The Great Grid Upgrade

Eastern Green Link 5 (EGL 5)

Preliminary Environmental Information Report

Volume 1
Part 3
Chapter 25 Marine Archaeology

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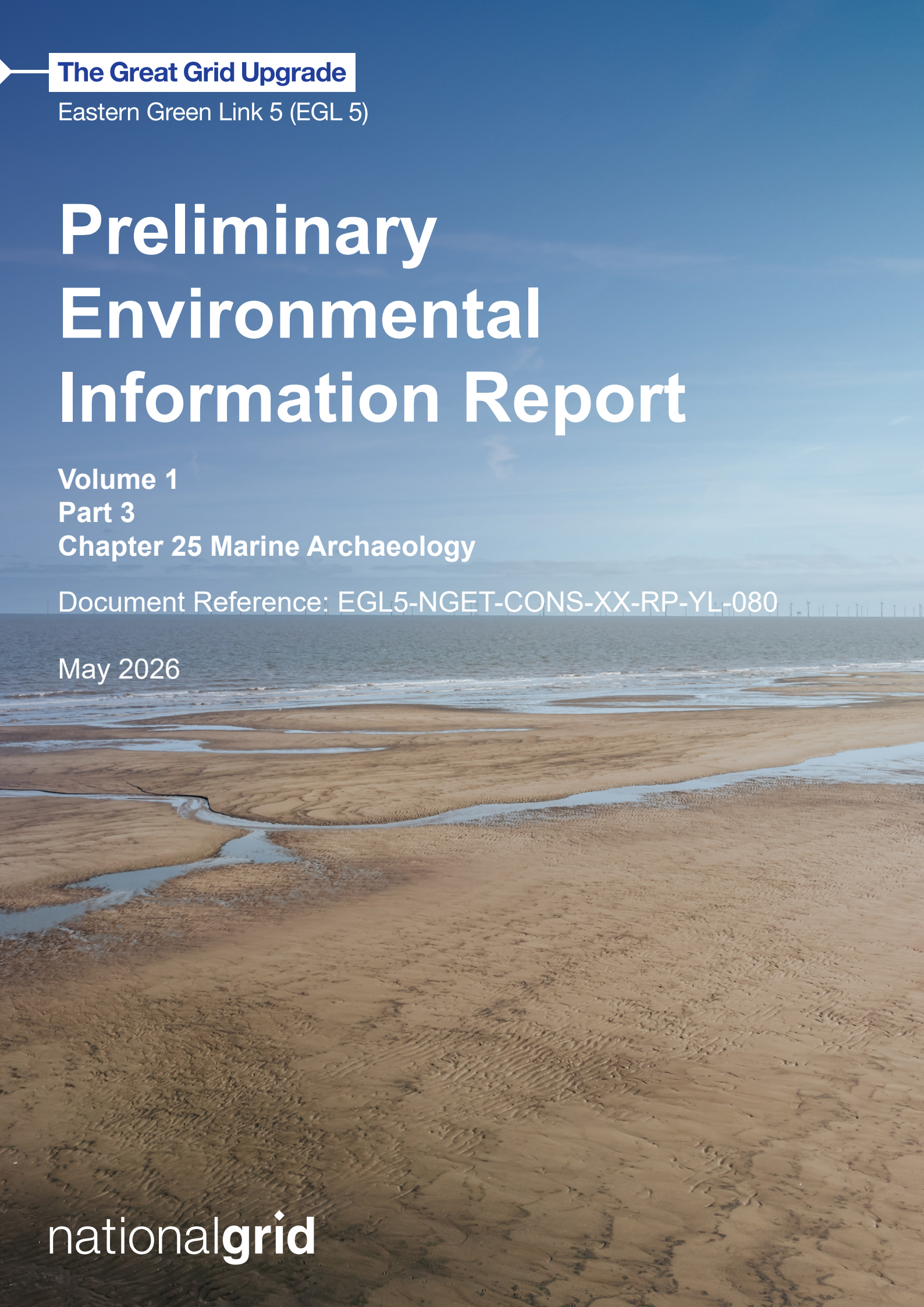

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25.1 Introduction

25.1.1 This chapter presents the preliminary findings of the Environmental Impact Assessment (EIA) undertaken to date for the Eastern Green Link (EGL) 5 English Offshore Scheme, with respect to the marine archaeology, including palaeolandscape and submerged prehistory; maritime and coastal remains; and aviation remains. The preliminary assessment is based on information obtained to date. It should be read in conjunction with the description of the Project provided in **Volume 1, Part 1, Chapter 4: Description of the Project**.

25.1.2 This chapter describes the methodology used, the datasets that have informed the preliminary assessment, baseline conditions, environmental measures, and the potential preliminary marine archaeology effects that could result from the English Offshore Scheme during the construction, operation (and maintenance), and decommissioning phases. Specifically, it relates to the English Offshore elements of the Scheme seaward of Mean High Water Springs (MHWS).

25.1.3 This chapter should be notably read in conjunction and considered alongside the following technical aspect chapters found in **Volume 1:**

- **Part 1, Chapter 4: Description of the Project;**
- **Part 1, Chapter 5: PEIR Approach and Methodology;** and
- **Part 3, Chapter 17: Coastal and Marine Physical Processes**;

25.1.4 There is spatial overlap with the onshore assessments that are being progressed for the English Onshore Scheme (see **Volume 1, Part 2 English Onshore Scheme**), with the Intertidal Zone sharing common receptors. This chapter should also therefore be read in conjunction with the following chapters found in **Volume 1**:

- **Part 2, Chapter 7: Cultural Heritage.**

25.1.5 This chapter is supported by the following figures in **Volume 3, Part 3:**

- **Figure 25-1 Marine Archaeology Study Area;**
- **Figure 25-2 UKHO Records (1 of 5);**
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- **Figure 25-26 Distribution of High Potential Archaeological Anomalies;**
- **Figure 25-27 High Potential Anomaly MSDS_001;** and
- **Figure 25-28 Terrestrial and Intertidal Records within the Study Area.**

25.1.6 This chapter is supported by the following appendices**:**

- **Volume 2, Part 1, Appendix 2.A: Regulatory and Planning Context;**
- **Volume 2, Part 1, Appendix 5.B: Outline Code of Construction Practice; and**
- **Volume 2, Part 1, Appendix 5.C: Outline Construction Environmental Management Plan (CEMP) ;**
- **Volume 2, Part 3, Appendix 25.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries;**
- **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records;**
- **Volume 2, Part 3, Appendix 25.C: Gazetteer of Geophysical Anomalies;** and
- **Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points.**

25.1.7 As set out in **Volume 1, Part 1, Chapter 1: Introduction,** cable installation and some associated activities beyond 12 Nautical Miles (NM), and emergency repair of the installed cable within the draft Order Limits are exempt under the Marine and Coastal Access Act 2009 (MCAA 2009). This chapter presents a preliminary assessment of the cable route from MHWS at the Anderby Creek Landfall to the marine boundary between English and Scottish adjacent waters. This is to ensure all likely significant effects of the English Offshore Scheme have been assessed. However, consent is not being sought for the exempt cable and only external cable protection and dredging for sandwave clearance is included in the Deemed Marine Licence (DML) beyond 12 NM.

Limitations

25.1.8 The information provided in this Preliminary Environmental Information Report (PEIR) is preliminary, the final assessment of potential significant effects will be reported in the Environmental Statement (ES). The PEIR has been produced to fulfil the Applicant's consultation duties in accordance with Section 42 of the PA2008 and enable consultees to develop an informed view of the preliminary potential significant effects of the English Offshore Scheme.

25.1.9 The baseline description collated in this chapter has been based on a range of publicly available data and information. It is assumed that the data collated is accurate as of the time of acquisition from public sources. The data will be supplemented with additional information acquired as part of the stakeholder engagement process and through the additional studies identified in this chapter to inform the ES.

25.1.10 Various technical assessments were undertaken to inform the EGL 3 and EGL 4 PEIR and ES. Where relevant (i.e., where construction methodologies are essentially identical, or where an impact pathway would occur over a similar spatial / temporal scope) the conclusions of those assessments have been used to scope 'in' or 'out' various impact pathways. These are not necessarily proposed to be repeated to inform the PEIR for this Project.

25.1.11 In the absence of data, a precautionary approach has been taken and professional judgement, based on experience of similar linear projects, have been used where required, to inform the scope of the assessment. Any limitations associated with data quality are outlined in Section 0 below.

25.1.12 There are no significant limitations relating to marine archaeology that affect the robustness of the preliminary assessment of the potential significant effects of the English Offshore Scheme.

Preliminary significance conclusions

25.1.13 The preliminary marine archaeology assessments presented in Section 25.10 onwards have concluded that the likely effects assessed are Minor Adverse and are considered to be **Not Significant**. These potentially adverse effects are ones that can be adequately controlled by best practice and legal controls and opportunities to reduce the significance of effects through mitigation may be limited. Further details of the methodology behind the assessment and a detailed narrative of the assessment itself are provided within the sections below.

25.2 Relevant Technical Guidance

Technical guidance

25.2.1 The legislation and planning policy which has informed the assessment of effects with respect to marine archaeology is provided within **Volume 1, Part 1, Chapter 2: Regulatory and Policy Overview** and **Volume 2, Part 1: Appendix 2.A: Regulatory and Planning Context**. Further information on policies relevant to the English Offshore Scheme is provided in **Volume 2, Part 1, Appendix 2.B: Marine Plan Policy Assessment.** Relevant technical guidance, specific to marine archaeology, that has informed this PEIR and will inform the assessment within the ES is summarised in **Table 25-1**, below.

Table 25-1 Technical guidance relevant to the marine archaeology assessment

Technical guidance document	Context
English Heritage. 2002. *Military Aircraft Crash Sites* (Ref 25.1).	General guidance on the protection of military crash sites.
Wessex Archaeology. 2008. *Military Aircraft Crash Sites at Sea A Scoping Study* (Ref 25.2).	Guidance regarding the management and understanding of sites that include aviation remains within marine environments.
The Crown Estate. 2021. *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects* (Ref 25.3).	Guidance on the range of archaeological methodologies that may be required as part of the initial investigation stages or the mitigation phase of offshore projects (not exclusive to offshore wind projects).
Wessex Archaeology. 2011. *Assessing Boats and Ships 1860-1950* (Ref 25.4).	Guidance on the assessment of shipwrecks from the mid-19th to mid-20th centuries.
Joint Nautical Archaeology Policy Committee. 2006. *Code of Practice for Seabed Developers* (Ref 25.5).	The Code provides guidance to developers relating to risk management and legislative implications of developing within the marine environment in the UK. It also outlines the responsibility of developers in protecting the UK's marine heritage.
English Heritage. 2008.*Conservation Principles, Policies and Guidance: For the sustainable management of the historic environment* (Ref 25.6).	The primary aim of the Conservation Principles, Policies and Guidance is to support the quality of decision-making, with the ultimate objective of creating a management regime for all aspects of the historic environment that is clear and transparent in its purpose and sustainable in its application.
Collaborative Offshore Windfarm Research Into the Environment (COWRIE). 2007. *Historic Environment Guidance for the Offshore Renewable Energy Sector* (Ref 25.7).	Generic guidance on the survey, appraisal and monitoring of the historic environment during the development of offshore renewable energy projects in the UK. The guidance is applicable to the marine environment and the coastal environment adjacent to any development, encompassing the intertidal area, coastal margin and those areas further inland likely to be affected by offshore renewable energy developments.
COWRIE. 2008. *Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy* (Ref 25.8).	A guidance notes on the assessment of cumulative effects on the historic environment during the development of offshore renewable energy projects in the UK. The guidance is applicable to the marine environment and the coastal environment adjacent to any development, encompassing the inter-tidal area, coastal margin and those areas further inland likely to be affected by offshore renewable energy developments.

