicative of an organic rich layer at the base of or within the features, which suggests that these features may be more likely to contain material of palaeoenvironmental interest. Two further high amplitude reflectors (75599 and 75631) have also been identified as potential containing a high percentage of organic material.

87. In addition there are 15 simple cut and fill features in the windfarm site (75329-30, 75336-7, 75596, 75600-1, 75605, 75619, 75632, 75634, 75637, 780050, 780052 and 780054) thought to be of similar age to these channels, but could not be traced any distance as coherent palaeochannels.

88. Unit 7 comprises pre-transgression fluvial, estuarine and terrestrial deposits laid down in the Holocene and with high potential to contain *in situ* and derived archaeological material, and palaeoenvironmental material. Three of the channel features described above (75594, 780053 and 75614) are thought to be infilled with Devensian Brown Bank formation deposits (Unit 6), However, a further three channel features are identified stratigraphically above and cutting into the interpreted Brown Bank formation (75597-8 and 75608), suggesting that they are post-Devensian in age. The three remaining channel features (75595, 75613 and 75616) are seen cutting into either Unit 3 or Unit 4. The age of these features is uncertain and they could be either Lower Devensian (Unit 5) or Pre-transgression features (Unit 7).

89. Similarly, within the offshore cable corridor there are a number of channels (780028, 780033 and 780034) and a complex channel (780043), also cut into Unit 1 or Unit 2, and interpreted as being of high archaeological potential. As above, the cut and fill features (780026,780027, 780029 to 780032 and 780035) are likely to be of similar age. One of these, interpreted as a complex cut and fill feature (780026), is seen on SBP data to cause some slight disturbance to lower horizons,

possibly indicative of increased gas content caused by the microbial breakdown of organic matter within the feature, which suggests that this feature is more likely to contain material of palaeoenvironmental interest.

90. In the nearshore area of the offshore cable corridor there are no interpreted palaeogeographic features, although there are seven separate areas (780036 to 780042) of acoustic blanking identified close to the seabed, possibly within a well-layered unit at the seabed and above the interpreted Westkapelle Ground Formation (Unit 2). This could represent an area of coarse sediment close to the surface causing acoustic blanking of the lower horizons. However, as acoustic blanking can also be indicative of the presence of gas, it may be that this feature represents gaseous organic matter such as peat. As such, these features have been retained as being of potential archaeological interest.

91. The modern marine sediment (Unit 8) is not considered to be of archaeological interest in itself although, in areas of mobile sediment (in particular where Unit 5 thickens into large sand waves), this unit has the potential to periodically bury maritime and aviation related archaeological material.

92. As agreed in consultation with Historic England, further geophysical and geotechnical survey will be undertaken post-consent and subject to archaeological and geoarchaeological assessment in order to further refine the interpretation of the potential for sea bed prehistory within the study area. This will contribute to the preparation of a Quaternary sedimentary deposit model for the study area as a primary objective in the delivery of mitigation to prevent significant impacts to sea bed archaeology.

16.5.2 Maritime and Aviation Archaeology

93. There are several recorded wrecks and obstructions charted by the UKHO (described below) although there are no known aircraft crash sites within the study area. Furthermore, there are no sites within the study area that are subject to statutory protection from the Protection of Wrecks Act 1973, the Protection of Military Remains Act 1986 or the Ancient Monuments and Archaeological Areas Act 1979.

94. Geophysical data (SSS, MBES and magnetometer) interpreted by Wessex Archaeology have demonstrated the presence of a total of 516 features within the East Anglia ONE North windfarm site. These features are discussed in detail in ***Appendix 16.1*** and are summarised in ***Table 16.14.*** A full list of sea bed features interpreted from the sub-bottom profiler and multibeam bathymetry data by Wessex Archaeology for the windfarm site are included in the gazetteer in Appendix 2 to ***Appendix 16.1.*** The locations of these features are illustrated on ***Figure 16.3 Maps a to d***).

Table 16.14 Anomalies of archaeological potential within the East Anglia ONE North windfarm site identified by Wessex Archaeology (*Appendix 16.1*, Table 8)

Archaeological discrimination	Quantity	Interpretation
A1	2	Anthropogenic origin of archaeological interest
A2	514	Uncertain origin of possible archaeological interest
A3	0	Historic record of possible archaeological interest with no corresponding geophysical anomaly
Total	516	

95. These anomalies have also been classified by probable type as shown in ***Table 16.15.***

Table 16.15 Types of anomaly within the East Anglia ONE North windfarm site identified by Wessex Archaeology (*Appendix 16.1*, Table 9)

Anomaly classification	Definition	Number of anomalies
Wreck (A1)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	2
Debris field (A2)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	14
Debris	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin.	74
Seabed disturbance (A2)	An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the sea bed.	9
Rope/chain (A2)	Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous)	6
Bright reflector (A2)	Individual objects or areas of low reflectivity, characteristic of materials that absorb acoustic energy, such as waterlogged wood or synthetic materials. Precise nature is uncertain	5
Dark reflector (A2)	Individual objects or areas of high reflectivity, displaying some anthropogenic characteristics. Precise nature is uncertain	164
Magnetic (A2)	No associated sea bed surface expression, and have the potential to represent possible buried ferrous debris or buried wreck sites	242
Total		516

96. Of the two wrecks (A1) within the windfarm site, only one has previously been charted by the UKHO. Anomaly 70609 (***Appendix 16.1***, Wreck Sheet 1) relates to

the possible remains of *Edinardu Antoinette* a Belgian sailing/fishing vessel which sank following a collision in 1926. The second A1 anomaly, 77111, (***Appendix 16.1***, Wreck Sheet 2) is described as a collection of debris, interpreted as being an unknown wreck.

97. A total of 514 anomalies have been discriminated as A2. These sea bed features have been identified as being of possible anthropogenic origin and have the potential to represent archaeological material on the sea bed of maritime or aviation origin. Magnetic only anomalies (without visible surface expression) may indicate the presence of buried objects with ferrous content that are of archaeological potential. It should be noted, however, that due to the magnetometer line spacing (1000m), it cannot be guaranteed that all ferrous items have been identified within the windfarm site. As agreed in consultation with Historic England, however, further magnetometer data will be acquired post-consent to provide additional detail which will inform the final layout of foundations and cables required for the project.

98. Sidescan sonar, multibeam bathymetry and magnetometer data interpreted by Wessex Archaeology has demonstrated the presence of a total of 874 features within the offshore cable corridor, including the section which extends towards East Anglia TWO and a section to the north of nearshore area which is now excluded following refinement of the offshore cable corridor boundary. These features are discussed in detail in ***Appendix 16.2***. Only those features within (or in close proximity to) the East Anglia ONE North offshore cable corridor (596 in total) are discussed below, as summarised in ***Table 16.16***. A full list of sea bed features interpreted from the sub-bottom profiler and multibeam bathymetry data by Wessex Archaeology for the cable corridor are included in the gazetteer in Appendix 1 to ***Appendix 16.2***. The locations of these features are illustrated on ***Figure 16.4***).

Table 16.16 Anomalies of archaeological potential within the East Anglia TWO cable corridor identified by Wessex Archaeology (*Appendix 16.2*, Table 8)

Archaeological discrimination	Quantity	Interpretation
A1	26	Anthropogenic origin of archaeological interest
A2	569	Uncertain origin of possible archaeological interest
A3	1	Historic record of possible archaeological interest with no corresponding geophysical anomaly
Total	596	

99. These anomalies have also been classified by probable type as shown in ***Table 16.15.***

Table 16.17 Types of anomaly within the East Anglia TWO cable corridor identified by Wessex Archaeology (*Appendix 16.2*, Table 9)

Anomaly classification	Definition	Number of anomalies
Wreck (A1)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	8
Recorded Wreck (A1, A3)	Position of a recorded wreck at which previous surveys have identified definite sea bed anomalies, but for which no associated feature has been identified within the current data set.	2
Debris field (A1)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	4
Debris field (A2)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	7
Debris (A1)	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin. Debris anomalies are assigned A1 on the basis that they are considered to represent likely associated wreck debris.	12
Debris (A2)	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin.	54
Seabed disturbance (A1)	An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the sea bed.	1
Seabed disturbance (A2)	An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the sea bed.	8
Rope/chain (A2)	Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous)	15
Bright reflector (A2)	Individual objects or areas of low reflectivity, characteristic of materials that absorb acoustic energy, such as waterlogged wood or synthetic materials. Precise nature is uncertain	10
Dark reflector (A2)	Individual objects or areas of high reflectivity, displaying some anthropogenic characteristics. Precise nature is uncertain	96
Magnetic (A2)	No associated sea bed surface expression, and have the potential to represent possible buried ferrous debris or buried wreck sites	379
Total		596

100. Each of the eight wrecks (A1) within the offshore cable corridor have previously been charted by the UKHO. Of those wrecks identified within the offshore cable corridor, seven are named wrecks, summarised in ***Table 16.18***.

Table 16.18 Summary of named wrecks within the offshore cable corridor

Anomaly	Summary	UKHO ID
70641	The wreck of the *St Patrick* (***Appendix 16.2***, Wreck Sheet 1), a wooden motor fishing vessel lost in 1976	10350
70645	The wreck of the *Groenlo* (***Appendix 16.2***, Wreck Sheet 2), a steamship that was torpedoed in 1941	10357
700218	The wreck of the *Jim* (***Appendix 16.2***, Wreck Sheet 3), a steamship built in 1908	10313
700244	The wreck of the *Mangara* (***Appendix 16.2***, Wreck Sheet 4), a steamship lost in 1915 having been torpedoed	10325
700255	The wreck of the *Alastair* (***Appendix 16.2***, Wreck Sheet 5), a steamship that was mined in 1915	10331
700591	The wreck of the *Magdapur* (***Appendix 16.2***, Wreck Sheet 7), a steamship that was mined in 1939	10321
700786	The wreck of the *Mascotte* (***Appendix 16.2***, Wreck Sheet 8), a steamship that was mined in 1916	10338

101. The eighth wreck within the offshore cable corridor is anomaly 700262, which corresponds to an unknown wreck recorded by the UKHO (UKHO 87913) (***Appendix 16.2***, Wreck Sheet 6). In addition, one recorded wreck (700565) was assigned an A1 archaeological discrimination as, although it was not covered by the geophysical data, a large magnetic anomaly on the closest line of magnetometer data indicated the wrecks presence on the seabed.

102. Four debris fields have been identified within the offshore cable corridor and also discriminated as A1. Anomaly 70639 (***Appendix 16.2***, Wreck Sheet 9) comprises a concentration of items of various shapes and sizes thought to be associated with unidentified wreck (UKHO 10674). Anomaly 700835 also consists of a collection of items, thought to be related to the wreck of the *Groenlo* (70645, UKHO 10357). Anomalies 700257 and 700258 (***Appendix 16.2***, Wreck Sheet 10), both comprising items of linear appearance and ferrous content, are located c. 70m from each other and have not been correlated to any existing records

103. Alongside the wrecks and debris fields outlined above, 12 distinct items of wreck-related debris (A1) have also been identified within the offshore cable corridor. Anomaly 700254 has been classified as debris identified as a possible rope and item that may be associated with the wreck of the *Alastair* (700255, UKHO 10331). Anomalies 700263 and 700829 represent debris thought to be associated with unnamed wreck 700262 (UKHO 89713) and the wreck of the *St. Patrick* (70641, UKHO 10350), respectively. Anomalies 700822-4 are interpreted as items of debris which may be associated with the debris field of an unknown wreck (70639).

Anomalies 700836-9 have been classified as debris which are possibly associated with the wreck of the *Groenlo* (70645, UKHO 10357). The remaining anomalies classified as debris comprise 700590 *(**Appendix 16.2***, Wreck Sheet 11*)* and 700605 *(**Appendix 16.2***, Wreck Sheet 12*)* which may represent possible wreck sites or associated debris.

104. In addition to the wrecks, debris fields and items of likely associated wreck debris, anomaly 700600 has also been classified as A1. This has been identified as an area of seabed disturbance associated within a very large magnetic anomaly, indicating a significant amount of ferrous material. This anomaly is located approximately 780 m from the wreck of the *Magdapur* (700591, UKHO 10321) although it is not clearly associated with the wreck.

105. A total of 569 anomalies have been discriminated as A2 and which, as described above for the windfarm site, have the potential to represent archaeological material on the sea bed of maritime or aviation origin. It should be noted, however, that due to the magnetometer line spacing (1000m), it cannot be guaranteed that all ferrous items have been identified within the offshore development area. As agreed in consultation with Historic England, however, further magnetometer data will be acquired post-consent to provide additional detail which will inform the final layout of foundations and cables required for the project.