Technical guidance document	Context
Historic England (HE). 2023. *Curating the Palaeolithic* (Ref 25.9).	This guidance explains the importance of the English Palaeolithic record in its Pleistocene context and best practices for protecting it through the planning process, illustrated by case studies from across the country.
HE. 2020. *Deposit Modelling and Archaeology* (Ref 25.10).	This guidance is written to help archaeologists working within the context of development-led projects to understand what deposit models are and the benefits that can be gained by using them. It is also relevant to any archaeological work where the intention is to characterise deep sequences of deposits.
HE. 2025. *Environmental Archaeology: A Guide to the Theory and Practice of Methods, from Sampling and Recovery to Post-excavation (third edition)* (Ref 25.11).	This document and the supporting appendices provide guidance for good practice in environmental archaeology, including practical advice on the applications and methods of environmental archaeology within archaeological projects. A range of case studies on the application of environmental archaeology approaches are presented, as well as a summary of commonly utilised biological remains.
HE. 2015. *Geoarchaeology: Using earth sciences to understand the archaeological record* (Ref 25.12).	This guidance document covers the use of geoarchaeology to assist in understanding the archaeological record.
HE. 2015. *Managing Significance in Decision-Taking in the Historic Environment* (Ref 25.13).	This document provides practical guidance to support the implementation of national heritage policy within the planning system. It emphasises the importance of understanding the significance of heritage assets as a foundation for informed and proportionate decision-making. The document outlines best practices for assessing significance, engaging appropriate expertise, using Historic Environment Records (HERs), and considering the impact of development proposals. It encourages early engagement, structured analysis, and transparent justification of any changes, aiming to conserve heritage assets in a manner appropriate to their value while allowing for sustainable development.
HE. 2025. *Marine Geophysics: Data Acquisition, Processing, and Interpretation: Guidance Notes (2nd Edition)* (Ref 25.14).	Guidance on the archaeological requirements for the acquisition, processing and interpretation of geophysical and hydrological data.
The Crown Estate. 2014. *Protocol for Archaeological Discoveries: Offshore Renewables Projects* (Ref 25.15).	Guidance document relating to the reporting procedure of archaeological discoveries in the offshore environment.

Technical guidance document	Context
HE. 2025. *Scientific Dating of Pleistocene Sites* (Ref 25.16).	These guidelines provide advice on best practice for the use of scientific dating on Pleistocene sites. They are applicable to all archaeological projects but are aimed primarily at those undertaken as part of the planning process.
Chartered Institute for Archaeologists (CIfA). 2020. *Standard and Guidance for Historic Environment Desk-Based Assessment* (Ref 25.17).	Generic guidance on the assessment of the historic environment during the development projects in the UK. The Code of Conduct guides the practices and standards for archaeological assessment both onshore and offshore.
HE. 2019. *Statements of Heritage Significance: Analysing Significance in Heritage Assets* (Ref 25.18).	This advice note provides clear guidance on how to assess and articulate the significance of heritage assets in support of planning and heritage consent applications. The document outlines a staged approach to decision-making, where significance is assessed prior to design development, ensuring that proposals are informed and proportionate.

25.3 Consultation and Engagement

Overview

25.3.1 The marine archaeology assessment has been informed by consultation responses and ongoing stakeholder engagement. An overview of the approach to consultation is provided in Section 5.9 of **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**. Key consultees identified to date are:

- Marine Management Organisation (MMO);
- Historic England (HE); and
- Lincolnshire County Council.

25.3.2 The programme of ongoing stakeholder engagement and consultation will be structured around key milestones in the design development and assessment process, thereby providing the opportunity to update and consult stakeholders on the evolving design and decision-making process. Further details and responses from stakeholder consultation are detailed within **Table 25-2** below and will continue to inform the preparation of the ES (see below, Section 25.23).

25.3.3 An overview of the technical engagement undertaken or planned to inform the marine archaeology assessment is provided in paragraphs 25.3.7 and 25.3.8.

Scoping Opinion

25.3.4 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 13 October 2025 (Ref 25.19). A summary of the relevant responses received in the Scoping Opinion in relation to the marine archaeology, and confirmation of how these have been addressed within the assessment to date, is presented in **Table 25-2**.

25.3.5 The information provided in the PEIR is preliminary and not all Scoping Opinion comments have been addressed at this stage, however, all comments will be addressed within the ES.

25.3.6 In addition to Scoping Opinion responses received for the Project, those received for the Scoping Opinion and PEIR for the EGL 3 and EGL 4 projects were considered in the preparation of this Chapter, where relevant to marine archaeology.

Table 25-2 Summary of Scoping Opinion responses for marine archaeology

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate (ID Ref 4.9.1).	No matters have been proposed to be scoped out of the assessment.	All potential impacts have been scoped into the assessment (see Section 25.7).
Planning Inspectorate (ID Ref 4.9.2).	Scoping Report **Table 26-7** identifies micro siting as a mitigation measure, but this is not included in the measures set out in paragraph 26.6.4. For clarity, the ES should set out if and where micro siting is intended to mitigate effects and how this is secured through the DCO.	Micro-siting, as an environmental measure, is discussed in Section 25.6 of this PEIR Chapter and will feed into the ES. Micro-siting will be employed, as necessary, alongside Archaeological Exclusion Zones (AEZs), mitigating potential impacts to known or potential marine archaeology receptors.

Technical engagement

25.3.7 Technical engagement with consultees in relation to marine archaeology is ongoing. A summary of the technical engagement undertaken up to the end of March 2026 is outlined in **Table 25-3**.

Table 25-3 Technical engagement for the marine archaeology assessment

Consultee	Consideration	How addressed in this PEIR
The Historic Buildings and Monuments Commission for England (Historic England).	A meeting was held virtually on 24 January 2025 to introduce the Project to the stakeholder. This also included a discussion of autonomous survey specification within the English Offshore Scheme. The key points were (copied from the meeting's minutes): • [Historic England] Asked whether Marine Archaeological consultants have been onboarded to support the survey and review data gained throughout the survey process;	Material Safety Data Sheet (MSDS) Marine were contracted to the Project to provide advice regarding the marine historic environment. As part of this Chapter, the geophysical data has been archaeologically reviewed (see Section 25.4 for methodology; Section 25.5 for results). Further geophysical surveys will be undertaken in the future, to supplement those undertaken prior to PEIR and

Consultee	Consideration	How addressed in this PEIR
	• [Historic England] Reiterated that there are several survey strategies to think about; with availability of new technology, a combination of surveys should be seen as singular items; • [Historic England] Advised that there is an important element of risk, which limits resolution, and is relieved that archaeological advice is being sought. Work to be led by consultancy, but desk-based work, on what to expect, the buffer would be bigger than 1k [km], unknown sites. Entirely dependent on SBP [Sub-Bottom Profiler], the best indication is in combination with all technology; and • [Historic England] to be kept abreast of survey outcomes as / when they become available.	to inform the ES, including Side Scan Sonar and Magnetometer. MSDS Marine will be available to support and advise prior to mobilisation, during data collection and to archaeologically review the results. Wider examination of the marine historic environment has been undertaken to inform this Chapter, using a study area of up to 2 km, measured from the boundary of the English Offshore Scheme (see Section 25.4**)**. As a stakeholder, Historic England will be presented with the results of the archaeological assessment of data through this PEIR Chapter.
	A virtual meeting was held on 24 March 2025, introducing the formal transition of the Project to 'Eastern Green Link 5', including introductions to the onshore and offshore Consents Teams. The key points relating to marine archaeology were: • [National Grid] gave a survey update to [Historic England]; and • [National Grid] gave an overview of the non-statutory consultation, key dates including the consultation period, in-person events and dates, two live webinars and materials taken to non-statutory consultation.	In line with stakeholder comments from meeting on 25 January 2025, marine survey progress was shared with the stakeholder as data comes available. NGET is committed to keeping stakeholders appraised of progress through statutory and non-statutory consultation.
	A virtual meeting was held on 27 August 2025, to inform the stakeholder on Project progress around time of Scoping Report submission and to introduce MSDS Marine as the lead for marine archaeology. The stakeholder was presented with an update of the Project overview. The key points were: • [Historic England] confirmed that future meetings for onshore archaeology will be held separately, however, meetings	An indicative Enhanced Advisory Service programme for engagement with Historic England, relating to both marine and terrestrial archaeology, has been prepared, submitted and agreed with the stakeholder.

Consultee	Consideration	How addressed in this PEIR
	to discuss offshore archaeology may be joined with meetings involving onshore discussions; and • [National Grid] to send an Enhanced Advisory Service document to Historic England, outlining a proposed schedule for future stakeholder engagement.	

25.3.8 Technical engagement with consultees specific to marine archaeology is ongoing. Meetings with Historic England are proposed between PEIR and ES, in addition to statutory consultation, and will be undertaken as necessary prior to the submission of the Development Consent Order (DCO). Should any further engagement with consultees specific to this discipline occur in the future, this will be made clear within the ES.

25.4 Data Gathering Methodology

25.4.1 This section provides an overview of the methods used to inform the assessment. The study area is described first, followed by data sources and detailed methods of the review.

25.4.2 The baseline assessment is primarily focused on known and potential remains relating to:

- Palaeolandscape and submerged prehistory;
- Maritime and coastal remains; and
- Aviation remains.

25.4.3 Onshore heritage assets are included in the discussion where these fall within the study area (see below).

Study Area

25.4.4 The study area for marine archaeology comprises a 2 km zone measured from the English Offshore Scheme draft Order Limits, illustrated by **Volume 3, Figure 25-1 Marine Archaeology Study Area**. The marine archaeology study area extends for 200 m above MHWS at the Anderby Creek Landfall as illustrated in **Volume 3, Figure 25-28 Terrestrial and Intertidal Records within the Study Area**, capturing archaeological data from the nearby terrestrial landscape with the potential to aid characterisation and interpretation of the marine archaeological character and potential for remains. This study area is considered suitable for characterising the marine archaeological resource of the English Offshore Scheme, as it will examine assets potentially susceptible to direct and / or indirect impacts, therefore adhering to best practice.