106. One feature has been given an A3 discrimination, located just outside and to the north of the offshore cable corridor at the nearshore end. Feature 700563 corresponds to a charted unknown wreck site (UKHO 87912), the recorded location of which is beyond the coverage of the geophysical datasets.

107. In addition to the known wrecks and anomalies described above, there is also potential for the presence of further maritime archaeological material to be present, dating from the Mesolithic period up to the present day, which has not previously been identified. There are many factors which affect the visibility and subsequent identification of wreck remains on the seafloor during hydrographic surveys (e.g. wooden-hulled vessels buried within sea bed sediments are less likely to be visible on geophysical survey data). As such, the potential for remains to exist depends on an understanding of the variable survivability and visibility of wrecks on the sea bed, with factors of consideration including the age of the vessel, the construction material, the sea bed sediment type, the prevailing hydrodynamic and sedimentary regimes of the area and the occurrence of any sea bed activities in that location. In the East Anglia ONE North windfarm site and offshore cable corridor, the greatest potential for previously undiscovered wreck material to be present is most likely to be associated with areas of sand waves where greater depths of sand may have incorporated and buried archaeological remains. A deposit of post-transgression Holocene marine sediment (Unit 5) is present across the study area which varies in thickness from a thin veneer to sand waves.

108. Within the study area there are 16 recorded losses of wrecks which have not previously been associated with identified wrecks on the sea bed. These are summarised in ***Table 16.19***.

Table 16.19 Summary of recorded losses

NRHE ID	Name	Date of Loss	Nationality	Type	Loss location
1300360	Britannia	1772	British	Wooden Sailing Vessel	Thorpe Ness
1243125	Reaper	1828	English	Wooden Sailing Vessel	Thorpe Ness
1235741	John	1851	English	Snow	Thorpe Ness
1236003	Frederick	1852	English	Brig	1 Mile south of Thorpe Ness
1432209	Corinthian	1852	English	Brig	Thorpe Ness
1211668	Sybil	1859	Welsh	Brigantine	Thorpe Ness
1337643	Henry Everest	1862	English	Barge	Off Thorpe Ness
1337883	Comorn	1868	British	Brigantine	Thorpe Ness Point
1211094	Thankful	1883	English	Snow	Thorpe Ness
1245992	Pallion	1883	British	Cargo vessel	Thorpe Ness Beach
1338616	Topaz	1885	English	Barge	Off Thorpe Ness
1338645	Lady Ernestine	1886	English	Schooner	Thorpe Rocks
1211285	Tricksey Wee	1886	English	Brig	Thorpe Ness Beach
1211501	Nancy	1887	English	Smack	Thorpe Ness Beach
1211508	Sirius	1888	German	Steamship	Thorpe Rocks
1339098	Australia	1892	English	Ketch	2 miles north of Aldeburgh Coastguard Station

109. The NRHE groups recorded losses at arbitrary points on the sea bed called Named Locations. Named locations represent general loss locations (e.g. off the coast of Suffolk) and do not (except by chance) relate to actual sea bed remains. Each of these 16 recorded losses is grouped at the location 'Thorpe Ness Suffolk', located just offshore from the landfall (***Figure 16.5***). As further information becomes available it is possible that any of the unnamed wrecks identified within the study

area may be correlated to one of these records of loss. Similarly, A2 anomalies of potential archaeological interest may also represent remains associated with any one of these losses.

110. A detailed analysis of the potential for maritime archaeology within the former East Anglia Zone was included as part of the ZEA, and as part of the DCO submissions for both East Anglia ONE (EAOW 2012) (Chapter 17, Appendix 17.1) and East Anglia THREE (EATL, 2015) (Chapter 17, Appendix 17.1). This potential is summarised in ***Table 16.20.***

Table 16.20 Summary of key areas of maritime archaeology potential

Period	Summary
Pre-1508AD	Potential for material associated with prehistoric maritime activities. Prehistoric maritime activities include coastal travel, fishing and the exploitation of other marine and coastal resources. Vessels of this period include rafts, hide covered watercraft and log boats. Such remains, if present, are likely to be concealed and protected by the extensive Holocene alluvium associated with the fairly rapid post-Devensian rise in sea level.
	Potential for material associated with later prehistoric maritime activities, including watercraft suitable for cross channel voyages to facilitate trade and the exploitation of deep water resources. Such remains are likely to comprise larger boat types, including those representing new technologies such as the Bronze Age sewn plank boats which are associated with a growing scale of seafaring activities.
	Potential for material of Romano-British date, associated with the expansion and diversification of trade with the Continent. Watercraft of this period, where present, may be representative of a distinct shipbuilding tradition known as 'Romano-Celtic' shipbuilding, often considered to represent a fusion of Roman and northern European methods.
	Potential for material associated with coastal and seafaring activity in the 'Dark Ages', associated with the renewed expansion of trade routes and Germanic and Norse invasion and migration. Vessels of this period may be representative of new shipbuilding traditions such as the technique.
	Potential for material associated with medieval maritime activity, including that associated with increasing trade between the UK and Europe, the development of established ports around the southern North Sea and the expansion of fishing fleets and the herring industry. Vessels of this period are representative of a shipbuilding industry which encompassed a wide range of vessel types (comprising both larger ships and vernacular boats). Such wrecks may also be representative of new technologies (e.g. The use of flush-laid strakes in construction), developments in propulsion, the development of reliable navigation techniques and the use of ordnance.
1509 to 1815AD	Increasing potential for post-Medieval shipwrecks representative of continuing technological advances in the construction, fitting and arming of ships, and in navigation, sailing and steering techniques. Vessels of this period continued to variously represent both the clinker techniques and construction utilising the flush-laid strakes technique.

Period	Summary
	Increasing potential for post-Medieval shipwrecks associated with the expansion of transoceanic communications and the opening up of the New World.
	Increasing potential for post-Medieval shipwrecks associated with the establishment of the Royal Navy during the Tudor period and the increasing scale of battles at sea, such as those of the Anglo-Dutch wars (particularly those fought off the East Anglian coast).
	Increasing potential for post-Medieval shipwrecks associated with continuing local trade and marine exploitation including the transport of goods associated with the agricultural revolution.
1816 to 1913AD	Increasing potential for the discovery of shipwrecks associated with the introduction of iron and later steel in shipbuilding techniques. Such vessels may also be representative of other fundamental changes associated with the industrial revolution, particularly with regards to propulsion and the emergence of steam propulsion and the increasing use of paddle and screw propelled vessels
	Potential for the discovery of shipwrecks demonstrating a diverse array of vernacular boat types evolved for use in specific environments
	Potential for wrecks associated with large scale worldwide trade, the fishing industry or coastal maritime activity including marine exploitation
1914 to 1945AD	Potential for the discovery of shipwrecks associated with the two world wars including both naval vessels and merchant ships. Wrecks of this period may also be associated with the increased shipping responding to the demand to fulfil military requirements. A large number of vessels dating to this period were lost as a result of enemy action.
Post 1946	Potential for wrecks associated with a wide range of maritime activities, including military, commerce, fishing and leisure. Although ships and boats of this period are more numerous, loses decline due to increased safety coupled with the absence of any major hostilities. Vessels dating to this period are predominantly lost as a result of any number of isolated or interrelated factors including human error, adverse weather conditions, collision with other vessels or navigational hazards or mechanical faults.

111. Similarly, while there are no known aircraft crash sites, nor reported losses, within the study area, there is potential for the discovery of previously unknown aircraft material, also associated with Unit 5. Military aircraft crash sites are of particular importance as all aircraft lost in military service are automatically protected under the Protection of Military Remains Act 1986. As for maritime archaeology, a detailed analysis of the potential for aviation archaeology within the former East Anglia Zone was included as part of the ZEA, and as part of the DCO submissions for both East Anglia ONE (Chapter 17, Appendix 17.1) and East Anglia THREE (Chapter 17, Appendix 17.1). This potential is summarised in ***Table 16.21.***

Table 16.21 Summary of key areas of aviation archaeology potential

Period	Summary
Pre-1939	Minimum potential for material associated with the early development of aircraft. Aircraft of this period may represent early construction techniques (e.g. those constructed of canvas covered wooden frames) or may be associated with the mass-production of fixed wing aircraft in large numbers during WWI.
	Minimum potential for material associated with the development of civil aviation during the 1920s and 1930s, associated with the expansion of civilian flight from the UK to a number of European and worldwide destinations.
1939 to 1945	Very high potential for WWII aviation remains, particularly as the East Anglian region acted as a hub for hostile activity. Aircraft of this period are likely to be representative of technological innovations propelled by the necessities of war which extended the reliability and range of aircraft.
Post-1945	Potential for aviation remains associated with military activities dominated by the Cold War, the evolution of commercial travel and recreational flying and the intensification of offshore industry (including helicopter remains). Aircraft of this period may be representative of advances in aerospace engineering and the development of the jet engine.

16.5.3 Intertidal Archaeology

112. As described in ***Chapter 6 Project Description*** the landfall to the north of Thorpeness is characterised by a shingle beach, with a raised terrace of shingle at the base of low lying cliffs which are partially vegetated by grasses, gorse and other small shrubs. There are no existing coastal defences at the landfall.

113. There are five records from the Suffolk HER relating to heritage assets mapped as wholly or partially within the intertidal zone within the study area (***Figure 16.5***).

114. One of these relates to the discovery of a clinker boat fragment washed up on the beach at Thorpeness Point (MSF 18832). The fragment is reported as ‘circa 40 feet long’ (c. 12m) and with ‘ribs and planking dowelled together’. The fragment is suggested to be about 150 years old. This discovery indicates the potential for further wreck remains, and associated artefacts, to be present, either lost on or washed up on the beach. For example, one of the reported losses described in ***section 16.5.2*** above, describes the wreck of *Tricksey Wee*, stranded at Thorpeness Beach in 1886. However, the potential for the burial for substantial remains to be present within the shingle beach is significantly reduced in comparison to the preservation of finer grained, sandier beaches, for example. This suggests that the potential for maritime related artefacts is more likely limited to isolated discoveries.

115. The remaining four records all relate to World War II defences:

- ARG032: Two World War II strongpoints on Thorpeness Common:

    - These two strongpoints are visible as structures and earthworks on aerial photographs from 1940 onwards, set back from the cliff edge.
- ARG052: World War II coastal defences to the North of Thorpeness:
    - A pillbox and associated barbed wire obstructions of World War II date are visible as structures on aerial photographs.
- LCS119: Extensive World War II beach scaffolding:
    - An extensive length of World War II anti-invasion beach scaffolding is visible on aerial photographs as a structure, running for c. 7km. Structures visible slightly to the east on the beach on aerial photographs of 1983 might also be the remains of beach scaffolding or the remains of earlier 'dragon's teeth' obstructions. Remains were also seen eroding from the cliff (concrete squares/blocks with remains of scaffolding poles cemented in).
- ARG033: A World War II Chain Home Extra Low Station K164:
    - The site of a Chain Home Extra Low (CHEL) radar station at Thorpeness. It was commissioned by the Royal Air Force in 1942 to provide low-coverage radar during the Second World War. The site was being developed for housing by 1969.

116. Beach defences were also recorded as part of the Suffolk Rapid Coastal Zone Assessment project which comprised a desk-based review followed by an intertidal field survey intended to verify the existence of features undertaken in 2002 (RCZA) (Everett et al 2003) (***Figure 16.5***). RCZA Site 507 is a record of a pillbox on the cliff top, corresponding to ARG033 and RCZA Site 511 is a record of a large open fronted blockhouse, also on the cliff top, corresponding to ARG032. A third record within the study area (RCZA 508) describes a ‘spread of concrete boulders and rubble including bonded blockwork’ on the beach possibly from an old pillbox on the cliff edge. This spread of rubble is recorded from the area of ARG052 and ARG032 and could originate from either site.

117. During the walkover survey undertaken by Headland Archaeology (see ***Appendix 24.1***), evidence of cliff erosion was noted at the eastern extent of the IODA, where fragments of concrete and metal relating to World War II defences were observed on the beach and within the cliff section. Three of the locations listed above were included in the walkover survey and the following observations were made:

- ARG032: Two World War II strongpoints on Thorpeness Common:
    - Not visible upon land. Area obscured by woodland and dense scrub overgrowth. Possibly visible from beachfront as decayed metal eroding from cliff face and concrete collapsed onto beachfront.
- ARG052: World War II coastal defences to the North of Thorpeness:

    - Eroded re-enforced concrete lumps located on beach. Visible sizes of 0.4 x 0.3m, 0.4 x 1.05m and 1.2 x 0.5m. Heavily decayed and partially covered by beach stone.
- ARG033: A World War II Chain Home Extra Low Station K164:
    - Not visible. Large area obscured by gorse and scrub overgrowth. Parts also inaccessible/fenced off due to cliff erosion and private land. Ceramic building material and concrete rubble eroding from top of cliff face is visible on the beach front.

118. This last record is located adjacent to ARG034 (WWII Strong point and Diver battery), recorded by the HER above MHWS. Headland Archaeology suggest that the material eroding from the top of the cliff face may also be associated with ARG034.

119. Neither the RCZA nor the walkover survey LCS119by Headland Archaeology recorded any evidence of beach scaffolding (LCS119) although during the RZCA field survey, remains were observed within Leiston Parish, further to the north along the beach (RCZA Site 520), eroding from a sandbank and described as:

    - concrete square with remains of scaffolding poles cemented in. Other block to left. Also concrete blocks visible on mid-tide line 3/400m N and S of feature. Concrete has rusted metalwork protruding.

120. The potential for the remains of World War II defences within the study area should be considered high. This may include the remains of anti-invasion beach scaffolding. Although no evidence of this specific feature, recording as running southwards for c. 7km from Leiston Parish, has been seen during walkover surveys, remains may still be present buried within the beach.

121. As part of the archaeological desk-based assessment undertaken by Headland (see ***Appendix 24.1***), LiDAR[2] data, aerial photographs and historic mapping data was used to identify potential sub-surface remains across the indicative onshore development area. As part of this exercise a number of previously unrecorded sites / features of potential archaeological interest were identified. Those found to partially intersect the intertidal zone comprise HA61 (a triangular feature interpreted as a possible field drain) and HA69 (enclosures, field boundaries and structures), each of which were indicated by aerial photographic data. The degree to which these features intersect the intertidal zone is minimal. Cable installation within the intertidal zone will avoid these assets, with the use of HDD with entry on the landward side of the cliffs, and exit below MLWS in the marine zone. The

[2] Light Detection and Ranging

potential exposure of these assets as part of groundworks on the landward side of the cliffs is considered as part of ***Chapter 24 Archaeology and Cultural Heritage***.

122. The potential for buried prehistoric remains, including palaeoenvironmental evidence, to be encountered within the intertidal zone is low. The use of HDD, with entry on the landward side of the cliffs, and exit below MLWS in the marine zone, means that surviving terrestrial land surfaces or prehistoric deposits of archaeological potential which may be present will not be exposed during cable installation.

16.5.4 Historic Seascape Character and Setting

123. The HSC of coastal and marine areas around England has been mapped through a series of eight separate projects funded by Historic England and undertaken between 2008 to 2015. The study area is located within the Newport to Clacton HSC (Oxford Archaeology 2011). This has since been followed by an initiative to consolidate the existing projects into a single national database (LUC, 2017). The programme uses a Geographic Information System (GIS) to map data that can be queried to identify the key cultural processes that have shaped the historic seascape within a given area.

124. The consolidated national GIS dataset was mapped against the study area to identify the primary cultural processes which have shaped the historic seascape of the study area. This includes both the current character types and the previous (prehistoric and historic) character types for which information is available. The accompanying character texts were used to identify the primary values and perceptions for each character type summarised in ***Table 16.22.***

Table 16.22 HSC – primary cultural processes in the study area

Broad Character Types	Character Sub-Types	Perceptions
Communications	Submarine telecommunication cable	Submarine telecommunications cables are mostly undetected in the marine environment. However, they are a highly reliable form of transferring information and are critical to our present-day life. They can be perceived as obstacles to certain sea users such as fishermen and dredgers.
Cultural Topography	Cliff	In East Anglia in general cliffs are primarily formed from clays and sand, making them very soft and subject to erosion. Cliffs have cultural value as vantage points and for recreational uses such as coastal walks and many serves as familiar coastal landmarks for land and sea users. Archaeological remains are often recovered eroding from the cliff, and within the study area, fragments of concrete and metal relating to WWII have been observed on the beach and within the cliff section (***Appendix 24.1***).

Broad Character Types	Character Sub-Types	Perceptions
	Shingle foreshore	In England as a whole, this character type remains highly valued as a place for inspiration and recreational activities (see summary for leisure beach below).
	Coarse sediment plains Fine sediment plains Mud plains Mixed sediment plains Sand banks with sand waves	The marine cultural topography overall is highly valued due to its biodiversity and habitat range and has high archaeological potential and can contribute to our understanding of past landscape use. These five types of sea bed sediments each provide distinct preservation conditions for wrecks and implications for the potential form and survival of underlying palaeolandscapes.
Fishing	Bottom trawling Drift netting Fishing ground Longlining Pelagic trawling Potting	Commercial fishing has long been important to this region and the industry remains a distinctive element of the East Anglian coastal character. Generally fishing fleets today have distinct fishing grounds, predominantly within 10 km of their home port. As such the local fishermen from each area know their particular area intimately. From a recreational point of view the traditional fishing industry has now taken on an almost 'quaint' character, a memory of better days. To the north of the landfall, Sizewell is a small fishing village with some boats still in operation from the beach and a strong recreational fishing community. Thorpeness to the south also has its origins as a small fishing Hamlet in the late 19th century.
Industry	Energy industry, hydrocarbon pipeline	The North Sea as a whole has always been important to the energy industry, most notably for its natural oil and gas resources which have been heavily exploited since the 1960s. More recently nuclear power and renewable energy sources have become viewed as more important as a result of increasing concerns about CO2 emissions from energy generation using fossil fuels. The North Sea and in particular the East Anglian coast has remained crucial to these newer energy industries.
Navigation	Maritime Safety, Daymark	Overall maritime safety features are considered both invaluable and locally characteristic of this area, although those located wholly offshore will only be known to small sectors of the community. The coastal landscape is dotted with daymarks and lighthouses which are now seen as particularly iconic. The HSC within the study area describes a Church tower (daymark).

Broad Character Types	Character Sub-Types	Perceptions
	Navigation hazard, hazardous water, wreck hazard	Historically, the sea has been perceived as a dangerous place which often behaves in expected and unpredictable ways. Based on the UKHO definition, wrecks become dangerous in shallow water when they are either exposed and/or found less than 10m below the sea-level. Wrecks have most relevance from their roles as hazards to navigational activity or as indicators of areas and routes of past navigational, naval or trading activity. For example, the study East Coast War Channels in the First and Second World War (Firth, 2014) examines the spatial extent of navigation channels and minefields between the Thames and the Scottish border during both wars and the heritage assets that are associated with these channels. Hazardous water includes wrecks and other hazards such as submerged rocks, shoal or flats. Navigational hazards have always been a preoccupation for sailors but they became prominent in people's consciousness, including in tales and myths, evoking rhymes and songs, due to the danger associated within them. Wrecks, although fatal for many, added to the local heritage of stories about dangers on the high seas. There are also now perceived as recreational opportunities, with many wrecks dived by both amateur dive groups and professional organisations. Many wrecks are also valued for their strong contribution to habitat diversity and by the fishing community as they attract certain prey specifies. See ***section 16.5.2*** for detail on wrecks within the study area.
	Navigation route Ferry crossing (Harwich to Esbjerg/ Harwich - Hook of Holland Ferry/ Kingston upon Hull - Zeebrugge Ferry)	Navigation activity has always been important to the East Anglian region economy and coastal character. For centuries communities have made their living from their proximity to the North Sea and its connecting routes, linking East Anglia to other parts of Britain and to the continent. Navigation activities are deeply ingrained in the psyche of the local communities.
Recreation	Leisure beach Leisure sailing	Recreation has long had a major formative role along much of England's present coastline. Primarily associated with positive outcomes including health benefits, greater social inclusion, cohesion and quality of life valued for its contributions to society as a whole. Much recreation is

Broad Character Types	Character Sub-Types	Perceptions
		essentially about various form of human enjoyment of landscape and seascape as an amenity. Specific to the study area, the Suffolk Coastal Path is promoted locally as part of the around England coastal path and an Outstanding Landscape Walk within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB). In the early 20th century, Thorpeness to the south of the landfall was developed from a small fishing hamlet into a holiday haven by Glencairn Ogilvie, with a country club, operations and maintenance and other planned facilities. Thorpeness remains a popular seaside holiday destination. The nearshore area of the cable route is also described in the HSC as a racing area (sailing).
Previous character types	Palaeolandscape component	Within the study area, the HSC describes the known existence of a general palaeolandscape, considered to be a mixture of estuarine plateau and marshlands. In England, value is becoming more positive on these remains and resource due to growing interest in submerged landscapes fuelled by the media and popular culture. In particular there is a developing interest within certain sectors of society who come into contact with the resource (e.g. fishermen and aggregate dredgers). Submerged landscapes are becoming ever more recognised and valued within the archaeological community. See ***section 16.5.1*** for detail on submerged prehistoric landscapes within the study area.
	Naval battlefield	The HSC maps areas of enemy contact minelaying, torpedo raids and air attacks on the east coast shipping industry (June 1940-45). Associated with East Coast War Channels (Firth, 2014). See ***section 16.5.2*** for detail on World War II maritime activity within the study area.
	World War 2 defence area	The HSC maps a general area combining a number of different military defensive features and structures. In particular there was a World War II strongpoint surrounded by a minefield at Aldringham cum Thorpe. See ***section 16.5.3*** for detail on World War II coastal activity within the study area.

125. The setting of a heritage asset is described as the surroundings in which a heritage asset is experienced (Historic England, 2017). Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.

126. Within the East Anglia ONE North windfarm site only one of the wrecks is currently identified. The setting of the wreck of the *Edinardue Antoinette* (70609) may be considered to contribute to its significance in terms of its loss and subsequent survival within its area of operation as a Belgian fishing vessel. However, the identity of the wreck is tentative and is yet to be confirmed. For the unidentified wreck (77111) there is no further information which can be used to ascertain the contribution the setting makes to its significance.

127. Within the East Anglia ONE North cable corridor, four of the named wrecks were lost during the hostilities of WWI (700244 and 700255) and WWII (70645 and 700591). The study East Coast War Channels in the First and Second World War (Firth 2014) examines the spatial extent of navigation channels and minefields between the Thames and the Scottish border during both wars and the heritage assets that are associated with these channels. Together with the presence of military installations within the intertidal zone (ARG032, ARG052, LCS119 and ARG033), the context of the East Coast war channels represents the wider setting of 20th century military activity within which the study area is located. The remains of loss vessels which operated within the East Coast war channels may thus have a setting that contributes towards their significance when considered against the wider backdrop of hostile military action.

128. The settings assessment undertaken for onshore heritage assets is presented in ***Appendix 24.1***. This concludes that, onshore, there is potential for material change in the setting of heritage assets in the western end of the study area only. The planned infrastructure at the landfall, comprising buried cables installed using HDD, will not result in any permanent change to the setting of heritage assets within the intertidal zone.

16.5.5 Heritage Significance (importance)

129. The offshore and intertidal archaeological and cultural heritage baseline within the study area (based on available information) comprises:

- Palaeogeographic features of probable/possible archaeological interest (P1 and P2);
- Recorded wrecks (A1 and A3);
- Geophysical anomalies of possible archaeological interest (A2);
- World War II coastal and beach defences, and the potential for associated archaeological material buried within the beach;
- Potential for the discovery of prehistoric sites and artefacts from the lower Palaeolithic to the Mesolithic;
- Potential for the discovery of maritime related archaeological material from the late Mesolithic to the present; and

- Potential for the discovery of aviation related archaeological material from the 20th century.

130. The heritage importance of the heritage assets outlined above are presented in ***Table 16.23.*** For the purposes of assessment, the importance of potential discoveries has been defined as high importance for *in situ* sites and finds and medium importance for isolated finds within secondary contexts. However, each individual discovery would be considered independently and any requirements for further data gathering or analysis would be considered on a case-by-case basis according to the importance of the discovery. Known un-named wrecks (and associated debris) are also assigned as high importance. Should further information be acquired which serves to identify these wrecks and informs upon their nature and character, their heritage importance may be revised in light of new data.