25.4.5 The scope of a marine archaeology study area is not defined by policy nor legislation, rather it is determined on a project-by-project basis. Industry guidance recommends agreement in the scope between the party undertaking the assessment and the "…*local authority's historic environment advisor*…" prior to data collection (Ref 25.17). The same approach to defining the study area scope was initially proposed for the EGL 3 and EGL 4 projects and agreed through consultation with relevant stakeholders, including Historic England. A large extent of crossover is exhibited between the EGL 3 and EGL 4 projects and the English Offshore Scheme. No feedback has been received from HE requiring amendment to this approach for EGL 5 and it has been assumed that the study area is acceptable.

25.4.6 Should further information demonstrate a potential for impacts to offshore heritage assets beyond this study area, this may be amended in agreement with the Applicant and key stakeholders.

25.4.7 Reference to onshore heritage assets is included in the discussion where these fall within the study area (i.e., above MHWS < 200 m). Such assets also feature in the assessment presented by **Volume 1, Part 2, Chapter 7: Cultural Heritage**.

25.4.8 The English Offshore Scheme installation will use a trenchless solution at the Anderby Creek Landfall, avoiding intrusive works in the intertidal area. Any proposed exit points for a trenchless solutions, where the cables transition from the cable ducts to seabed burial, would be entirely in the subtidal environment.

Desk study

25.4.9 The existing data sets and literature with relevant coverage to the study area, which have been used to inform the baseline characterisation for marine archaeology, are outlined in **Table 25-4**. Project-specific data obtained and used to inform this assessment are presented in the sub-sections below.

Table 25-4 Data sources used to inform the marine archaeology assessment

Organisation	Data source	Data provided
British Geological Survey (BGS).	GeoIndex Offshore (Ref 25.20).	Offshore geology and geotechnical data.
	BGS TextViewer (Ref 25.21).	UK offshore regional reports.
BRITICE Glacial Mapping Project.	University of Sheffield (Ref 25.22).	Information regarding the geomorphology (landforms) of the last British-Irish ice sheet.
CITiZAN	Coastal and Intertidal Zone Archaeological Network (Ref 25.23).	Non-designated heritage assets.
European Marine Observation and Data Network (EMODnet).	European Commission EMODnet Map Viewer (Ref 25.24).	Sub-seabed palaeolandforms and palaeolandscapes.

Organisation	Data source	Data provided
Historic England.	Intertidal and Coastal Peat Database (Ref 25.25).	Locations and results of analysis of intertidal peat deposits.
	National Marine Heritage Record (NMHR) (Ref 25.26).	Designated and non-designated heritage assets in the marine zone.
Lincolnshire County Council.	Lincolnshire Historic Environment Record (HER) (Ref 25.27).	Non-designated heritage assets, including those formerly held by the National Record of the Historic Environment (NRHE).
Marine Environmental Data and Information Network (MEDIN).	MEDIN portal (Ref 25.28).	Marine geology, geotechnical data and publicly accessible shipwrecks.
North Sea Palaeolandscapes Project.	Archaeology Data Service (Ref 25.29).	Assessment of the North Sea palaeolandscapes based on legacy seismic and other data.
Trove	Historic Environment Scotland (Ref 25.30).	Designated and non-designated heritage assets.
United Kingdom Hydrographic Office (UKHO).	Admiralty Marine Data Portal (Ref 25.31).	Wrecks and obstructions.
UK Government.	Explore Marine Plans: Map data (Ref 25.32).	Wrecks designated under the Protection of Military Remains Act, 1986.

Survey work

25.4.10 Primary data for the English Offshore Scheme was acquired from a suite of geophysical surveys starting 23 April 2025 and completing 24 June 2025, using Uncrewed Surface Vessels (USVs). This comprised the collection of Multibeam Echosounder (MBES) Bathymetry and Sub-bottom Profiler (SBP) data. The resultant preliminary interpretations of these data (Ref 25.33) were used to inform this PEIR.

25.4.11 A walkover survey of the intertidal zone at the Anderby Creek Landfall location was undertaken on 6 October 2025 to 7 October 2025. The results have been included in Section 25.5, where relevant. In summary, five features / artefacts and three peat exposures were recorded during this survey.

25.4.12 The following sub-sections describe the data collection, data deliverables, data quality and methodology for archaeological assessment in further detail.

Methodology: archaeological assessment of geophysical and hydrographic data

Data collection

25.4.13 The geophysical survey data for the English Offshore Scheme was acquired by XOCEAN from April to June 2025. The coverage extended from the maritime boundary between Scotland and England, in the north, to the Lincolnshire coast, in the south, with a survey corridor width of 300 (in <70 m water depth) to 500 m (in >70 m depth).

25.4.14 The main Route Position List (RPL) for the planned EGL 5 cable route runs from Kilometre Point (KP) 0, in sub-block NS01, to KP 411.92, in sub-block D21, through the B blocks (east split route).

25.4.15 Blocks E01 to F02 (west split route) comprise alternative Route E RPL, with KPs ranging from KP 0, at the southern end of Block E01, to KP 39.453, at the northern end of Block F02.

25.4.16 The survey was planned with 20 m line spacing in sub-block NS01, 30 m in other nearshore blocks and 50 m spacing for offshore blocks. The line spacing was planned to achieve 200 per cent coverage with a 0.5 m x 0.5 m cell size for MBES data and 100 per cent coverage with a 0.5 m x 0.5 m cell size for backscatter data.

25.4.17 The survey equipment used is provided below in **Table 25-5**.

Table 25-5 Geophysical and hydrographic sensor specifications

Sensor	Manufacturer	Model	Frequency	Minimum specification.
Multibeam	Norbit	B51S Winghead.	200 – 700 kilohertz (kHZ), typically 400 kHz.	0.5 x 0.5 m cell size.
Parametric SBP.	Innomar	Medium – 100 (USV).	8 – 12 kHz.	10 m penetration.

Positioning

25.4.18 All data were collected with reference to the Universal Terrestrial Reference System 1989 (ETRS89) datum and Universal Transverse Mercator (UTM) Zone 30 North projection (ETRS89 Z30N). All vertical depths are relative to Lowest Astronomical Tide (LAT) and were reduced to LAT using Vertical Offshore Reference Frames (VORF).

25.4.19 Vessel positioning and inertial navigation were achieved using an Applanix Wavemaster II POSMV, giving a horizontal accuracy of 0.2 m and a vertical accuracy of 0.1 m. Roll and pitch accuracy was 0.02° and heading accuracy 0.03°.

Data deliverables

25.4.20 The survey deliverables included both raw and processed data, alongside interpretations and operations reports. The primary deliverables are detailed in **Table 25-6**, below.

Table 25-6 Data deliverables

Sensor	Data type	Format
Sub-bottom Profiler.	Raw lines.	.sgy
	Processed lines.	.sgy
	Isopach	.flt, .xyz, .shp
	Horizons	.flt, .xyz
Multibeam Bathymetry.	Grids (at 0.5 m).	.tiff
	Mosaic (at 0.5 m).	.tiff
	Geodatabase	.gdb
Reports	Survey results report (REF 25.32).	.pdf

Data quality and limitations

25.4.21 The MBES data covered the extents of the pre-defined survey blocks, providing coverage of a least 100 per cent. The data are of good quality, with no significant errors in positioning or vertical heights noted. The ability to grid the data at 0.5 m means that a reasonable level of detail can be determined for larger anomalies, such as wrecks. However, there may be instances where smaller anomalies may exist on the seabed but not be visible within the data, or where accurate interpretation of anomalies is unable to be made, due to the resolution of the data.

25.4.22 MBES data is considered to provide the most accurate positioning due to the direct and fixed correlation between the sensor, the Differential Global Positioning System (DGPS) antennas and the Motion Reference Unit (MRU) and is the primary source of anomaly positioning.

25.4.23 The MBES data appear to be of an appropriate specification, coverage and quality to undertake the archaeological assessment. However, the assessment of MBES in isolation can limit the robustness of the interpretation. Typically, MBES data is collected alongside Side Scan Sonar (SSS), which allows for the identification of smaller anomalies and finer detail, and Magnetometer data, which allows for the identification of ferrous material on, or directly below, the seabed. Additional data collection and assessment will be required prior to impacts on the seabed, the specification of which should be commensurate with the guidance provided by Historic England for an ‘investigation’ survey (Ref 25.14). These data will be acquired at a future stage by SSS and Magnetometer sensors.

25.4.24 SBP data were collected to a pre-determined line plan, largely providing suitable coverage and penetration for the interpretation of the palaeoenvironment. Acceptable depth of resolution was defined at a minimum 10 m below seabed (BSB) and 2.5 km crossline spacing, with the sensor often exceeding this benchmark and able to resolve intricate internal structures. Full gridded coverage was achieved across the survey area, with no gaps. The line spacing was not constant, varying along the survey corridor.

25.4.25 The SBP data appear to be of an appropriate specification, coverage and quality to undertake a preliminary archaeological assessment, noting that additional data collection and interpretation may be required prior to construction.

Archaeological assessment of data

25.4.26 The archaeological assessment of data was undertaken by a qualified and experienced maritime archaeologist with a background in geophysical and hydrographic data acquisition, processing and interpretation.

25.4.27 Following delivery of the required datasets, an initial review was undertaken to gain an understanding of the geological and topographic make-up of the survey area. Within the extent of the survey area, the potential for variations in the seabed is high and can affect the interpretation of anomalies. The assessment considers the full extents of the survey data, which was collected within pre-defined survey blocks. The assessment of desk-based sources was undertaken within the extents of the survey data, relating to seabed wrecks, obstructions and historic environment assets, as well as wrecks and documented sightings / experiences of historic wrecks. These data are used to inform of known wrecks or the likelihood of encountering physical remains relating to such.

25.4.28 Whilst the data coverage extends beyond the pre-defined survey blocks, the purpose of the assessment is to characterise the historic environment and therefore data from the wider area (full survey extents) were considered.

Multibeam Bathymetry

25.4.29 Data were supplied as a depth-embedded raster. The raster was imported into ArcGIS Pro 3.4 and a hill-shaded surface applied. Shading was adjusted to ensure the optimal presentation of data. The resulting 3-Dimensional (3D) image was viewed on a block-by-block basis and all anomalies of potential anthropogenic origin identified and recorded.

25.4.30 Records include, at a minimum: an image of the anomaly; dimensions; and a description. A rating of archaeological potential was assigned to the anomaly following the criteria outlined in **Table 25-7**, below.