Table 16.23 Assessment of heritage significance (importance)

Asset Type	Definition		Importance
Potential *in situ* prehistoric sites	Primary context features and associated artefacts and their physical setting (if/where present)		High
	Known submerged prehistoric sites and landscape features with the demonstrable potential to include artefactual material		High
Potential submerged landscape features	Other known submerged palaeolandscape features and deposits likely to date to periods of prehistoric archaeological interest with the potential to contain *in situ* material		High
Potential derived Prehistoric finds	Isolated discoveries of prehistoric archaeological material discovered within secondary contexts		Medium
Potential palaeoenvironmental evidence	Isolated examples of palaeoenvironmental material		Low
	Palaeoenvironmental material associated with specific palaeolandscape features or archaeological material		High
Known maritime heritage assets	Named wrecks and associated debris (A1)	*St Patrick* (70641) and debris 700829	Low
		Edinardue Antoinette (70609) *Groenlo* (70645), associated debris field 700835 and debris 700836-9 *Jim* (700218) *Mangara* (700244) *Alastair* (700255) and debris	Medium

Asset Type	Definition		Importance
		700254 *Magdapur* (700591) *Mascotte* (700786)	
	Debris identified as possible wreck sites or associated debris (A1)	700590, 700605, 700257 and 700258	High
	Un-named wrecks and associated debris fields / debris (A1)	77111, 700262, debris field 70639 and debris 700263, 700822-4,	High
	Seabed disturbance associated with large magnetic anomaly (A1)	700600	High
	Previously recorded wrecks not seen in geophysical data (A1, A3)	700565, 700563	High
Additional anomalies	Anomalies identified by geophysical assessment that could be of anthropogenic origin (A2)		High
Potential wrecks	Wrecks within the study area that are yet to be discovered		High
Potential derived maritime finds	Isolated artefacts lost from a boat or ship or moved from a wreck site		Medium
Potential aircraft	Aircraft within the study area that are yet to be discovered		High
Potential derived aviation finds	Isolated artefacts lost from an aircraft or moved from a crash site		Medium
Intertidal assets	Findspot (isolated boat fragment washed up on beach and no longer *in situ*)		Negligible
	World War II coastal defences (fragmentary and buried remains on beach)		Medium
Potential derived intertidal finds	Isolated artefacts and findspots dating to all periods which are located within the intertidal zone.		Medium

131. The named wreck of the *St Patrick* (70641, including associated debris 700829) is a modern wreck site and is assigned low heritage importance on this basis.

132. The remaining named wrecks represent vessels built in the late 19th / early 20th century, five of which were lost as a result of 20th century hostilities. The *Mangara* (700244), *Alastair* (700255, and associated debris 700254) and *Mascotte* (700786) were lost during WWI. The *Mascotte* and *Alastair* are recorded as relatively well intact wrecks, whereas the wreck of the *Mangara* is described as

being very large and dispersed, possibly in two pieces. The *Groenlo* (70645 and associated debris field 700835 and debris 700836-9) and *Magdapur* (700591) were lost during WWII and are recorded as being slightly broken up and broken in two, respectively. The date of loss of the *Jim* (700218), which presents as a large and dispersed wreck, is not recorded, although as a vessel built in 1908 it is likely that this vessel too was lost as a result of 20th century hostilities. The *Edinardu Antoinette* sank following a collision in 1926. These wrecks are each considered to represent average examples of wrecks from this period, exhibiting characteristics which are relatively well represented in the known wreck resource around the UK. On the basis that they may be considered to as assets of regional importance due to their association with the World Wars and the East Coast channels, they are regarded as heritage assets of medium importance.

16.5.6 Anticipated Trends in Baseline Conditions

133. The existing environment for offshore archaeology and cultural heritage as set out above has been shaped by a combination of factors, with the most prevalent being changes in global sea levels and associated climatic and environmental conditions which have affected the burial and preservation of prehistoric archaeology, and latterly that of maritime and aviation archaeology.

134. Historic England (2018) recognise, 'that the marine and inter-tidal zones are dynamic and have always undergone natural environmental change and changing patterns of use and exploitation which are nothing new'.

135. In terms of natural coastal change, the landfall is located within a dynamic stretch of coastline, with coastal erosion and shoreline retreat, including collapsing cliffs, representing a significant concern in the region. Historical trends indicate that erosive conditions are likely to be ongoing, resulting in the erosion and exposure of heritage assets currently present within and along this stretch of the coastline. Within the study area, as discussed in ***section 16.5.3*** above, there is evidence of cliff top military defences eroding onto the beach although, elsewhere entire settlements have been lost to the sea, such as Dunwich in Suffolk. The concrete and metal material eroding from the top of the cliff face (above MHWS) thought to be the remains of a WWII Strong point and Diver battery (ARG034) observed and recorded by Headland Archaeology as part of a walkover survey provide one such example.

136. Patterns of extreme weather can also impact archaeology. Trends identified as part of the national HSC recognise that climate change impacts on water temperature, for example, are already changing the microclimates where wrecks are located and affecting their preservation. Furthermore, although sea levels are comparatively stable at present, cycles of burial and exposure resulting from marine physical processes, including storm events which can result in the stripping of shallow sediment from the sea bed and beach, have an ongoing effect upon the

preservation of archaeological material. For example, high levels of ongoing storm activity in early 2014 revealed a number of wrecks around the country on beaches that had rarely or never been seen before. By contrast, increased burial arising as a result of changes in marine physical processes due to climate change may cause heritage assets to be subject to increase levels of burial. Exposed heritage assets are at greater risk from erosion and degradation as a result of the effects of physical processes than those which remain buried and are consequently provided with greater protection from continued sediment cover. These cycles of burial and exposure are anticipated to continue although the effect upon individual heritage assets is difficult to predict as this will depend upon site specific conditions and will vary depending upon the nature of any exposed archaeology.

16.6 Potential Impacts

137. This section outlines potential impacts as a result of the project and their significance, using the assessment methodology described in ***section 28*** and ***Chapter 5 EIA Methodology*****.**

138. The proposed East Anglia ONE North project has the potential to impact upon the historic environment in a number of ways, through both direct (physical) changes and indirect changes (e.g. non-physical changes to the setting of heritage assets or alteration to heritage assets as a result of changes to physcial processes arising as a result of the proposed East Anglia ONE North project).

139. Direct (physical) impacts, as stated in the NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b: 49), encompass direct effects from the physical siting of the project. Direct impacts to heritage assets, either present on the seafloor or buried within sea bed deposits, may result in damage to, or total destruction of, archaeological material or the relationships between that material and the wider environment (stratigraphic context or setting). These relationships are crucial to developing a full understanding of an asset. Such impacts may occur if heritage assets are present within the footprint of elements of the proposed East Anglia ONE North project (i.e. foundations or cables) or within the footprint of activities such as sea bed clearance, anchoring or the placement of jack up barges.

140. The proposed East Anglia ONE North project also has the potential to change the hydrodynamic and sedimentary process regimes, both locally and regionally. Alterations to hydrodynamic and sedimentary process regimes may result in impacts of an in-direct (physcial) nature occuring upon heritage assets. Changes in coastal processes can lead to re-distribution of erosion and accretion patterns while changes in tidal currents, for example, may affect the stability of nearby morphological and archaeological features. Indirect impacts to heritage assets may occur if buried heritage assets become exposed to marine processes, due to increased wave / tidal action for example, as these will deteriorate faster than those

protected by sediment cover. Conversely, if increased sedimentation results in an exposed site becoming buried this may be considered a beneficial impact.

141. Indirect impacts on the historic environment of a non-physical nature, as stated in NPS EN-3 (DECC 2011b: 67), include effects on the setting of heritage assets. Indirect impacts upon the setting of heritage assets have the potential to occur throughout the lifetime of the project, thus encompassing all phases, from construction, into operation and subsequent decommissioning. The setting of a heritage asset is the surroundings in which a heritage asset is experienced (Historic England 2017). Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral. Indirect impacts to setting may occur if a development affects the surroundings in which a heritage asset is experienced. Similarly, impacts to the character of the historic seascape may occur with the introduction of new elements causing a change in that character which may affect present perceptions of that seascape across an area. Indirect impacts upon the setting of heritage assets may arise as a result of above sea bed infrastructure for the project during the operational phase, the effects of which may be long-term or permanent in nature. Indirect impacts upon the setting of heritage assets may also arise as a result of construction and decommissioning works, although effects will be, by comparison, shorter in duration and of a temporary nature.

16.6.1 Potential Impacts during Construction

142. The East Anglia ONE North Offshore Windfarm Scoping Report (SPR 2017) identified eight potential impacts (excluding cumulative impacts which are considered separately in ***section 16.7***) that may occur within the construction phase. These impacts have been incorporated in the following section. Of those impacts identified within the scoping report, a number are inextricably related. On this basis, in order to reduce repetition and enhance the readability of the impact assessment presented below, where appropriate, these impacts have been combined and assessed within a single section. ***Table 16.24*** demonstrates how the impacts identified within the scoping report correlate to those assessed in this chapter for construction, operation and decommissioning.

Table 16.24 Correlation of impacts identified within the scoping report and those presented in this PEIR chapter

Impact in the East Anglia ONE North Offshore Windfarm Scoping Report	Where addressed in this PEIR chapter
Physical disturbance activities resulting in damage to, or destruction of, known heritage assets	Construction Impact (1): Direct impact to known heritage assets
Physical disturbance resulting in damage to, or destruction of, potential heritage	Construction Impact (2): Direct impact to potential heritage assets

Impact in the East Anglia ONE North Offshore Windfarm Scoping Report	Where addressed in this PEIR chapter
assets in the event of unexpected discoveries	
Deterioration of heritage assets which become exposed to the effects of marine processes as a result of sediment reduction	Construction Impact (3): Indirect impact to heritage assets from changes to physical processes
Increased protection afforded to heritage assets which become buried as a result of sediment accretion.	Construction Impact (3): Indirect impact to heritage assets from changes to physical processes
Construction/maintenance activities within the setting of designated or non-designated heritage assets which temporarily affect the significance of an asset (adverse, indirect impact)	Construction Impact (4): Impacts to the setting of heritage assets and historic seascape character
Construction/maintenance activities which temporarily affect the character of the historic seascape (adverse, indirect impact)	Construction Impact (4): Impacts to the setting of heritage assets and historic seascape character
Accumulation of published archaeologically interpreted geophysical and geotechnical data and information from chance discoveries which contributes significantly to a greater understanding of the offshore archaeological resource (beneficial, indirect impact).	Addressed as a cumulative impact.
Deterioration of heritage assets which become exposed to the effects of marine processes as a result of sediment reduction (including scour) associated with changes to physical processes caused by the construction and operation of multiple projects (adverse, indirect impact)	Construction Impact (3): Indirect impact to heritage assets from changes to physical processes

143. In addition to the impacts outlined above, a further impact (Construction Impact (5): Impacts to site preservation conditions from drilling fluid breakout) has been scoped into the assessment, based on stakeholder and regulatory engagement and consultation undertaken in relation to projects for similar offshore renewable developments.

16.6.1.1 Impact (1): Direct impact to known heritage assets

16.6.1.1.1 Impacts Prior to Mitigation

144. With the application of the embedded mitigation (see ***section 16.3.3***), it is anticipated that all direct impacts to known heritage assets as a result of the project would be avoided, where possible.

145. Subject to approval by Historic England, AEZs are proposed for the two A1 anomalies within the East Anglia ONE North windfarm site comprising a 100m buffer around the wreck extents (***Table 16.25)***. Both wrecks were previously recorded during the assessment of data for East Anglia THREE at which time 100m AEZs were specified. As no new geophysical data has been acquired over these sites Wessex Archaeology (***Appendix 16.1***) recommended that the proposed 100m AEZs are retained unchanged.

146. AEZs are also recommended for each of the 26 A1 anomalies and recorded wreck (A3) within the offshore cable corridor (***Table 16.25***). For the items of wreck debris, an AEZ of 15m has been recommended. However, in all cases this is already covered by the associated wreck's recommended 50m AEZ with the exception of the AEZ for 700822, which itself is immediately adjacent to the 50m AEZ for debris field 70639.

147. As stated above, proposed AEZs may be reduced, enlarged or removed in agreement with Historic England if further relevant information becomes available post-consent.

148. The known heritage assets described above are illustrated on ***Figure 16.3*** and ***Figure 16.4*** and detailed in ***Table 16.25***.