Table 25-7 Criteria for the assessment of archaeological potential

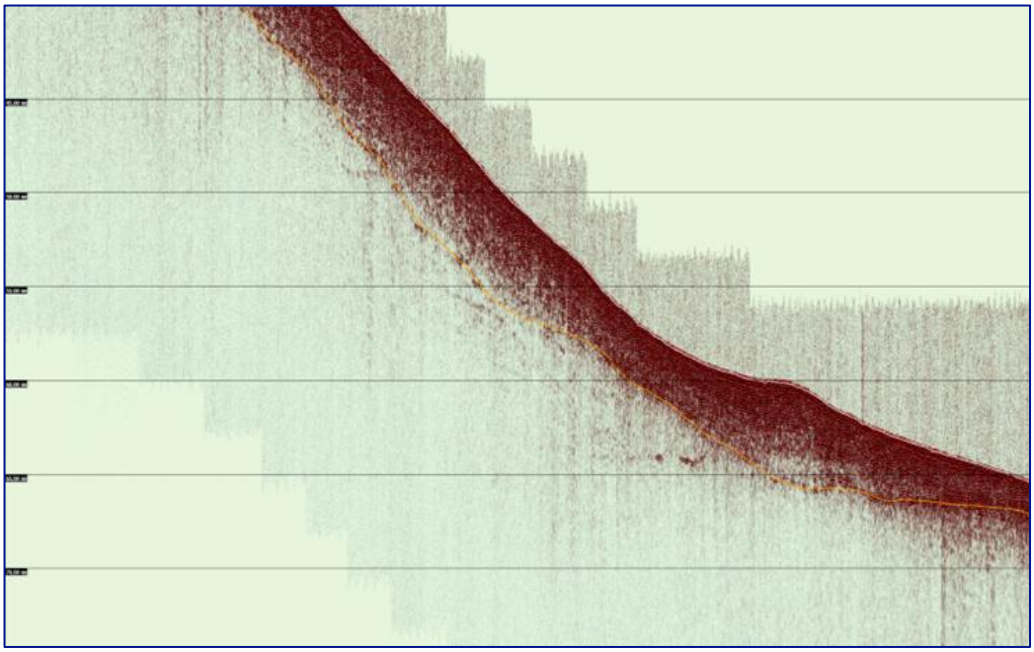
Potential	Criteria
Low	An anomaly potentially of anthropogenic origin but that is unlikely to be of archaeological significance. Examples may include: discarded modern debris (such as rope, cable, chain or fishing gear); small, isolated anomalies with no wider context; and small boulder-like features with associated magnetometer readings.
Medium	An anomaly believed to be of anthropogenic origin but that would require further investigation to establish its archaeological significance. Examples may include: larger unidentifiable debris or clusters of debris; unidentifiable structures; and significant magnetic anomalies.
High	An anomaly almost certainly of anthropogenic origin and with a high potential of being of archaeological significance. High potential anomalies tend to be the remains of wrecks, the suspected remains of wrecks, or known structures of archaeological significance.

Palaeolandscape and Sub-bottom Profiler interpretation

25.4.31 Sub-surface data acquired from seismic and geotechnical surveys is key to understanding the palaeolandscape potential of the English Offshore Scheme. These data have been assessed to identify ground conditions and the interpretations fed into the assessment of archaeological potential. Seismic data was collected using Innomar parametric SBP. The Innomar SBP used a low frequency (8 to 12 kHz) to achieve a minimum interpretable penetration depth of 10 m.

25.4.32 A reduced penetration was achieved on the flanks of the Inner Silver Pit (Block B03), where 5 m penetration seems apparent. This limited the ability of the archaeological review to assess the stratigraphy and inform the archaeological potential of this part of the English Offshore Scheme (**Plate 25-1**).

Plate 25-1 Example of reduced SBP penetration on the western flank of the Inner Silver Pit (SBP Line B03_183549)



25.4.33 The preliminary interpretations presented by the geophysical survey results report (Ref 25.33) informed the primary basis of assessment for the palaeolandscape. Horizons defining the boundaries between sedimentary units were identified within the seismic data, based on their acoustic characteristics. No further interpretation of geological units was presented.

25.4.34 A sample of 25 lines of seismic data (comprising 19 in-lines and six crosslines; **Table 25-10**) was examined by an experienced geoarchaeologist to determine its suitability for archaeological assessment and to further inform the palaeolandscape assessment. This sample comprised a combination of lines referenced in the geophysical survey results report and additional lines selected independently to provide a broader assessment of data quality and consistency of interpretation. A greater number of lines were selected from the southern part of the English Offshore Scheme, where the geology is considered more complex and warrants closer scrutiny.

25.4.35 The Revision 1 horizons were imported into Moga Seaview as .XYZ files in Two Way Time (TWT), with LAT as the datum, and viewed against the seismic sections to evaluate interpretation.

25.4.36 The archaeological assessment of the seismic data is restricted at the PEIR stage by the limited detail provided by the geophysical survey results report on the seismic character of the interpreted horizons and of the units between them. No information was given on the likely age of these units or their attribution to geological formations or depositional environments.

25.4.37 Using the available deliverables, the seismic facies of the units between the interpreted horizons were characterised to provisionally assign them to geological formations and age ranges, as this information is required to evaluate archaeological potential. The results were assessed alongside existing studies contributing to the understanding of the palaeolandscape and prehistoric archaeological potential within the region.

25.4.38 The interpretations presented in Section 25.5 are provisional and subject to change following updates to the geophysical survey results report and the integration of results from geotechnical investigations. Revised interpretations, as appropriate, will be presented by the ES.

25.4.39 These sources were reviewed to establish an understanding of the geological make-up of the study area, formations present and their palaeoenvironmental and archaeological potential. Information about the wider area has also been used to better contextualise the various environments experienced in the area during the Pleistocene and Holocene.

25.5 Overall Baseline

25.5.1 The baseline assessment is primarily focused on known and potential remains relating to:

- Palaeolandscape and submerged prehistory;
- Maritime and coastal remains; and
- Aviation remains.

25.5.2 All sources have been used to develop an understanding of the heritage baseline within the study area throughout the Quaternary period. This data is assessed and presented chronologically within the report, beginning with the potential for submerged prehistoric landscapes. These sources were assessed and information compiled into a gazetteer for the study area (**Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records**).

Chronology

25.5.3 Three chronological systems are used when discussing archaeological remains or periods. These are as follows:

- Absolute dates: These are fixed dates that correspond with calendar years and are suffixed with BC (Before Christ) or AD (Anno Domini). For example, a date of 641 BC occurred 2,667 years ago and a date of 1066 AD occurred 960 years ago (correct as of 2026);
- Calibrated radiocarbon dates: these can either be presented as calendar dates or as the number of years before 1 January 1950 (before practical radiocarbon dating technology was available and before large-scale nuclear testing altered the global ratio of 14C to 12C, making dating subsequent to this date unreliable). For example, a date of 11,700 Before Present (BP) occurred 11,776 years ago (correct as of 2026) and could also be presented as 9,749 BC, noting that there is no ‘year zero’, so 1 is subtracted from each date; and

- Uncalibrated radiocarbon dates: these are dates that are based on the radiocarbon dating that do not take fluctuations in 14C levels into account. These dates can be calibrated using a calibration curve to convert them into calendar dates.

25.5.4 This assessment will use both BP and BC dates. For events or sites that pre-date the Mesolithic (10,000 BP / 8,000 BC), dates are usually given in BP. From the Mesolithic onwards dates are generally given in BC. In some cases, dates after the Mesolithic are provided in BP where environmental features and events are discussed, such as the development of the current coastlines of the UK in approximately 6,000 BP.

Archaeological periods and quaternary chronology

25.5.5 The main archaeological periods discussed in England are listed in **Table 25-8** and are derived primarily from Historic England's interpretation of prehistoric and historic periods (Ref 25.34).

25.5.6 The Quaternary chronology of the UK is outlined in **Table 25-9**, based on Marshall, 2020 (Ref 25.35) and Lisiecki, 2005 (Ref 25.36). Marine Isotope Stages (MIS) are alternating warm and cold periods derived from oxygen isotope data taken from deep sea core samples.

Table 25-8 Archaeological periods in England

Archaeological period	Sub-period	Dates
Palaeolithic	Lower	970,000 – 150,000 BP.
	Middle	150,000 – 42,000 BP.
	Upper	42,000 – 12,000 BP.
Mesolithic	Early	10,000 – 7,000 BC.
	Late	7,000 – 4,000 BC.
Neolithic	Early	4,000 – 3,300 BC.
	Middle	3,300 – 2,900 BC.
	Late	2,900 – 2,200 BC.
Chalcolithic		2,500 – 2,200 BC.
Bronze Age	Early	2,600 – 1,600 BC.
	Middle	1,600 – 1,200 BC.
	Late	1,200 – 700 BC.
Iron Age	Early	800 – 300 BC.
	Middle	300 – 100 BC.
	Late	100 BC – AD 43.
Roman		43 – 410 AD.
Early medieval		410 – 1066 AD.
Medieval		1066 – 1540 AD.
Post-medieval		1540 – 1900 AD.
Modern		1901 – Present.

Table 25-9 Later quaternary chronology

Stage		Age (ka BP)		Climate	Marine Isotope Stage	Geo. epoch	Sub. epoch	Archaeological period
Main	**Sub.**	**Start**	**End**					
Beestonian	-	970	936	Interglacial	25	Pleistocene	Early Pleistocene.	Lower Palaeolithic.
	-	936	917	?	24			
	-	917	900	Stadial	23			
	-	900	866	Interglacial	22			
Cromerian Complex.	-	866	814	*	21			
	-	814	790		20			
	-	790	761		19		Middle Pleistocene.	
	-	761	712		18			
	-	712	676		17			
	-	676	621		16			
	-	621	563		15			
	-	563	524		14			
	-	524	478		13			
Anglian	-	478	424	Stadial	12			
Hoxnian	-	424	374	Interglacial	11			
Wolstonian Complex	-	374	337	Stadial?	10			
	Purfleet	337	300	Interglacial	9			

Stage		Age (ka BP)		Climate	Marine Isotope Stage	Geo. epoch	Sub. epoch	Archaeological period
Main	Sub.	Start	End					
	Early	300	243	Stadial?	8			Middle Palaeolithic.
	Aveley	243	191	Interglacial	7			
	Late	191	123	Stadial	6			
Ipswichian	-	123	109	Interglacial	5e		Late Pleistocene.	
Early Devensian	-	109	96	Stadial	5d			
	Chelford	96	87	Interstadial	5c			
	-	87	82	Stadial	5b			
	Brimpton	82	71	Interstadial	5a			
	-	71	57	Stadial	4			
Mid-Devensian	Upton Warren	57	29	Interstadial	3			Upper Palaeolithic.
Late Devensian	Dimlington	29	14.7	Stadial	2			
	Windermere	14.7	12.9	Interstadial				
	Loch Lomond	12.9	11.7	Stadial				
Holocene	-	11.7	Present	Interglacial	1	Holocene		Mesolithic

* The Cromerian sequence is poorly understood, however, there is evidence for a series of small expansions of the British Irish ice sheet, marking at least four interstadials and five warm episodes.

= Double line marks the Bruhnes-Matuyama magnetic reversal episode (*c.* 780 ka BP).