Table 16.25 Recommended AEZs within the East Anglia ONE North windfarm site study area and offshore cable corridor

WA ID	Type	Position		Recommendation
		Easting	Northing	
70609	Wreck	455967	5795276	100m buffer around current features extent
77111	Wreck	464178	5808047	100m buffer around current features extent
70639	Debris field	429622	5797407	100m buffer around current feature extent
700823	Debris	429573	5797373	15m buffer around feature (incorporated within AEZ for debris field 70639)
700824	Debris	429585	5797375	15m buffer around feature (incorporated within AEZ for debris field 70639)
700822	Debris	429487	5797383	15m buffer around feature (immediately adjacent to AEZ for 70639)

WA ID	Type	Position		Recommendation
		Easting	Northing	
70641	Wreck	430250	5796405	50m buffer around current feature extent
700829	Debris	430247	5796406	15m buffer around feature (incorporated within AEZ for wreck 70641)
70645	Wreck	431268	5798215	50m buffer around current feature extent (merges with AEZ for debris field 70085)
700835	Debris field	431208	5798167	50m buffer around current feature extent (merges with AEZ for wreck 70645)
700836	Debris	431225	5798178	15m buffer around feature (incorporated within AEZ for wreck 70645 and debris field 700835)
700837	Debris	431228	5798179	15m buffer around feature (incorporated within AEZ for wreck 70645 and debris field 700835)
700838	Debris	431237	5798179	15m buffer around feature (incorporated within AEZ for wreck 70645 and debris field 700835)
700839	Debris	431245	5798189	15m buffer around feature (incorporated within AEZ for wreck 70645 and debris field 700835)
700218	Wreck	407392	5782532	50m buffer around current feature extent
700244	Wreck	410382	5785290	50m buffer around current feature extent
700255	Wreck	413082	5787765	50m buffer around current feature extent
700254	Debris	413086	5787738	15m buffer around feature (incorporated within AEZ for wreck 70255)
700257	Debris field	411763	5788611	50m buffer around current feature extent (immediately to the north and merged with AEZ for debris field 700258)
700258	Debris field	411768	5788539	15m buffer around current feature extent (immediately to the south and merged with AEZ for a further debris field 700257)
700262	Wreck	408286	5783069	50m buffer around current feature extent
700263	Debris	408289	5783167	15m buffer around feature
700590	Debris	411428	5783615	15m buffer around feature
700591	Wreck	411648	5783222	50m buffer around current feature extent

WA ID	Type	Position		Recommendation
		Easting	Northing	
700600	Seabed disturbance	411596	5782442	15m buffer around feature
700605	Debris	413543	5788077	15m buffer around feature
700786	Wreck	416532	5790383	50m buffer around current feature extent
700563	Recorded Wreck	406008	5783583	100m around the recorded location (centre point)
700565	Recorded Wreck	406127	5783160	100m around the recorded location (centre point)

149. AEZs are not recommended at this time for features assigned an A2 archaeological discrimination. The positions of these features will be avoided by means of micro-siting the project design, where possible. The archaeological assessment of pre-construction survey data, including high resolution geophysical data undertaken for the purposes of UXO identification, will further clarify the nature and extent of these anomalies and the scheme design would be modified to avoid heritage assets where possible. If features cannot be avoided, then additional work may be required to establish the archaeological interest of the feature (e.g. investigation of individual anomalies (ground truthing) through ROV and/or diver survey) and to record features prior to removal, as appropriate.

150. Within the intertidal zone, all known intertidal assets will be avoided through the use of HDD. HDD will be used at the landfall to install the cable ducts, passing below the beach deposits, and thereby avoiding impacts upon intertidal assets.

151. In summary, due to the commitment of the applicant to implement AEZs for all known A1, to avoid all A2 and A3 anomalies where possible and to utilise HDD at the landfall, thereby avoiding previously recorded intertidal heritage assets, there will be **no impact** to known heritage assets during construction.

16.6.1.2 Impact (2): Direct impact to potential heritage assets

16.6.1.2.1 Impacts Prior to Mitigation

152. It is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets). Therefore, unavoidable direct impacts may occur if archaeological material is present within the footprint of the project associated with the following activities:

- Seabed preparation (including UXO and boulder clearance, where required);
- Installation of wind turbine foundations and foundations for other offshore infrastructure;

- Installation of ancillary infrastructure;
- Installation of offshore cabling;
- Seabed contact by legs of jack-up vessels and / or anchors; and
- Cable installation at the landfall.

153. Any adverse effects upon potential heritage assets due to construction-related works would likely be permanent and irreversible in nature. Once archaeological deposits and material, and the relationships between deposits, material and their wider surroundings have been damaged or disturbed, it is not possible to reinstate or reverse those changes. As such, direct impacts to the fabric or physical setting would represent a total loss of an asset, or part of it, and the character, composition or attributes of the asset would be fundamentally changed or lost from the site altogether.

154. In practice, the magnitude of the effect will not be fully understood until after the potential heritage asset has been encountered and the impact has occurred. However, as a precautionary approach, it should be assumed that total loss or substantial harm is possible and in accordance with the definitions in ***Table 16.10***. On this basis, direct impacts upon potential heritage assets are generally considered to be of potentially high magnitude. However, the extent of any impact will depend on the presence, nature and depth of any such remains, in association with the depth, location and nature of construction-related groundworks and contact with the sea bed.

155. For the purpose of this assessment, potential heritage assets are regarded as comprising the following asset types (the importance of which is presented in ***Table 16.23***):

- Potential *in situ* prehistoric sites;
- Potential submerged landscape features;
- Potential derived Prehistoric finds;
- Potential palaeoenvironmental evidence;
- Potential wrecks;
- Potential derived maritime finds;
- Potential aircraft;
- Potential derived aviation finds; and
- Potential derived intertidal finds.

156. Within the intertidal zone, the use of HDD, with entry on the landward side of the cliffs, and exit below MLWS in the marine zone, means that impacts to potential

intertidal archaeological material will be avoided. It is anticipated that HDD will pass beneath Quaternary deposits of potential archaeological interest.

157. *In situ* prehistoric, maritime and aviation sites offshore are assessed as being of potentially high heritage significance, as are potential submerged landscape features and potential palaeoenvironmental evidence (where associated with palaeolandscape features or archaeological material). In accordance with the significance matrix in ***Table 16.11***, direct impacts to these heritage asset types thereby have the potential to be of **major adverse** significance, as a worst case scenario.

158. Isolated discoveries of archaeological material discovered within secondary contexts (chance finds, comprising derived prehistoric, maritime, aviation and intertidal finds) will be mitigated by means of implementing the established SPR offshore windfarms archaeological protocol (SPR 2015) based upon ORPAD (The Crown Estate 2014) (see embedded mitigation, ***section 16.3.3***). Isolated artefacts, either of prehistoric, maritime or aviation origin within reworked deposits may be considered less sensitive to change than *in situ* material, as their relationship with their context or physical setting is less relevant to understanding their significance. The sensitivity (heritage significance) of isolated finds is therefore considered to be medium. The magnitude of the effect is assessed to be low as, through the means of the protocol, artefacts brought to the surface will be retained for further assessment and provided with conservation as necessary to secure the long-term stabilisation of the artefact as proportionate to its significance. Although removal from the marine context will still result in the destruction of that contextual relationship, albeit a secondary context (i.e. not *in situ*), isolated artefacts have limited capacity to accommodate physical changes or influences therefore resulting in only a minor loss of, or alteration to, key characteristics, features or elements. The impact significance is therefore considered to be **minor adverse**.

159. The application of the mitigation measures outlined in ***section 16.3.3*** will ensure that direct impacts to potential heritage assets, if they occur during the construction phase, will be reduced to **minor** adverse. Further assessment of pre-construction geophysical and geotechnical data will provide further information on the prehistoric, maritime and aviation archaeological resource and will thereby further reduce the risk of impacts occurring. In the event of unexpected discoveries (and unavoidable impact), the provision of prompt archaeological advice through the application of the protocol for archaeological discoveries will reduce the potential for further impact and will allow appropriate measures (such as further investigation and recording) to remedy or offset the impact to be implemented.

160. The mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance including *Model Clauses for*

Archaeological Written Schemes of Investigation: Offshore Renewables Projects. (The Crown Estate, 2010). An Outline WSI setting out the methodology for all proposed embedded mitigation will be prepared and submitted as part of the DCO application.

16.6.1.3 Impact (3): Indirect impact to heritage assets from changes to physical processes

16.6.1.3.1 Impacts Prior to Mitigation

161. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to ***section 7.6.1*** (Potential Impact during Construction) of ***Chapter 7 Marine Geology, Oceanography and Physical Processes*****.**

162. Construction activities associated with foundation, inter-array, platform link and offshore export cable installation have the potential to disturb sediments from the sea bed (near-surface sediments) and from several tens of metres below the sea bed (sub-surface sediments). Those sediments disturbed will be re-deposited which may result in changes to the sea bed level. The re-deposition of sea bed sediments may, in turn, conceal (either partially or wholly) any present archaeological / cultural heritage receptors.

163. With regards to changes in sea bed level, the worst case scenario has been identified in relation to foundation installation. As part of foundation installation, following re-deposition, near surface sediments may form a mound local to the point of release. The resulting mound would be a measurable protrusion above the existing sea bed (likely to be tens of centimetres to a few metres high) with the sediment within the mound similar to that on the existing sea bed. Any remaining near-surface sea bed sediments from this release will likely be more widely dispersed before settling on the sea bed, with the thickness of deposits from the plume across the wider sea bed area likely being very small (order of millimetres). Due to their fine-grained nature, the re-deposition of sub-surface sediments during foundation installation will likely result in a greater dispersion across a wider area, with bed level changes largely immeasurable. Changes in sediment concentration due to inter-array cable, platform link cable and offshore export cable installation would be less than those arising from the disturbance of sediments during foundation installation activities.

164. The magnitude of effect of changes in sea bed level has been judged as low in relation to near-field effects and negligible in relation to far-field effects in ***Chapter 7 Marine Geology, Oceanography and Physical Processes*****.** It is notable that near-field effects are confined to a relatively small area of sea bed (likely to be of the order of several hundred metres up to a kilometre from each foundation location), and would not cover the whole East Anglia ONE North windfarm site.

165. Taking this into account, archaeological and cultural heritage receptors near-field of installation activities may be subject to increased sediment cover. The level of sediment cover will vary, with a depth of up to a few metres high possible for any archaeological and cultural heritage receptor present in the vicinity of the point of release for near-surface sediments released during foundation installation. Given that increased sediment cover is not expected to result in any alteration to any assets present, the magnitude of effect is considered to be nil / none, resulting in **no impact**.

16.6.1.4 Impact (4): Impacts to the setting of heritage assets and historic seascape character

16.6.1.4.1 Impacts Prior to Mitigation

166. The HSC of the study area and the setting of marine heritage assets will be temporarily affected during the construction phase by the presence of vessels, personnel and infrastructure associated with construction activities. The worst case scenario anticipates that construction activities offshore could have a duration of approximately 27 months, although this may include periods of no on site construction activity.

167. Construction activities may change perceptions of character with respect to the primary cultural processes which have been established and spatially defined through the HSC. The assessed capacity of each of the character sub-types to accommodate change during construction is set out in ***Table 16.26***.

Table 16.26 Capacity of perceptions of character to accommodate change during construction

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Submarine telecommunication cable	As submarine telecommunications cables are mostly undetected in the marine environment it is unlikely that perceptions of this character type would be altered by construction activities.	No change
Cliffs and Shingle Foreshore	The commitment to using HDD would remove impacts to the coastal path and beach at Thorpeness. Impacts to Thorpeness and Sizewell beach would therefore be limited to indirect impact during drilling, with works above MHWS at the HDD entry point resulting in potential disturbance of people's experience of the beach and cliffs as a place for inspiration and recreational activities. This disturbance will however be	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	temporary and short-term, with no discernible long-term or permanent change anticipated.	
Coarse sediment plains Fine sediment plains Mixed sediment plains Mud plains Sand banks with sand waves	The primary perceptions which associate marine cultural topography with high archaeological potential could be enhanced through the accumulation of publicly available data in the event of unexpected discoveries reported through the protocol for archaeological discoveries during construction activities.	Potential beneficial change
Bottom trawling Drift netting Fishing ground Longlining Pelagic trawling Potting	Although there will be areas where fishing activities are temporarily displaced as a result of construction works, fishing activities will still be permitted in areas of the offshore development not undergoing construction activities.	No change
Hydrocarbon pipeline	Overall, perceptions of the North Sea energy industry place greater emphasis upon nuclear power and renewable energy. The HSC states that Britain has the best offshore wind resource in Europe and the marine zone of East Anglia is well placed to take advantage of this. Changing perceptions associated with the construction of East Anglia ONE North are therefore likely to be seen as part of this natural progression for energy generation and as a positive change from fossil fuels to renewable energy.	Potential beneficial change
Maritime Safety, Daymark	As stated by the HSC, overall the area has a long history of maritime safety features which is at risk of being forgotten if not fully recorded. Short term construction activities at the landfall, however, are considered	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	unlikely to result in a meaningful change to the perceived character.	
Navigation hazard, hazardous water, wreck hazard	The primary perceptions which associate hazardous water and wrecks with local heritage and stores relating to dangers of the high seas, to recreational diving and to wrecks as habitats could be enhanced through the provision of publicly available data on sea bed features identified during geophysical survey, and in the event of unexpected discoveries reported through the protocol for archaeological discoveries during construction activities.	Potential beneficial change
Navigation route Ferry crossing (Harwich to Esbjerg/ Harwich - Hook of Holland Ferry/ Kingston upon Hull - Zeebrugge Ferry)	Construction activities and additional vessel traffic would occur in the context of one of the busiest shipping channels between south east England and mainland Europe and it is anticipated that no change to the perception of this character type would occur as a result of construction activities.	No change
Leisure beach Leisure sailing	As described above, the commitment to using HDD would remove impacts to the coastal path and beach at Thorpeness. Impacts to Thorpeness and Sizewell beach would therefore be limited to indirect impact during drilling, with works above MHWS at the HDD entry point resulting in potential disturbance of people's experience of the beach for leisure activities. This disturbance will however be temporary and short-term, with no discernible long-term or permanent change anticipated.	No change
Palaeolandscape component	There is the potential for positive enhancement of primary perceptions associated with a growing interest in submerged landscapes through the	Potential beneficial change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	provision of publicly available data on palaeolandscapes following the further archaeological and geoarchaeological assessment of survey data.	
Naval battlefield and World War 2 defence area	There is the potential for positive enhancement through the provision of publicly available data on the wider 20th setting and character of 20th century military activity within the study area is.	Potential beneficial change

168. The table above demonstrates that for most character sub-types, perceptions of historic character will remain unchanged or will result in a potential beneficial change.

169. In terms of setting, as part of the initial settings assessment undertaken in relation to onshore heritage assets, ***Chapter 24 Archaeology and Cultural Heritage*** (with further detailed assessment provided in ***Appendix 24.1***) has concluded that any changes in setting due to construction activities would be temporary and of sufficiently short duration that they would not give rise to material harm. The same conclusions are considered as applicable to marine and intertidal heritage assets and as such, indirect (non-physical) impacts upon the setting of such asserts during the construction phase have therefore also been excluded from further consideration (**no impact**).

16.6.1.5 Impact (5): Impacts to site preservation conditions from drilling fluid breakout

16.6.1.5.1 Impacts Prior to Mitigation

170. A breakout of drilling fluid (employed during the drilling process during HDD works) during construction works may have the potential to spread into archaeological deposits, features and materials thereby causing an adverse effect upon site preservation.

171. The drilling fluid used during HDD works is typically a mixture of water and bentonite or polymer continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilise the borehole, cool the cutting head, and lubricate the passage of the product pipe. Bentonite is a common drilling fluid for HDD and is a naturally occurring clay which, when mixed with water, provides a gel like lubricant known as ‘drilling mud’ for the drilling process. Bentonite typically has a neutral pH level similar to that of water / seawater. In order to minimise the potential for breakout of the drilling fluid throughout the drilling process itself, the

monitoring of fluid pressures will be embedded into the project design to minimise the potential for breakout and an action plan will be developed and procedures adopted so that any drilling fluid breakout is handled quickly and efficiently. Once the drilling process is complete, the fluid would remain annulus around the duct, with no potential to spread into surrounding deposits.

172. The potential for drilling fluid to breakout and spread into or 'coat' archaeological deposits, features and materials, thereby causing an adverse impact upon site preservation, has as such been assessed as being of negligible magnitude of effect, and with a receptor of negligible / medium sensitivity this results in a **negligible** to **minor** adverse significance as a worst case scenario.

16.6.2 Potential Impacts during Operation

16.6.2.1 Impact (1): Direct impact to known heritage assets

16.6.2.1.1 Impacts Prior to Mitigation

173. With the application of the embedded mitigation (see ***section 16.3.3***), and the retention of AEZs throughout the project lifespan, it is anticipated that all direct impacts to known heritage assets will be avoided. As such, there will be **no impact** to known heritage assets during operation.

16.6.2.2 Impact (2): Direct impact to potential heritage assets

16.6.2.2.1 Impacts Prior to Mitigation

174. Direct impacts to potential marine heritage assets are unlikely to occur as a result of intrusive maintainence (as any impacts would have occurred during construction and subject to appropriate and proportionate additional mitigation measures, as and where necessary), however, there is the potential for impacts to occur if archaeological material is present within the footprint of jack-ups or vessel anchors deployed during planned or unscheduled maintenance activities. As for construction activities, impacts should be considered to have the potential to be of major adverse significance, although the application of embedded mitigation (see ***section 16.3.3***) is anticipated to reduce this to **minor adverse**.

175. There will be **no impacts** at the landfall during the operation phase as there will be no groundworks within or disturbance of intertidal deposits.

16.6.2.3 Impact (3): Indirect impact to heritage assets from changes to physical processes

16.6.2.3.1 Impacts Prior to Mitigation

176. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to ***section 7.6.2*** (Potential Impact during Operation) of ***Chapter 7 Marine Geology, Oceanography and Physical Processes*****.**

177. The presence of the foundations of the turbines, meteorological mast and offshore platforms may cause changes to the tidal and wave regimes, which in turn, have

the potential to affect the sediment regime and / or sea bed morphology of the windfarm site. The worst case magnitude of effect upon tides is assessed as low (near-field) and no-change (far-field), and for waves as low (near-field) and negligible (far-field). As a worst case scenario, these changes to the marine physical processes would therefore be low in magnitude and largely confined to the near-field environment (e.g. wake zone or wave shadow to each individual wind turbine foundation).

178. Changes to the sea bed morphology which may indirectly impact archaeology and cultural heritage receptors may occur due to the presence of foundation structures in the form of scour formation. Those receptors considered to be vulnerable in this regard consist of known maritime heritage assets and additional anomalies and potential wrecks and aircraft.

179. The requirement for scour protection for the proposed East Anglia ONE North project is not yet fully determined. If no scour protection is required, there is the potential for the presence of the foundations to cause scour-hole formation in the sea bed adjacent to the foundation due to flow acceleration in its immediate vicinity (tens of metres). Previous studies have revealed (overly-conservative) a worst case scour volume under a 50-year return period event of about 5,000m^3 per wind turbine, for an individual foundation of similar type and size to the worst case for the proposed East Anglia ONE North project (with respect to footprint effects, jackets with (up to four) suction caissons present the greatest physical footprint on the sea bed without scour protection).

180. Any archaeological and cultural heritage receptors within the area in which scouring may take place may be subject to greater levels of exposure as a result of the project, thereby increasing their potential to undergo decay and damage.

181. Despite this potential, given the implementation of AEZs around all known A1 anomalies (which are inclusive of a cautionary buffer around the known extent of anomalies), A1 anomalies are likely to be beyond any scour-hole developed. This impact is therefore considered to represent a negligible magnitude of effect. The A1 anomalies identified within the East Anglia ONE North offshore wind farm and offshore cable corridor are considered to be of low (*St Patrick* 70641 and debris 700829), medium (*Edinardue Antoinette* 70609, *Groenlo* 70645 associated debris field 700835 and debris 700836-9, *Jim* 700218, *Mangara* 700244, *Alastair* 700255 and debris 700254, *Magdapur* 700591) and high (700590, 700605 and 700258, 77111, 700262, debris field 70639 and debris 700263, 700822-4, 700600 and 700565) heritage importance, thereby resulting in a **minor** adverse impact significance.

182. The A2 and A3 anomalies will be avoided by means of micrositing the project design, where possible. The distance between offshore components and any A2

and A3 anomalies present has not yet been determined. However, in the event that no scour protection is installed, micro-siting of the project design to avoid A2 and A3 anomalies will have already taken into account the potential for scour-holes to develop in the locality of turbine foundations. By the operational phase, pre-construction survey data within and immediately surrounding the turbine foundation locations will have been archaeologically assessed (e.g. geophysical data undertaken for the purposes of UXO identification). This process will serve to clarify the nature and extent of these anomalies so that the project design could be modified, taking into account the potential for scour-hole formation, to avoid heritage assets where possible. This impact is therefore considered to represent a negligible magnitude of effect, resulting in a **minor adverse** impact significance.

183. Indirect impacts may also occur if previously unrecorded archaeological material (e.g. potential wrecks or aircraft) is present within the area in which scour-hole formation will take place. However, given that any assets currently unrecorded within the area immediately surrounding the proposed turbine locations will have been previously identified as part of the archaeological assessment of pre-construction surveys and investigations (e.g. as part of confirmation investigations), indirect impacts upon potential archaeological and cultural heritage receptors are expected to be of negligible magnitude, resulting in a **minor adverse** impact significance.

184. The provision of scour protection will prevent the development of scour around the foundations, thereby avoiding the effects of the indirect impacts outlined above, Scour protection will, however, increase the maximum footprint on the sea bed of the foundation (the effects of which are included and assessed in relation to Construction impacts (1) and (2) (see ***sections 142*** and ***16.6.1.2***).

16.6.2.4 Impact (4): Impacts to the setting of heritage assets and historic seascape character

16.6.2.4.1 Impacts Prior to Mitigation

185. During the operational life of the proposed East Anglia ONE North windfarm the presence of the wind turbines, offshore platforms, met mast and vessels during this operational phase will introduce a clear change to both the visual setting and the character of the seascape.

186. The setting of marine heritage assets will be affected during the operational phase by the presence of vessels, personnel and infrastructure associated with maintenance activities and by the presence of wind turbines and associated infrastructure. Those wrecks considered to have a setting which may be considered as contributing towards their significance are the named wrecks recorded to have been lost during the hostilities of WWI (700244, 700255 and 700786) and WWII (70645 and 700591) and the wreck *Edinardu Antoinette* (70609). Despite this, the baseline setting is already influenced by passing vessels

in this area associated with industry, fishing and recreation, thereby reducing the sensitivity and potential magnitude of change. The potential impact to the setting of marine heritage assets is considered to be of negligible magnitude (a minor alteration of an asset which does not affect its significance in any notable way) and of **minor adverse** significance.

187. The settings assessment undertaken for onshore heritage assets is detailed in ***Appendix 24.1*** and assessed further in ***Chapter 24 Archaeology and Cultural Heritage***. It has been concluded that, given that much of the proposed East Anglia ONE North project comprises underground elements, changes in settings would be temporary and only during construction works. These areas of work (i.e. proposed landfall location and the majority of the proposed onshore cable corridor) can be identified and excluded from further consideration. Consideration of setting during the operation of the proposed project onshore is therefore addressed in relation to the predicted visual change of the proposed East Anglia ONE North project and confined to the cable ducts in the vicinity of Aldringham Court and the proposed National Grid substation and East Anglia ONE North substation, neither element of which are likely to be visible from the landfall area. The planned infrastructure at the landfall, comprising buried cables installed using HDD, is therefore not considered to give rise to material harm to the setting and associated significance of heritage assets within the intertidal zone (**no impact**).

188. As for construction above, maintenance activities and the presence of the windfarm infrastructure may change perceptions of character with respect to the primary cultural processes which have been established and spatially defined through the HSC. The assessed capacity of each of the character sub-types to accommodate change during operation is set out in ***Table 16.27***.

Table 16.27 Capacity of perceptions of character to accommodate change during operation

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Submarine telecommunication cable	As submarine telecommunications cables are mostly undetected in the marine environment there will be no change to perceptions of historic character.	No change
Cliffs and Shingle Foreshore	The presence of landfall infrastructure will remain largely undetectable and therefore not perceived by the public. No change to perceptions of the foreshore are anticipated.	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Coarse sediment plains Fine sediment plains Mixed sediment plains Mud plains Sand banks with sand waves Palaeolandscape component Naval battlefield and World War 2 defence area	The presence of the installed infrastructure may result in a change to the perception of these marine areas as being of high archaeological potential. The physical presence of cables and foundations, for example, will limit ease of access for future research within the project areas thereby reducing the perceived archaeological potential. This change will however be offset by the accumulation of publicly available data acquired by the project prior to construction which is considered to be of public value.	Character has capacity to accommodate change. Publication of data and completion of archaeological works to acceptable professional standards will help offset potential adverse impacts.
Bottom trawling Drift netting Fishing ground Longlining Pelagic trawling Potting	The distance of the East Anglia ONE North wind farm from the coast, and the minimal above ground infrastructure at the coast, means that the project will be largely undetectable by the public and historic perceptions of the traditional fishing industry, which the HSC described as having taken on a 'quaint' character, a memory of better days, will remain largely unchanged. Fishing activities will not be prohibited during the operation phase of the windfarm, although temporary restrictions may apply around major maintenance activities.	No change
Hydrocarbon pipeline	Overall, perceptions of the North Sea energy industry place greater emphasis upon nuclear power and renewable energy. The HSC states that Britain has the best offshore wind resource in Europe and the marine zone of East Anglia is well placed to take advantage of this. Changing perceptions associated with the construction of East Anglia ONE North are therefore likely to be seen as part of this natural progression for energy generation and as a positive	Potential beneficial change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	change from fossil fuels to renewable energy.	
Maritime Safety, Daymark	The presence of landfall infrastructure and offshore export cables will remain largely undetectable and therefore not perceived by the public. No change to perceptions of maritime safety are anticipated.	No change
Navigation hazard, hazardous water, wreck hazard	The project may result in a change to the perception of navigational hazards on the basis that the introduction of wind turbines represents additional navigation hazards. They are, however, equipped with navigational features such as warning lights. In addition, information on the location of the various types of offshore renewable energy installations can be found on navigational charts, and updated as necessary by Admiralty Notices to Mariners. Any urgent information regarding offshore renewable energy installations will be promulgated by navigational warnings. On this basis, this character sub-types are considered to have the capacity to accommodate this level of change.	Minor change
Navigation route Ferry crossing (Harwich to Esbjerg/ Harwich - Hook of Holland Ferry/ Kingston upon Hull - Zeebrugge Ferry)	Maintenance activities and additional vessel traffic would occur in the context of one of the busiest shipping channels between south east England and mainland Europe and it is anticipated that no change to the perception of this character type would occur.	No change
Leisure beach Leisure sailing	The presence of landfall infrastructure and offshore export cables will remain largely undetectable and therefore not perceived by the public. The presence of wind turbines may alter	Minor change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	the perception of recreational boating activities. However, as leisure sailing will continue to take place, this character sub-types is considered to have the capacity to accommodate this level of change.	