Current baseline

25.5.7 This section outlines the current baseline for marine archaeology within the study area. The baseline assessment is informed by a range of desk-based sources and project-specific survey data, outlined in Section 25.4.

Designated heritage assets

25.5.8 Designated heritage assets comprise sites, structures and areas of significant cultural heritage importance to warrant protection and recognition under national policy. Designated assets comprise:

- Scheduled Monuments;
- Remains designated under the Protection of Military Remains Act (1986);
- Protected Wrecks;
- World Heritage Sites;
- Battlefields;
- Listed Buildings;
- Parks and Gardens; and
- Conservation Areas.

25.5.9 No marine or terrestrial designated heritage assets lie within the marine archaeology study area.

Non-designated heritage assets

25.5.10 Non-designated heritage assets comprise assets often of regional or local importance. Whilst they have the potential to contribute to understanding of the past, some have not been considered of the highest value to be formally designated under national policy. Others may remain undesignated due to their nature or location beyond 12 NM but may demonstrate the attributes worthy of designation. Non-designated assets are weighed against all available evidence when assessing their significance within the scope of a proposed development, in line with current UK Government policy (Ref 25.37).

25.5.11 Seventy-eight (78) UKHO records lie within the study area, comprising:

- Nine records up to 12 NM (wrecks or possible wrecks);
- 69 records beyond 12 NM:
  - 44 wrecks or possible wrecks;
  - 22 foul ground records;
  - Two possible boulders; and
  - One debris record.

25.5.12 The National Marine Heritage Record (NMHR) holds heritage record data for England's marine regions. At the time of data acquisition in 2025, the National Record for the Historic Environment (NRHE) held heritage record data for England's terrestrial regions. At the time of writing this Chapter, the NRHE had transferred its data to relevant regional

HERs. Therefore, although terrestrial records within the study area are now managed by the Lincolnshire HER, this section refers to them as 'NRHE records', to avoid alteration of each record's metadata. A review of this data, including an updated search within the study area, will be conducted as part of the ES.

25.5.13 Notwithstanding the above clarifications, the NMHR and NRHE hold 26 records within the study area, comprising:

- 10 offshore wreck records (eight of which correspond with UKHO records within the study area and two (W_082 and W_081) relating to UKHO records situated beyond the study area, lying 15 km west and 22 km southeast from their respective NMHR record);
- Eight intertidal sites, monuments or findspots (situated between MHWS and Mean Low Water Springs (MLWS)) (all of which also appear in the Coastal and Intertidal Zone Archaeological Network (CITiZAN) dataset and four of which also appear in the HER dataset);
- Seven terrestrial sites, monuments or findspots (above MHWS) (all of which also appear in the CITiZAN dataset and one of which also appear in the HER dataset); and
- One offshore record (below MLWS) relating to the recovery of two pieces of peat.

25.5.14 The Trove database holds five records within the study area (beyond 12 NM only), comprising:

- Three wrecks (corresponding with UKHO records); and
- Two documented losses (with no corresponding UKHO record).

25.5.15 The Lincolnshire HER holds 11 records for the intertidal and terrestrial elements of the study area:

- Seven artefact findspots (four of which also appear in both the CITiZAN and NRHE datasets);
- Two earthwork monuments (one of which also appear in the NRHE datasets); and
- Two structures (sites of former structures or extant).

25.5.16 The CITiZAN database holds 53 records within the study area, comprising:

- 15 records within the intertidal zone for sites or artefact findspots (five of which also appear in the HER dataset and nine of which also appear in the NRHE dataset); and
- 38 terrestrial records for sites or artefact findspots (one of which also appears in the HER dataset and six of which also appear in the NRHE dataset).

25.5.17 Where a concentration of seemingly associated CITiZAN records was observed in the dataset, records were combined and grouped under a single TI_ID (see TI_027, TI_028 and TI_033). In this instance, data were spatially represented in figures by the most centrally recorded asset.

25.5.18 Archaeological review of the geophysical and hydrographic data identified 131 surface anomalies of potential archaeological interest, comprising:

- One high potential anomaly;
- 13 medium potential anomalies; and

- 117 low potential anomalies.

25.5.19 A project-specific walkover survey of the intertidal area at Anderby Creek recorded a further five features and three peat exposures, none of which correlate spatially with other records. The five features comprised:

- Two pieces of wood, likely naturally occurring and eroded from nearby peat beds;
- One piece of peat;
- One length of rope; and
- One embedded and eroded wooden post.

25.5.20 The distribution of archaeological and wreck records and geophysical anomalies are illustrated by:

- **Volume 3, Part 3, Figure 25-2 UKHO Records (1 of 5);**
- **Volume 3, Part 3, Figure 25-3 UKHO Records (2 of 5);**
- **Volume 3, Part 3, Figure 25-4 UKHO Records (3 of 5);**
- **Volume 3, Part 3, Figure 25-5 UKHO Records (4 of 5);**
- **Volume 3, Part 3, Figure 25-6 UKHO Records (5 of 5);**
- **Volume 3, Part 3, Figure 25-10 Distribution of Archaeological Anomalies;**
- **Volume 3, Part 3, Figure 25-11 Distribution of Low Potential Archaeological Anomalies;**
- **Volume 3, Part 3, Figure 25-12 Distribution of Medium Potential Archaeological Anomalies;**
- **Volume 3, Part 3, Figure 25-26 Distribution of High Potential Archaeological Anomalies;** and
- **Volume 3, Part 3, Figure 25-28 Terrestrial and Intertidal Records within the Study Area.**

25.5.21 A full list of the same records and anomalies is presented within **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records** and **Volume 2, Part 3, Appendix 25.C: Gazetteer of Geophysical Anomalies**.

Palaeolandscape assessment and submerged prehistory

25.5.22 This section examines a wide range of geological and archaeological data to establish the baseline for the known early prehistoric (Palaeolithic and Mesolithic archaeological periods; *c.* 1,000,000 to 6,000 BP; **Table 25-8**) resource within the study area and potential for as-yet undiscovered remains. Although submerged at present, parts of the study area were periodically sub-aerially exposed during early prehistory, potentially offering opportunities for hominin and animal occupation.

25.5.23 The geology of the study area is discussed in two sub-divisions: pre-Quaternary bedrock and Quaternary deposits.

25.5.24 The geology of the study area has been examined by a range of studies, which have been consulted to inform this assessment. The principal sources are the BGS offshore regional reports (ORR), of which the study area traverses the scope of two:

- The geology of the southern North Sea (Goodwin Sands in the south to 55° N) (Ref 25.38); and
- The geology of the central North Sea (55° N to 58° N – only up to 57° 30’ N west of 0°) (Ref 25.39).

25.5.25 Primary data has been acquired for the English Offshore Scheme, including seismic data to inform sub-seabed geological interpretation. Reports accumulating and interpretating the sub-seabed geology have been prepared for EGL 5 and reviewed for this assessment are listed in Section 25.4.

25.5.26 The geologic discussion within this section has been primarily guided by review of the preliminary interpretations of site-specific geophysical data. In addition, the geophysical data report incorporated geotechnical data acquired by the EGL 3 and EGL 4 projects, where sample locations correlated with SBP lines surveyed for the English Offshore Scheme. These data comprised lithological descriptions from vibrocore (VC) samples and inferred descriptions from cone penetration tests (CPTs).

25.5.27 Where relevant, wider literature, comprising BGS geologic mapping and published reports and other academic literature, has been introduced to the discussion where this may allow further refinement of the interpretation of the geophysical and geotechnical data.

25.5.28 The shapefiles informing the layout and reproduced in relevant figures are as follows:

- Block plan: IOGP_SSDM_1142_EPSG25830_V2_20251010_1; and
- KPs: P2378_EGL5_KP_ETRS89_UTM30N_Rev6.

Pre-Quaternary bedrock

25.5.29 BGS mapping of the bedrock within the study area can generally be categorised as chalk-dominated; mudstone and sandstone; or complex.

25.5.30 From KP 0 to 141, the southern section of the study area is largely chalk dominated (Chalk Group) with the Cromer Knoll Group (mudstone, sandstone and tuff), Humber Group (mudstone, limestone and calcareous) and, to a lesser extent, Permian and Triassic (mudstone, sandstone and halite-stone) geologies present in the eastern extent of the study area.

25.5.31 Moving northwards, from KP 141 to 200, the English Offshore Scheme traverses a range of geologies, summarised below:

- Cromer Knoll Group (siliciclastic, argillaceous rock or mudstone and tuff);
- Kimmeridge Clay Formation (mudstone);
- Corallian Group (limestone);
- Oxford Clay Formation (mudstone);
- West Sole Group (sandstone and mudstone);
- Lias Group (mudstone and limestone); and
- Chalk Group.

25.5.32 The remaining northern section of the study area (KP 200 to 411.94) is dominated by the Chalk Group, with Palaeocene rocks (mudstone, sandstone and lignite) present along the eastern extent and infrequently traversed by the English Offshore Scheme.

25.5.33 Faulting is common within the surrounding bedrock, with several faults mapped crossing the study area.

25.5.34 Provisional interpretation of the geophysical data has identified bedrock geology below the seabed from KP 82.5 to 299, with intermittent outcrops between KP 142 to 239.8 (Blocks C07, C08, C09, C11, C12, C13 and D03).

Quaternary deposits

25.5.35 The Quaternary period of geologic history began *c*. 2,588,000 years ago and continues into the present, thus encompassing the known period of hominin existence in the British Isles. Quaternary deposits therefore have the potential to contain evidence of hominin activity and other remains of archaeological interest.

25.5.36 The Quaternary geology of the North Sea is complex, having been influenced by a series of glacials and interglacials over the past million years (**Table 25-9**). Archaeological potential for a deposit is therefore attained by correlating several factors, principally:

- Environmental conditions;
- Post-depositional processes; and
- Hominin presence / activity.

25.5.37 Although several deposits are found to continue across the regional divide between the southern and central North Sea, the nomenclature of similar deposits (in both lithology and chronology) changes. This change in nomenclature has arisen from numerous factors, including ice-flow separation, ice-sheet derivation and limits to interdigitating geological units (Ref 25.40). Equivalency of geological units is described, where possible, throughout the discussion of Quaternary deposits and in **Table 25-11**.

25.5.38 The geophysical survey results report did not attempt to correlate the identified geological units with known formations or members of the North Sea as recognised by the BGS. As this process of correlation is necessary to inform the archaeological assessment, this was undertaken by MSDS Marine's geoarchaeologist, using the horizon descriptions presented by the geophysical report and examination of a sample of seismic line profiles (**Table 25-10**).

25.5.39 To simplify the discussion presented within this sub-section, unique IDs have been attributed to likely distinct geological units, divided by identified horizons. The latest horizonal data was version 'Revision 1', whereas the available geophysical survey results report was version 'Revision 0'. The latest horizons were reviewed alongside the report as part of the archaeological review and are identified in discussion throughout this sub-section.

25.5.40 The conclusions of this assessment are provisional and will be reviewed alongside further revisions to the geophysical survey results report and geotechnical data acquired for the English Offshore Scheme as part of the ES.