189. The table above demonstrates that for most character sub-types, perceptions of historic character will remain unchanged or will result in a potential beneficial change. This is with the exception of navigational hazards and leisure sailing, the perceptions of which are likely to be altered to a small degree due to the presence of the wind turbines and offshore platforms within the East Anglia ONE North windfarm site. Leisure sailing would not be excluded from the offshore development area, therefore it has been concluded that this character sub-type has the capacity to accommodate this level of change. By introducing features in the seascape that are considered to represent navigational hazards (e.g. the wind turbines and offshore platforms), the presence of the offshore components necessarily alters the perception of navigational hazards in the area. Nonetheless, with the introduction of measures which serve to reduce any risk to surrounding shipping (e.g. by means of charting or associated navigational marks / lights), this character sub-type has the capacity to accommodate this level of change.

16.6.2.5 Impact (5): Impacts to site preservation conditions from heat loss from installed cables

16.6.2.5.1 Impacts Prior to Mitigation

190. Underground cables generate heat which dissipates naturally to the surrounding ground during power transmission. As stated in ***section 6.5.9*** (Electrical Infrastructure) of ***Chapter 6 Project Description*** For the offshore export cables, heat loss per metre is 30W/m[3]. For inter-array cables, heat loss per metre is 40W/m[4]. The heat loss from electrical cables has the potential to have a damaging effect on any marine archaeological remains that may be present.

191. The maximum heat loss and subsequent dissipation of heat through the soil will not be determined until the soil structure (thermal properties) and final engineering design are known and confirmed. However, it is expected that any heat dissipation will be localised and confined to the areas immediately surrounding the cables and ducts.

[3] For a typical 1,000mm^2 offshore HVAC 132kV 3-core cable.
[4] For a typical 800mm^2 offshore HVAC 33kV 3-core cable.

192. As the effect of heat loss is restricted to the immediate vicinity of the cables, and as all known heritage assets will be avoided through design as part of the embedded mitigation for the project (see ***section 16.3.3***) there will be no impact to known heritage assets associated with the heat loss from cables. With regard to potential heritage assets, the area affected from heat loss will be spatially no greater than the footprint of direct impacts from cable installation. Given that the areas within the immediate locality of the cables will have been subject to disturbance as a result of cable installation, any potential heritage assets (where present) therein will already have been disturbed as part of the construction phase, and appropriate mitigation applied (see section above). On this basis, there will be **no further impact** during operation associated with the heat loss from cables.

16.6.3 Potential Impacts during Decommissioning

193. No decision has been made regarding the final decommissioning policy for the project as it is recognised that industry best practice, rules and legislation change over time. The detailed decommissioning activities and methodology would be determined later within the project lifetime so as to be in line with latest and current guidance, policy and legislation at that point. At that juncture, the decommissioning methodology would be agreed with the relevant authorities and statutory consultees. Offshore, decommissioning is likely to include removal of all of the wind turbine components, foundations (in part, where above sea bed level) and sections of the inter-array cables and platform link cables.

194. With regards to offshore export cables, general UK practice would be followed. Buried cables would be cut at the ends and left *in situ*, except for the intertidal zone where the cables would be at risk of becoming exposed over time.

16.6.3.1 Impact (1): Direct impact to known heritage assets

195. With the application of the embedded mitigation (see ***section 16.3.3***), and the retention of AEZs throughout the project lifespan, it is anticipated that all direct impacts to known heritage assets will be avoided. As such, there will be **no impact** to known heritage assets during decommissioning.

16.6.3.2 Impact (2): Direct impact to potential heritage assets

196. It is anticipated that the likely scope of the decommissioning works would involve removal of the accessible installed components. With regards to offshore cables, general UK practice would be followed. For the most part, buried cables would be cut at the ends and left *in situ.* This is with the exception of buried cables within the intertidal zone across the beach where the cables would otherwise be at risk of becoming exposed over time.

197. Direct impacts to potential marine heritage assets may occur if archaeological material is present within the footprint of jack-ups or vessel anchors deployed during decommissioning activities. Direct impacts to potential intertidal heritage

assets may also occur within the nearshore area should cables at risk of being exposed over time require removal (via excavation or jetting).

198. As with construction and operation activities, impacts should be considered to have the potential to be of major adverse significance, although the application of embedded mitigation (e.g. the implementation of OPRAD, see ***section 16.3.3***) is anticipated to reduce this to acceptable levels (**minor adverse**).

16.6.3.3 Impact (3): Indirect impact to heritage assets from changes to physical processes

199. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to ***section 7.6.3*** (Potential Impact during Decommissioning) of ***Chapter 7 Marine Geology, Oceanography and Physical Processes***.

200. During the decommissioning phase, there is potential for wind turbine, foundation and (where undertaken), cable removal activities to cause changes in suspended sediment concentrations and / or sea bed or shoreline levels as a result of sediment disturbance effects. ***Chapter 7 Marine Geology, Oceanography and Physical Processes*** has assessed that the magnitude of effects would be comparable to those identified for the construction phase. Accordingly, given that **no impact** was assessed for archaeology and cultural heritage receptors during the construction phase, it is anticipated that the same would be valid for the decommissioning phase.

16.6.3.4 Impact (4): Impacts to the setting of heritage assets and historic seascape character

201. Decommissioning activities may result in a further change to the setting of heritage assets and historic seascape character with the removal of the wind turbines and associated infrastructure. The presence of vessels, personnel and infrastructure associated with decommissioning activities will also temporarily affect the setting and character of the project area. However, as for construction these impacts are temporary and reversible and the change to setting and character during decommissioning is therefore considered to be of negligible magnitude (a minor alteration of an asset which does not affect its significance in any notable way) and of **minor adverse** significance.

16.7 Cumulative Impacts

202. There are a large number of constructed / consented and planned offshore windfarms, aggregate dredging licence areas, oil and gas licences and licensed disposal sites within 100km of the offshore development area. Of these, only the proposed East Anglia TWO project overlaps with the East Anglia ONE North offshore development area in terms of footprint. As the proposed East Anglia ONE North project is subject to the same embedded mitigation as the proposed East

Anglia TWO project, comprising the avoidance of known heritage assets wherever possible, then there is no pathway for cumulative direct impacts on the known heritage assets identified in ***section 16.6*** of this PEIR.

203. With respect to unavoidable impacts to potential heritage assets, and to the settings of heritage assets and the historic character of the study area, cumulative impacts are possible. However, as the extent of these potential heritage assets which could be subject to cumulative impact are unknown, it is not possible to identify which constructed / consented or planned projects would have the potential to have a cumulative impact with the proposed East Anglia ONE North project. Therefore, a definitive list of projects assessed as part of this chapter is not provided as part of this CIA. Rather the potential for cumulative impact is discussed as a broad narrative in ***sections 16.7.1*** and ***16.7.2*** below.

204. The cumulative impact assessment for marine physical processes is set out in ***section 7.7*** of ***Chapter 7 Marine Geology, Oceanography and Physical Processes***, the results of which inform the assessment of the potential for cumulative indirect impact to heritage assets from the effects of marine physical processes set out below.

205. ***Table 16.28*** summarises the project specific impacts identified in ***section 16.6***, alongside their potential to act cumulatively with other projects.

Table 16.28 Potential Cumulative Impacts

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction Impact (1): Direct impact to known heritage assets	No	High	Direct cumulative impacts to known heritage assets are unlikely to occur due to the avoidance of known archaeological sites and features identified through EIA for constructed and planned projects as part of the consenting process.
Construction Impact (2): Direct impact to potential heritage assets	Yes	Low (as yet unknown heritage assets)	Although the effect of unavoidable impacts will be mitigated by agreed measures as part of the consenting process for each of the constructed and planned projects, the impacts will still have occurred and permanent damage or destruction will have taken place. The assessment of cumulative impacts, therefore, needs to consider the effect of multiple unavoidable

Impact	Potential for cumulative impact	Data confidence	Rationale
			impacts from multiple projects upon the archaeological resource.
Construction Impact (3): Indirect impact to heritage assets from changes to physical processes	No	High	***Chapter 7 Marine Geology, Oceanography and Physical Processes*** concludes that there will be no significant cumulative impact on the baseline wave, tidal and sediment regime.
Construction Impact (4): Impacts to the setting of heritage assets and historic seascape character	Yes	High	Across the region, cumulative impacts to the setting of heritage assets and historic seascape character may occur as a result of the construction of multiple projects.
Construction Impact (5): Impacts to site preservation conditions from drilling fluid breakout	No	High	Cumulative impacts cannot occur as the drilling fluid utilised is confined to the immediate locality of the buried cables.
Operation Impact (1): Direct impact to known heritage assets	No	High	Direct cumulative impacts to known heritage assets are unlikely to occur due to the retention of AEZs throughout the life of constructed and planned projects.
Operation Impact (2): Direct impact to potential heritage assets	Yes	Low (as yet unknown heritage assets)	There is potential for multiple unavoidable impacts associated with operations and maintenance activities (e.g. cable repairs and vessel anchors/jack up legs) during the operation phases of multiple projects.
Operation Impact (3): Indirect impact to heritage assets from changes to physical processes	No	High	***Chapter 7 Marine Geology, Oceanography and Physical Processes*** concludes that there will be no significant cumulative impact on the baseline wave, tidal and sediment regime.
Operation Impact (4): Impacts to the setting of heritage assets and	Yes	High	Across the region, cumulative impacts to the setting of heritage assets and historic seascape character may occur as a result of

Impact	Potential for cumulative impact	Data confidence	Rationale
historic seascape character			the presence of multiple constructed projects.
Operation Impact (5): Impacts to site preservation conditions from heat loss from installed cables	No	High	Cumulative impacts cannot occur as any heat dissipation is confined to the immediate locality of the cables.
Decommissioning Impact (1): Direct impact to known heritage assets	No	High	Direct cumulative impacts to known heritage assets are unlikely to occur due to the retention of AEZs throughout the life of constructed and planned projects.
Decommissioning Impact (2): Direct impact to potential heritage assets	Yes	Low (as yet unknown heritage assets)	There is potential for multiple unavoidable impacts associated with decommissioning considered cumulatively with activities associated with other projects.
Decommissioning Impact (3): Indirect impact to heritage assets from changes to physical processes	No	High	***Chapter 7 Marine Geology, Oceanography and Physical Processes*** concludes that there will be no significant cumulative impact on the baseline wave, tidal and sediment regime.
Decommissioning Impact (4): Impacts to the setting of heritage assets and historic seascape character	Yes	High	Changes to the setting of heritage assets and historic seascape character will occur although the nature of this change will depend upon the decommissioning plans for multiple projects.

16.7.1 Cumulative direct impact to potential heritage assets

206. There is potential for cumulative direct impacts to discrete (potential) heritage assets from both the proposed East Anglia ONE North and East Anglia TWO projects.

207. It is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets). Therefore, unavoidable direct impacts may occur if archaeological material is present within the footprint of invasive groundworks and or sea bed contact (e.g. by jack-up legs / anchors). As potential heritage assets are assigned a precautionary high heritage importance (***Table 16.23***) and the

magnitude of effect is also potentially high (as a worst case scenario), there is the potential for direct impacts of major adverse significance to occur upon potential heritage assets, although the application of embedded mitigation (see ***section 16.3.3***) is anticipated to reduce this to **minor adverse**.

208. Despite this potential, the application of embedded (see ***section 16.3.3***) and additional (see ***section 16.6.1.1.1***) mitigation measures is expected to reduce the level of harm to potential heritage assets through reducing, remedying and offsetting these potential impacts for both projects. As such, the potential cumulative impact is considered to be **minor adverse.** Cumulative direct impacts upon discrete (potential) heritage assets with other projects are not anticipated to occur as the footprints of projects do not overlap.