Table 25-10 Sample of SBP lines reviewed by the archaeological assessment

	Line type.	
SBP Line ID	**In-line**	**Cross-line**
	NS01_172520	NS01_060125
	A01_135448	A02_040156
	A01_084009	B02_195911
	A01_142042	C09_034309
	A02_073636	D04_200200
	A03_052022	D12_182128
	A05_231136	
	B01_005648	
	B01_083815	
	B02_043836	
	B03_183549	
	C02_011339	
	C04_005252	
	C09_175425	
	D04_183107	
	D12_191435	
	D19_221024	
	D21_210521	
	F02_112551	

Table 25-11 Provisional interpretation of quaternary geological units within the English Offshore Scheme

MSDS unit ID	Horizon		Formation	Depositional environment	Age
	Top	Bottom			
U01	H00	H05	Modern marine sediments.	Marine	Early Holocene to present; MIS 1.
U02a	H00 / H05	H06 nearshore.	Upper Botney Cut / Elbow.	Estuarine / marginal marine.	Late Devensian (post-LGM) to Early Holocene; MIS 2 to 1.
U02b	H05	H07	Lower Botney Cut.	Glacigenic	Late Devensian (post-LGM) to Early Holocene; MIS 2 to 1.
U02c	H06 nearshore	H10b / H10c*	Upper Botney Cut / Elbow.	Possibly fluvial.	Late Devensian (post-LGM) to Early Holocene; MIS 2 to 1.
U02d	H00	H05b	Whitehorn / Fitzroy members, Forth Formation.	Glaciomarine / low energy marine.	Late Devensian; MIS 2.
U03	H05	H06 (north).	Forth / Coal Pit.	Glaciomarine	Late Devensian; MIS 2.
U04	H05 / H06 / H07	H10	Bolders Bank / Forth.	Proglacial, likely glaciomarine / glaciolacustrine.	Late Devensian; MIS 2.
U05	H00 / H05	H11*	Bolders Bank.	Glacigenic	Late Devensian; MIS 2.
U06	H11*	H12*	Uncertain	Uncertain	Late Devensian; MIS 2.
U07	H05 / H06 / H10 / H11* / H12*	Base Boulders Bank* / H20 / H30	Bolders Bank (south) / Wee Bankie (north).	Glacigenic	Late Devensian; MIS 2.
U08	H11	H20	Possibly Dogger Bank.	Periglacial / proglacial.	Likely Late Devensian; MIS 2.
U09	H20	H30	Uncertain	Uncertain	Uncertain

*Horizons defined by Revision 1 gridded data only (not picked by XOCEAN (Ref 25-33).

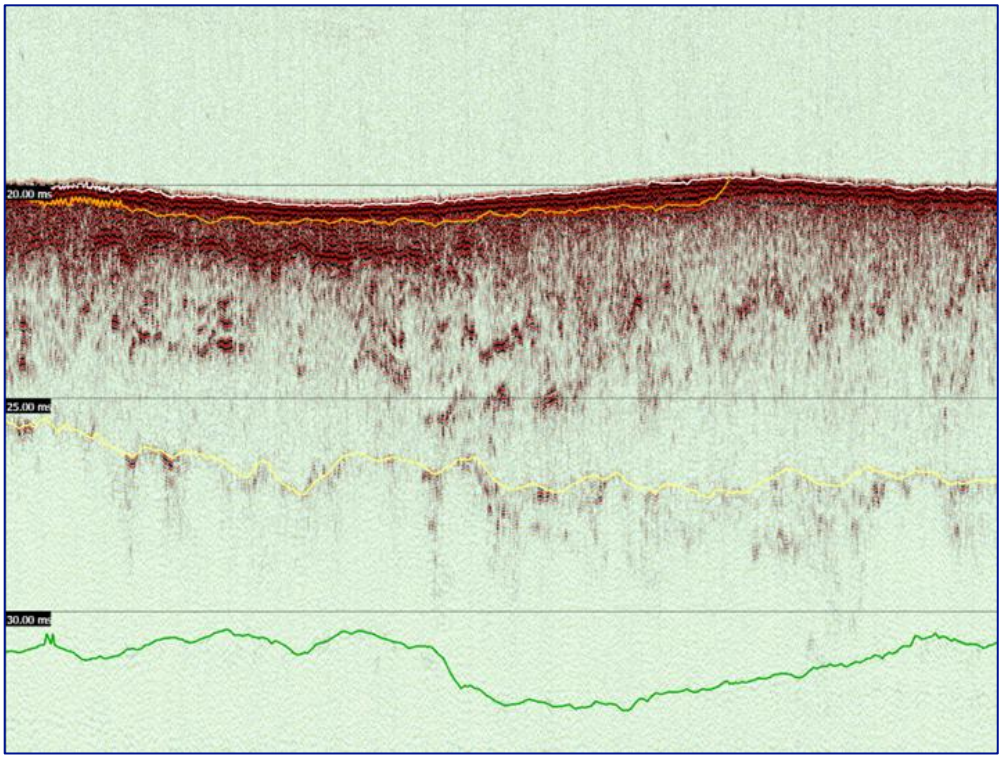
Unit U01

25.5.41 Unit U01 is defined by upper Horizon H00 (seabed) and basal Horizon H05. Horizon H05 was identified as an erosional surface defining the base of the mobile, modern marine sediments (Unit U01), occasionally characterised by small, channel-like features. Megaripples shown by the MBES data suggest that Unit U01 is predominantly comprised of sand.

25.5.42 Unit U01 has been identified throughout most of the English Offshore Scheme, except within Block A01, where it appears to have been truncated. The Unit generally measures 0.2 - 3 m thick, exhibiting a broad trend of thickening further offshore, and appears thicker (<5 m) where characterised by sandwaves.

25.5.43 The archaeological review of the seismic sample generally agreed with the picking of basal Horizon H05, however, some inconsistencies were identified, including abrupt termination of the picked reflector, crosscutting of other horizons and gridding issues in northern survey blocks. An example is presented by **Plate 25-2**, where picking of Horizon H05 ends abruptly, though the reflector appears to continue.

Plate 25-2 Example of Horizon H05 (orange) terminating in Block A05 (SBP Line A05_231136)



25.5.44 The seismic character of Unit U01 is defined by a strong seabed doublet, underlain by weak amplitude reflections, with thickness varying in response to seabed geomorphic features, such as sandwaves.

Unit U02a

25.5.45 Unit U02a is defined by upper Horizons H00 / H05 and basal Horizon H06. Both Horizons H05 and H06 have been interpreted as erosional surfaces. Horizon H06 was picked in Blocks A01 to A03, in the south of the English Offshore Scheme, and in D15 to D20, in the north.

25.5.46 Archaeological review of the seismic sample highlighted the likelihood of Horizon H06 defining two distinct units: one in the southern, nearshore part of the English Offshore Scheme and another in the north (**Plate 25-3**). Unit U02a relates to the former (Unit U03 the latter). In this area, the archaeological review picked Horizon H06 also in Block NS01 and elsewhere in Block A01 (**Plate 25-4**).

Plate 25-3 Comparison of Horizon H05 (orange) and H06 (pale blue) reflections in Block A01 (SBP Line A01_135448) (left) and Block D19 (SBP Line D19_221024) (right)

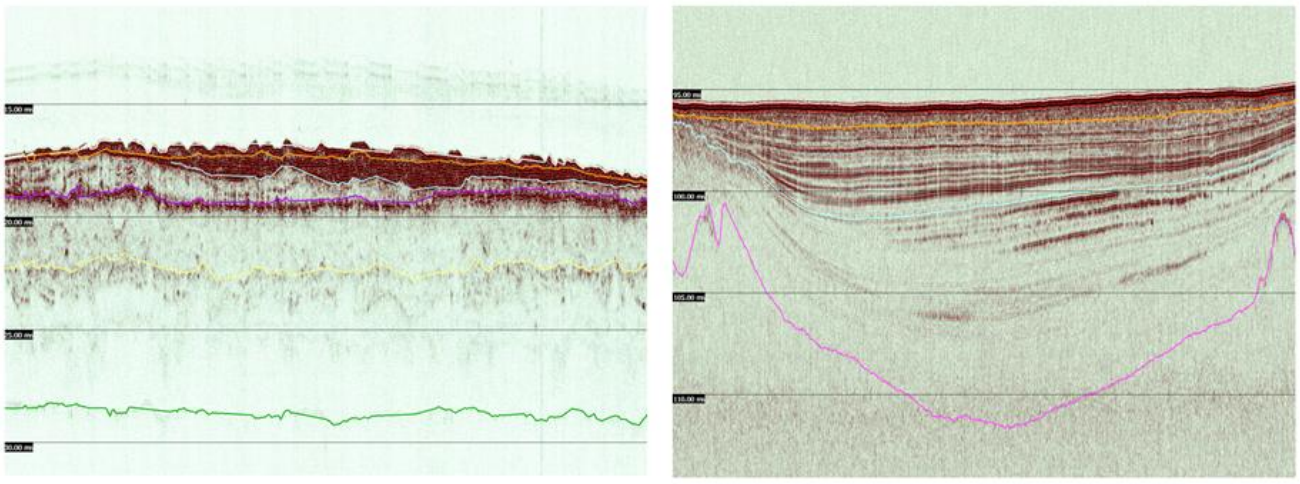
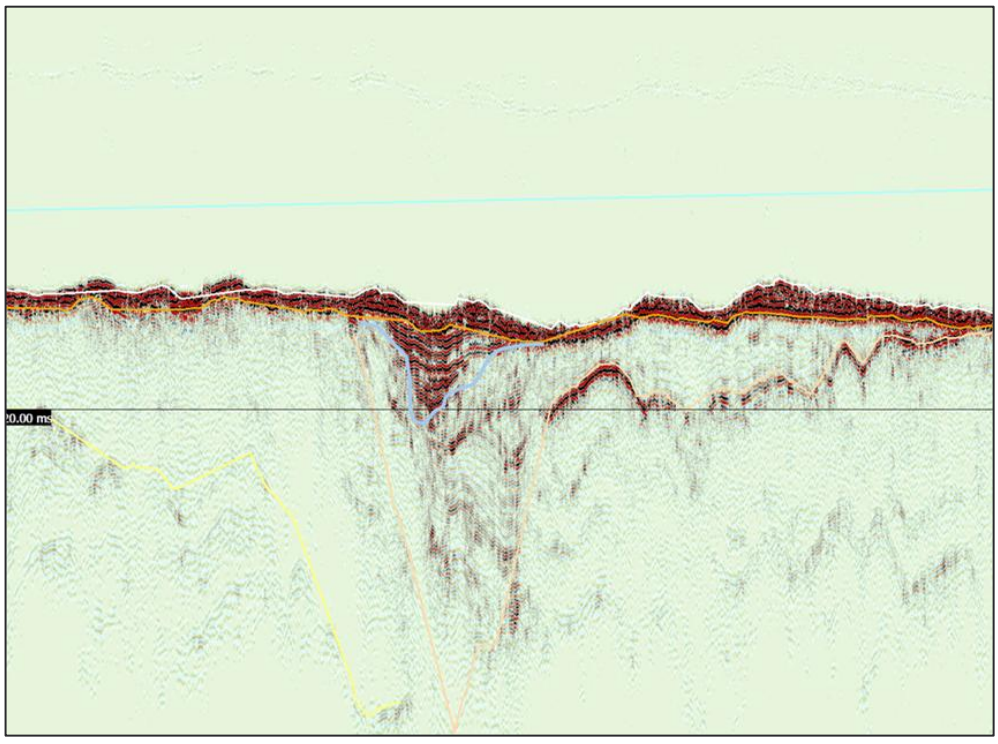


Plate 25-4 Additional pick of Horizon H06 (orange) in Block A01 (SBP Line A01_084009)



25.5.47 Unit U02a is characterised by strong-amplitude, parallel to laminated reflections, constrained within and bidirectionally onlapping Horizon H06.

25.5.48 Unit U02a most likely represents estuarine / marginal marine deposits infilling post-glacial topography (in the form of broad undulations or channel incisions), measuring 1 - 2 m thick. This Unit likely correlates with upper elements of the Botney Cut Formation and Elbow Formation, dating from the post-Last Glacial Maximum (LGM) to Early

Holocene (MIS 2 to 1), and may contain organic material and fine-grained laminated sediments that could provide datable horizons and material suitable for palaeoenvironmental analysis.

25.5.49 In this nearshore zone (broadly correlating with Blocks A01 to C06), the Unit also coincides spatially with areas where existing channels and Holocene features have previously been mapped by the Humber Regional Environment Characterisation (Ref 25.41), the North Sea Palaeolandscapes Project (Ref 25.42) and recent updates produced by the Unpath'd Waters Project (Ref 25.43).

Unit U02b

25.5.50 Unit U02b is defined by upper Horizon H05 and basal Horizon H07, identified within Blocks C04, F02, D12 and D13. Basal Horizon H07 incises Unit U04, defining a series of small channels measuring *c*. 50 m wide and 1 m deep.

25.5.51 Unit U02b is characterised by a heterogeneous infill, dominated by weak amplitude reflections with some semi-continuous, strong amplitude reflections, including small, high amplitude channels.

25.5.52 This Unit within Blocks C04 and F02 has been provisionally correlated with lower elements of the Botney Cut Formation (Late Devensian; MIS 2), although smaller, more recent channels may date to the Early Holocene (MIS 1). Unit U02b also spatially correlates with a north to south trending fluvial channel mapped by the North Sea Palaeolandscapes Project (Ref 25.42), dated to the Holocene.

25.5.53 Correlation of the Unit in Blocks D12 and D13 was more problematic. Here, the seismic character was defined by strong amplitude lenses of chaotic reflections, overlain by weak amplitude, chaotic reflections, infilling the topography created by the lenses. This Unit in Blocks D12 and D13, though underlain by the same picked Horizon H07, is unlikely to correlate with Unit U02b in Blocks C04 and F02. Further examination of the data would be required to better resolve this area.

Unit U02c

25.5.54 Unit U02c is defined by upper Horizon H06 and basal Horizons H10b / H10c. The Unit has been identified in the nearshore survey blocks NS01 and A01 to A03. The archaeological review combined Horizons H10b and H10c, due to the similarity of seismic character and stratigraphic positions.

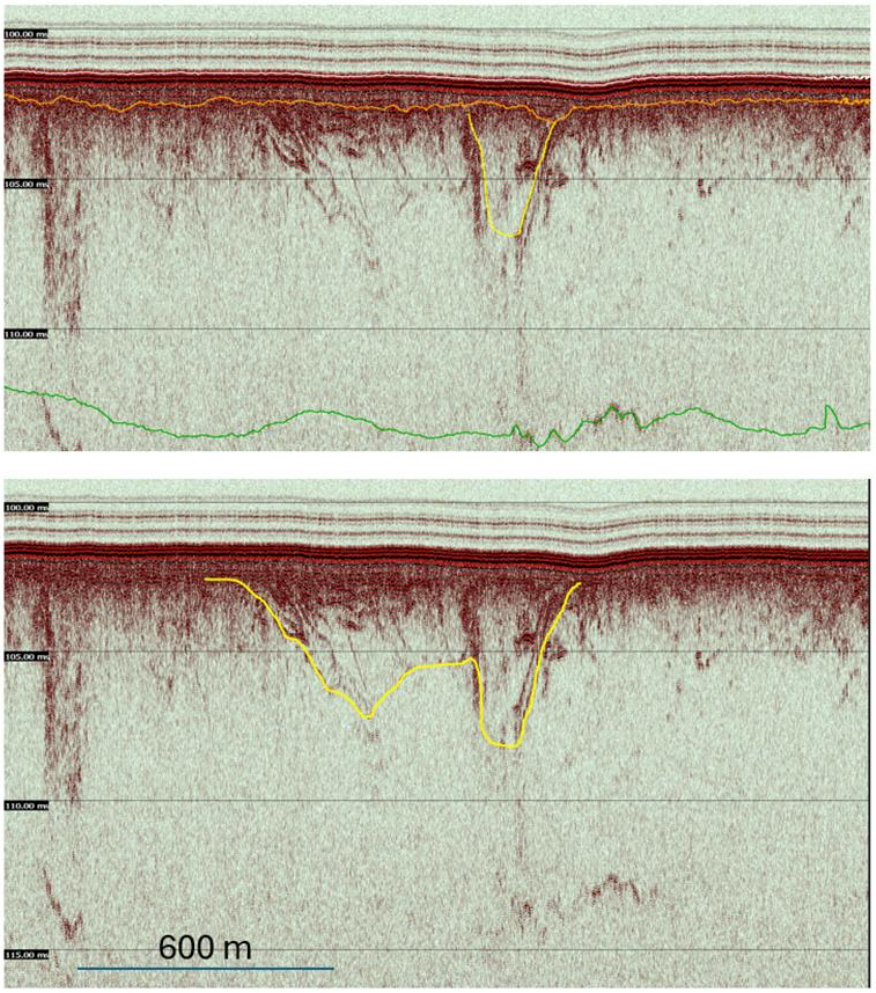
25.5.55 Unit U02c appears as the infill of a series of east to west trending channels, with very strong amplitude reflections at the base, overlain by a package of heterogeneous, weak amplitude, largely transparent reflections. These reflectors are locally parallel but elsewhere inclined, potentially reflecting laterally migrating, fluvial bedforms. Intermittent strong reflections are also present.

25.5.56 In Block NS01, weaker amplitudes in the central infill may indicate shallow gas, suggesting the basal strong amplitudes could be associated with organic-rich material, deposited in post-glacial terrestrial to brackish environments. The base is defined by a sharp, erosional boundary between very strong amplitude, low frequency reflections and underlying weak amplitude, transparent to chaotic reflections. This differs from the interpretation given in the geophysical survey results report, which places the base above the basal strong amplitude package. The basal reflector may represent a basal peat associated with the Elbow Formation, although a gravel lag cannot be ruled out.

Unit U02d

25.5.57 Unit U02d is defined by upper Horizon H00 and basal Horizon H05b (a medium amplitude, erosional surface incising the underlying Unit U07). The Unit was only identified in Block D21, defined by a pronounced, east to west aligned, channel-like incision (Horizon H05b), measuring up to 200 m wide and 3 m deep. The archaeological review suggested an expansion of the interpretation of Horizon H05b incising into the underlying Unit U07, positing an indication of lateral migration of the channel. **Plate 25-5** illustrates the initial interpretation of Horizon H05b (above) and the proposed revision (below) (only Horizon H05b is illustrated by the latter).

Plate 25-5 Alternative interpretation of Horizon H05b in Block D21 (SBP Line D21_210521)



25.5.58 The acoustic characteristics of the channel fill (Unit U02d) comprised chaotic reflections of heterogeneous amplitude, with some inclined reflections potentially indicating lateral migration of the channel.

25.5.59 Unit U02d likely correlates with the Whitehorn or Fitzroy members of the Forth Formation, laid down in low energy glaciomarine or marine environments of the Late Devensian (MIS 2), however, the age and origins of the channel remain uncertain.

Unit U03

25.5.60 Unit U03 is defined by upper Horizon H05 and basal Horizon H06. Although Horizon H06 was picked as a single, discontinuous reflector in Blocks A01 to A03 and D15 to D20 within the geophysical survey results report, the archaeological review posited the likelihood of the Horizon defining two distinct units. Unit U03 is present only in northern survey blocks D15 to D20, measuring up to 5 m thick (Unit U02a is present in southern blocks A01 to A03) (**Plate 25-3**).

25.5.61 Unit U03 is characterised by laterally continuous, low-angle parallel reflections, with variable, cyclical seismic amplitudes, comprising a weak amplitude, transparent basal package overlain by heterogeneous strong / weak / strong reflection packages. These expressions are suggestive of low-energy, sheet-like deposition within a large topographic depression. The base of the Unit is weak amplitude and currently poorly constrained. Similar facies and geometries extend below the interpreted boundary, potentially down to Horizon H10, although reflections between Horizon H06 and the interpreted base are of weaker amplitude.

25.5.62 The Unit has been tentatively correlated with low energy glaciomarine environments of the Forth Formation (Whitehorn or Fitzroy members) or possibly the Coal Pit Formation, dating to the Late Devensian (MIS 2).

Unit U04

25.5.63 Unit U04 is defined by upper Horizons H05 / H06 / H07 and basal Horizon H10. Horizon H10 is identified as an erosional surface, expressed as a strong amplitude reflector incising the underlying glacial deposits. It is unclear, however, if the southern and northern picks represent the same reflector, given the differences in seismic characteristics of the overlying Unit. This uncertainty presents difficulty in defining the stratigraphic relationships of several units presented in **Table 25-11.**

25.5.64 Unit U04 has been identified intermittently through the English Offshore Scheme, exhibiting highly variable acoustic characteristics. Within the nearshore (southern) survey blocks, Unit U04 is characterised by high-angle inclined reflections, weak amplitudes at the base becoming stronger upwards and is locally chaotic, with evidence of deformation. The Unit is truncated by Horizons H05 and H06 and potentially represents a moraine complex or glaciotectonised unit. In this region, Unit U04 has been provisionally correlated with glaciotectonised or ice-marginal deposits of the Bolders Bank Formation, dating to the Late Devensian (MIS 2).

25.5.65 Within the central survey blocks, the Unit comprises laterally continuous, sub-horizontal reflections (similar to the northern blocks), with weak amplitudes becoming more chaotic and stronger upwards. In this region, the correlation with known Quaternary units is less clear. The acoustic characteristics are suggestive of glaciomarine / glaciolacustrine deposits, possibly equivalent to the Dogger Bank Formation further south in this section and Forth Formation (St Andrew's Bay, Whitehorn and / or Fitzroy members) further north, dating to the Late Devensian (MIS 2).