209. However, the extents of palaeolandscapes from various periods are largely unmapped and may extend beyond the parameters of an individual project (e.g. where palaeolandscape features are identified which form part of the wider North Sea palaeolandscape). Similarly, multiple unexpected discoveries of maritime or aviation finds (including newly identified wrecks or crashed aircraft which may be impacted during offshore activities) could result in a negative cumulative impact upon the overall *in situ* maritime / aviation archaeological resource of the wider region. Should multiple unavoidable impacts occur during the construction, operation or decommissioning of multiple projects, then cumulative impacts therefore have the potential to occur. This may result in the loss of unique aspects of former submerged landscapes or of the *in situ* maritime and aviation archaeological resource. In addition, if a site is damaged or destroyed, comparable sites elsewhere may increase in importance as a result of greater rarity and any future direct impacts will be of greater significance. Whatever potential impact may occur as a result of this would be somewhat offset by the beneficial impact outlined below.

210. However, due to the acquisition and archaeological assessment of geophysical and geotechnical survey data carried out for various offshore developments in recent years, the information provided by previously unrecorded heritage assets is already seen to be contributing significantly to a greater understanding of the historic environment within offshore contexts. As such, any unavoidable impacts and the data / records produced in mitigating their effects can also be regarded as a significant, beneficial cumulative effect. Any positive effect, however, must be demonstrated by the completion of studies to professional archaeological standards and the results produced must be made publicly available. This beneficial effect is discussed further in ***section 16.7.3*** below.

16.7.2 Cumulative impacts to the setting of heritage assets and historic seascape character

211. The introduction of the proposed East Anglia ONE North project into the existing baseline conditions will result in a change to the presently perceived historic seascape character. Perceptions of character with respect to the primary cultural processes which have been established and spatially defined through the HSC are set out in ***Table 16.22***, and the expected changes associated with construction and operation are set out in ***Table 16.26*** and ***Table 16.27***. This assessment has concluded that the presently perceived historic character is considered to have high capacity to accommodate the change.

212. Despite these conclusions, the installed or planned infrastructure and associated activities required for the constructed / consented and planned offshore windfarms, aggregate dredging licence areas, oil and gas licences and licensed disposal sites in the wider region of the proposed East Anglia ONE North project, when considered together, indicates the potential for a significant cumulative change from a historically perceived, open North Sea seascape to a seascape characterised by industrial infrastructure and activities. In particular, with respect to the large number of planned offshore windfarm projects, perceptions of historic seascape character may change to reflect a perception of the southern North Sea as associated primarily with offshore renewables.

213. On this basis, although the presently perceived historic character is considered to have high capacity to accommodate change, cumulative impacts to historic seascape character of the wider region of the proposed East Anglia ONE North project (and across the southern North Sea as a whole) will occur as a result of the construction of multiple projects. Whether this is considered a negative or positive effect is subjective and may be entirely dependent upon the view of individuals as to whether or not they perceive a seascape associated with offshore renewables as a negative or positive change. This subjectivity is expressed in the National Historic Seascape Characterisation project character area text for 'Energy Industry', which states that renewable energy generation produces strong and sometimes polarised views (LUC, 2017a, 2017b and 2017c).

16.7.3 Cumulative beneficial impact of accumulation of data

214. Research agendas focussing on the marine historic environment of the North Sea have gained considerable momentum in recent decades, with data acquired from development-led investigations increasingly considered to represent a significant opportunity to enhance our understanding of the archaeology and cultural heritage resource in offshore contexts. These research agendas fall in line with various policy frameworks which have been developed to ensure the sustainable development of the North Sea, taking into account the non-renewable nature of the marine historic environment.

215. The North Sea is not the property of any nation, although distinctions are made between territorial waters (the administrative and political division which form part of a particular nations territory up to 12 nautical miles) and Exclusive Economic Zones (EEZs), which represent sea zones prescribed by the United Nations Convention on the Law of the Sea over which a state has special rights regarding the exploration and use of marine sources. Although the proposed East Anglia ONE North project is within the United Kingdom's EEZ, any data acquired and archaeologically assessed as part of the project also has the potential to feed in to wider research objectives initiated by neighbouring EEZs in the North Sea (most notably, the Dutch and Belgium EEZs).

216. For example, in the Netherlands, the Cultural Heritage Agency, in conjunction with Rijkswaterstaat (the Dutch maritime and marine management organisation), has commissioned the production of a policy advice map for the North Sea's submerged archaeological landscapes. The incentive is to produce a spatial planning map comprising landscape zoning and geoarchaeological research guidelines for each zone to be used throughout EIA processes and the permit procedure. This is accompanied by a database of historic ship wreck sites, maintained and updated by the Cultural Heritage Agency.

217. As part of the Belgian Marine Spatial Plan for the North Sea, a master plan for the North Sea (inclusive of underwater cultural heritage considerations), has also been produced to aid the planning process and to ensure that the economic development of the North Sea is optimally guaranteed without degradation of the environment. The SeArch project was established to this end, to develop an efficient evaluation methodology to estimate the archaeological potential of work affected areas at sea and for the preparation of a clear policy and legal framework in relation to marine archaeological heritage in Belgium.

218. There have also been considerable advances in research of submerged landscapes in recent decades, with offshore wind activities representing a significant opportunity to both acquire data, and to implement targeted survey and sampling to inform understanding of North Sea submerged landscapes in accordance with co-ordinated strategies. For example, palaeolandscape research in the southern North Sea and the English Channel has been undertaken by the Flanders Marine Institute (platform for marine research), in partnership with the Ghent University, the Royal Institute for Natural Sciences (RBINS), the Natural History Museum of Rotterdam (The Netherlands) and the University of Bradford (UK) (http://www.vliz.be/en/palaeolandscape-research).

219. The potential for integrated research and management represents a positive cumulative impact of development-led initiatives across all sectors of the North Sea. Alongside data produced through UK offshore wind farm development, and that of other European nations bordering the North Sea, data sharing across

national boundaries has the potential to result in a significant beneficial impact. The positive effect of this, however, is dependent on the completion of studies to professional archaeological standards, and upon the publication of results, and raw data where appropriate, so that the benefit can be realised by those engaged in marine archaeological research (and the offshore wind farm industry) for both commercial and non-commercial purposes.

16.8 Inter-relationships

220. Potential interrelationships for offshore and intertidal marine archaeology and cultural heritage are listed in ***Table 16.29.***

Table 16.29 Chapter topic inter-relationships

Topic and description	Related Chapter	Where addressed in this Chapter
Indirect impact to heritage assets from changes to physical processes	***Chapter 7 Marine Geology, Oceanography and Physical Processes***	***Sections 16.3.2*** and ***16.6***
Indirect (non-physical) impacts upon the setting of heritage assets (designated and non-designated) and direct impact on deposits of geoarchaeological / palaeoenvironmental interest.	***Chapter 24 Archaeology and Cultural Heritage***	***Sections 16.3.2*** and ***16.6***
Indirect (non-physical) impacts upon the setting of heritage assets (designated and non-designated)	***Chapter 28 Offshore Seascape, landscape and Visual Amenity***	***Section 16.6***

16.9 Interactions

221. The impacts identified and assessed in ***section 16.6*** could give rise to synergistic impacts as a result of interacting with one another. The worst case impacts assessed within the chapter take these interactions into account. These areas of interaction are presented in ***Table 16.30***, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 16.30 Interaction between impacts

Construction stage impacts					
	Impact 1: Direct impact to known heritage assets	Impact 2: Direct impact to potential heritage assets	Impact 3: Indirect impact to heritage assets from changes to physical processes	Impact 4: Impacts to the setting of heritage assets and historic seascape character	Impact 5: Impacts to site preservation conditions from drilling fluid breakout
Impact 1: Direct impact to known heritage assets	-	No	No	No	No
Impact 2: Direct impact to potential heritage assets	No	-	Yes	No	Yes
Impact 3: Indirect impact to heritage assets from changes to physical processes	No	Yes	-	Yes	Yes
Impact 4: Impacts to the setting of heritage assets and historic seascape character	No	No	Yes	-	No
Impact 5: Impacts to site preservation conditions from drilling fluid breakout	No	Yes	Yes	No	-

Operation stage impacts					
	Impact 1: Direct impact to known heritage assets	Impact 2: Direct impact to potential heritage assets	Impact 3: Indirect impact to heritage assets from changes to physical processes	Impact 4: Impacts to the setting of heritage assets and historic seascape character	Impact 5: Impacts to site preservation conditions from heat loss from installed cables
Impact 1: Direct impact to known heritage assets	-	No	No	No	No
Impact 2: Direct impact to potential heritage assets	No	-	Yes	Yes	No
Impact 3: Indirect impact to heritage assets from changes to physical processes	No	Yes	-	Yes	No
Impact 4: Impacts to the setting of heritage assets and historic seascape character	No	Yes	Yes	-	No
Impact 5: Impacts to site preservation conditions from heat loss from installed cables	No	No	No		-
Decommissioning stage impacts					
The detailed decommissioning activities and methodology would be determined later within the project lifetime. Assuming that decommissioning activities are confined to areas previously disturbed as part of construction works, it is anticipated that the decommissioning impacts will be no worse than those of construction.					

16.10 Summary

222. A summary of the findings of the PEIR for marine archaeology and cultural heritage is presented in ***Table 16.31***.

223. In accordance with the assessment methodology presented in ***section 28***, this table should only be used in conjunction with the additional narrative explanations provided in ***section 16.6***.

Table 16.31 Potential Impacts Identified for offshore and intertidal archaeology and cultural heritage

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Direct impact to known heritage assets	Wrecks and Anomalies (A1)	High	High	Major adverse	Nothing further to embedded mitigation (AEZs)	**No impact**
	A3 wrecks	High	High	Major adverse	Nothing further to embedded mitigation (AEZs/Avoid location)	**No impact**
	Additional anomalies (A2)	High	High	Major adverse	Nothing further to embedded mitigation (Avoid location)	**No impact**
	Intertidal assets	Negligible /Medium	No impact	No impact	None	**No impact**
Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	High	High	Major adverse	Further assessment	**Minor adverse**
	Intertidal assets	Negligible /Medium	No impact	No impact	None	**No impact**
	Isolated finds	Medium	Low	Minor adverse	Protocol to be established	**Minor adverse**

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Indirect impact to heritage assets from changes to physical processes	Known and potential heritage assets	Low to High	None / Nil	No impact	None	**No impact**
Impacts to the setting of heritage assets and historic seascape character	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. In terms of setting, it has been concluded that any changes to setting due to construction activities would be temporary and of sufficiently short duration that they would not give rise to material harm (see ***Chapter 24 Archaeology and Cultural Heritage*** for further information regarding onshore and inter-tidal heritage assets).					
Impacts to site preservation conditions from drilling fluid breakout	Intertidal assets	Negligible /Medium	Negligible	Negligible/Minor	None	**Negligible/Minor adverse**
Operation						
Direct impact to known heritage assets	As for construction					No impact
Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	High	High	Major adverse	Further assessment	**Minor adverse**
Indirect impact to heritage assets from changes to physical processes	Known and potential heritage assets	Low to High	Negligible	Minor Adverse	None	**Negligible**
Impacts to the setting of heritage assets and	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. The planned infrastructure at the landfall, comprising buried cables installed using HDD, is not considered to give rise to material harm to the setting of intertidal assets. The					

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
historic seascape character	baseline setting of known wrecks within the offshore cable corridor are already influenced by passing vessels in this area associated with industry, fishing and recreation, thereby reducing the sensitivity and potential magnitude of change. The potential impact to the setting of marine heritage assets is considered to be of negligible magnitude and of **minor adverse** significance.					
Impacts to site preservation conditions from heat loss from installed cables	Known and potential heritage assets	Low to High	No impact	No impact	None	**No impact**
Decommissioning						
Direct impact to known heritage assets	As for construction					**No impact**
Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	High	High	Major adverse	Further assessment	**Minor adverse**
Indirect impact to heritage assets from changes to physical processes	As for construction					**No impact**
Impacts to the setting of heritage assets and historic seascape character	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. In terms of setting, it has been concluded that any changes to setting due to decommissioning activities would be temporary and of sufficiently short duration that they would not give rise to material harm (see ***Chapter 24 Archaeology and Cultural Heritage*** for further information regarding onshore and inter-tidal heritage assets					

224. Potential cumulative impacts are summarised in ***Table 16.32.***

Table 16.32 Potential Cumulative Impacts Identified for offshore and intertidal archaeology and cultural heritage

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Direct impact to known heritage assets	*In situ* prehistoric, maritime or aviation sites	Low to High	High	Major adverse	Nothing further to embedded mitigation (Avoidance)	**No impact**
Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	Medium to High	High	Major adverse	Further assessment/ reporting protocol	**Minor adverse (plus positive benefit from accumulation of data)**
Impacts to the setting of heritage assets and historic seascape character	Cumulative impacts to the setting of heritage assets and historic seascape character will occur. Whether this is considered adverse/beneficial depends upon individual perceptions of a seascape associated with offshore renewables as a negative or positive change.					

16.11 References

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