25.5.66 In the northern blocks, Unit U04 exhibits laterally continuous, low-angle parallel reflections, similar to Unit U03 but with consistently weaker amplitudes, with occasional strong amplitude reflections. Here, Unit U04 likely correlates with the Forth Formation, laid down in glaciomarine environments of the Late Devensian (MIS 2).

Unit U05

25.5.67 Unit U05 is defined by upper Horizons H00 / H05 and basal Horizon H11. Horizon H11 was reviewed as a Revision 1 grid but was not identified or discussed in Revision 0 of the geophysical survey results report. Unit U05 has been identified intermittently From Block A01 to Block B03.

25.5.68 The Unit is characterised predominantly by chaotic, discontinuous reflections, forming a largely weak amplitude unit with intermittent strong amplitudes, becoming stronger towards the top with semi-continuous reflections. Horizon H11 is, in most areas, a strong amplitude, continuous reflection, potentially erosional, defining the upper limit of Unit U06 and associated with small, V-shaped incisions immediately below. In Block B02, Horizon H11 was also picked within the infill of the depression defined by Horizon H12, where it caps a series of strong amplitude reflections and forms the boundary to weaker, more chaotic reflections above. The equivalence of Horizon H11 outside the Horizon H12 depression to the similarly picked reflector within is uncertain.

25.5.69 Unit U05 is provisionally correlated with Bolders Bank Formation deposits, comprising subglacial diamicton, dating to the Late Devensian (MIS 2).

Unit U06

25.5.70 Unit U06 is defined by upper Horizon H11 and basal Horizon H12, appearing only in Block B02. The Unit is characterised by weak amplitude, chaotic reflections. Horizon H12 represents an erosional surface and is expressed as a strong amplitude reflection, incising into the underlying Unit U07.

25.5.71 The origins and depositional environment of Unit U06 remain uncertain, though its stratigraphic placement between LGM glacial units (Units U05 above and U07 below) suggest a Late Devensian date (MIS 2).

Unit U07

25.5.72 Unit U07 is defined by upper Horizons H05 / H06 / H10 / H11 / H12 and by basal Horizons H20 / H30. This Unit has been identified throughout the English Offshore Scheme. Basal Horizon H20 is a sub-parallel, irregular and laterally continuous reflector, defining the top of a zone of stronger amplitude reflections, becoming more irregular and shallower in the northern Blocks D01 to D21.

25.5.73 The Unit is characterised predominantly by chaotic, discontinuous reflections, forming a largely weak amplitude unit, with intermittent strong amplitude reflections. Unit U07 has been provisionally correlated with regional subglacial till formations, dating to the Late Devensian (MIS 2): Bolders Bank Formation, where present in the southern North Sea, and Wee Bankie Formation, where present in the central North Sea.

Unit U08

25.5.74 Unit U08 is defined by upper Horizon H11 and basal Horizon H20, identified within Blocks A01 to B03.

25.5.75 Closely spaced, small incisions (*c*. 25 - 50 m wide and 1 - 2 m deep) are present within the upper part of the Unit, infilled by very strong amplitude reflections, potentially representing proglacial deposition. This interpretation is consistent with limited and short-lived glacial occupation of the area at *c*. 23,000 to 24,000 BP. The remainder of the Unit is characterised by predominantly weak amplitude reflections.

25.5.76 Unit U08 may represent periglacial / proglacial deposits equivalent to the Dogger Bank Formation and partly resembles elements of the Boxtel Formation, in the Dutch sector of the southern North Sea. As such, Unit U08 likely dates to the Late Devensian (MIS 2) and may comprise glaciolacustrine, glaciofluvial and aeolian sediments.

Unit U09

25.5.77 Unit U09 is defined by upper Horizon H20 and Basal Horizon H30 and has been identified throughout much of the English Offshore Scheme. The Unit was difficult to characterise, due to reduced seismic quality. Where resolved, its internal geometry comprises locally inclined reflections. Basal Horizon H30 defines the upper surface of the bedrock.

Geomorphology

Glaciations

25.5.78 The known history of hominin occupation of Britain is marked by three main stages of glaciation: the Anglian (478,000 - 424,000 BP; MIS 12), the Wolstonian complex (374,000 - 123,000 BP; MIS 10 to 6) and the Devensian (109,000 - 11,700 BP; MIS 5d to 2). The latter two each include several interstadials, of which less information is available for the Wolstonian. The pre-Anglian Cromerian complex and Beestonian stage also express evidence of a series of stadials and interstadials, however, these sequences are poorly understood at present (Ref 25.44) (Ref 25.45) and the latter generally precedes known hominin occupation of Britain.

25.5.79 Glaciation models suggest that the study area was likely covered by ice during much of MIS 12, 6 and, ice-free during MIS 5d to 5a and MIS 3 and covered once more during the Last Glacial Maximum (LGM; *c.* 27,000; MIS 2). During the Wolstonian Complex (MIS 10 to 6), a series of glacial retreats and readvances characterised the study area, with more northerly parts most likely to have lain under ice (Ref 25.46) (Ref 25.47) (Ref 25.48).

25.5.80 Conjoining of the British-Irish and Fennoscandian ice sheets across the North Sea persisted up to 18,000 BP and the study area was likely not entirely ice-free until *c*. 16,000 BP (Ref 25.47).

25.5.81 The maximum glacial extent for the Last Glacial Maximum (LGM; *c*. 27,000 BP) during the Devensian, informed by several studies, is presented by **Volume 3, Figure 25-7 Glacial Extents**.

Glacial geology

25.5.82 The Swarte Bank Formation, mapped by the BGS within Block B01 but not identified by the geophysical survey, has been dated to MIS 12 through correlation with the Peelo Formation in Dutch waters. Such evidence of the Anglian is rare offshore and subsequent glacial and hydrodynamic processes are understood to have eroded much of the Anglian-era geological deposits and landforms.

25.5.83 The extent of Wolstonian glaciations is recorded northward of that of the Anglian, although this also covered much of the North Sea and the entirety of the study area at its maximum. No glacial till or other deposits dating to the Wolstonian have been identified. Like Anglian deposits, Wolstonian deposits have likely been extensively eroded by Devensian glacial activity and hydrodynamic processes.

25.5.84 The Devensian glaciations are the best understood and most widely studied of the Pleistocene glaciations, particularly the Dimlington (29,000 - 14,700 BP) and Loch Lomond (12,900 - 11,700 BP) stadials. The greatest extent of ice during the LGM was attained at various times for different locations, generally peaking at *c.* 26,000 BP (Ref 25.49). Timing and maximum extents remain a subject of debate for researchers; within the North Sea, the maximum southerly extent was attained between *c.* 20,000 BP or as late as 17,000 BP, reaching the Norfolk coast. This peak correlates with the Dimlington stadial and a single sea level limiting point suggests a contemporary (19,498 BP) relative sea level (RSL) of -17.85 m (AA34281; **Volume 3, Part 3, Figure 25-9 Sea Level Model; Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points**), indicative of seawater locked up in glacial ice.

25.5.85 Units U02b, U04, U05, U07 and U08 are partly or wholly attributable to Devensian glacial processes.

Glacial landforms

25.5.86 Glaciation introduces a range of processes which result in changes to the bedrock, sedimentary deposits and geometry of the landscape. Some of the resultant landforms are determined by the movement and weight of the ice overburden, whereas others are caused by associated hydrodynamic processes.

25.5.87 The EMODnet geological database (Ref 25.24) maps a series of tunnel valleys and fluvial channels both intersecting and in the vicinity of the southern extent of the study area, broadly corresponding with Blocks B01 to C06. Sub-glacial tunnel valleys in this location have also been identified in the BRITICE project (Ref 25.22). A tunnel valley system is also mapped by EMODnet around Blocks D12 to D15, crossing Block D15 (with no correlative in the geophysical data interpretation). These features are illustrated by **Volume 3, Part 3, Figure 25-8 Sub-seabed Geomorphology** and suggest the extent of impacts and aftereffects of glacial ice on the subsea landscape within the study area.

25.5.88 Beyond the study area and further inland in the vicinity of the proposed Anderby Creek Landfall, the BRITICE project maps moraine complexes: accumulations of unconsolidated debris deposited by a glacier. As above, these deposits are indicative of the impact and aftereffects of glacial ice on the subsea landscape within and around the study area.

25.5.89 V-shaped channel features identified by the geophysical survey results report are generally identified as ‘tunnel valleys’, however, this term is typically used to define large, sub-glacial erosional features, formed by high pressure sub-glacial meltwater and measuring 300 m - 3 km wide and up to 400 m deep (Ref 25.50) (Ref 25.51). As such, the blanket use of this term may be misleading, particularly where smaller, though similarly shaped, channels may be more accurately interpreted as sub-glacial meltwater channels.

Sea level data

25.5.90 Data relating to past sea levels can be correlated with geological and glacigenic data to inform our understanding of palaeolandscape development during the Late Quaternary and Early Holocene. Analysis of reconstructed palaeolandscapes can inform subsequent discussions relating to human occupation and archaeological potential.

25.5.91 There are few Sea Level Index Points (SLIPs) offshore in the North Sea and none within the central region. Many SLIPs are largely located along the current coastline and within waterways and lowlands, such as The Fens, the Humber valley.

25.5.92 Sea level studies for this period are complex and subject to a wide range of variables. One of the key factors is that of glacial isostatic adjustment (GIA), relating to the viscoelastic response (deformation) of Earth structures arising from glacial ice-load (Ref 25.52). The British-Irish ice sheet developed outward from the Scottish Highlands during the Dimlington stadial (29,000 - 14,700 BP), extending as far south as the Norfolk coast and the Western Approaches (**Volume 3, Part 3, Figure 25-7 Glacial Extents**). Northern parts of Britain were therefore subject to greater depression and rebound, which are to be expected within the RSL record.

25.5.93 Shennan *et al*., (Ref 25.53) have produced a recent and extensive study of RSL in Britain and Ireland since the LGM. Their study, incorporating over 2,100 data points including SLIPs and marine and terrestrial limiting data, provides regional insights into RSLs across the British Isles. A sub-sample of 471 SLIPs and limiting points, covering the principal part of the eastern seaboard of Britain, was consulted to inform the discussion of this sub-section.

25.5.94 The World Atlas of Last Interglacial Shorelines (WALIS) dataset provides SLIPs and limiting points ranging from South Wales and Brittany to Kattegat, using a range of stratigraphic constraints and dating techniques to inform sea level studies, principally for the Ipswichian interglacial (MIS 5e) but also data for the latter part of the Wolstonian Complex (MIS 7 to 6) and Early to Mid-Devensian (MIS 5d to 4) (Ref 25.54). The WALIS data points are rated qualitatively, each for the RSL data and dating, ranging from ‘very poor’ to ‘excellent’.

25.5.95 A total sub-sample of 504 SLIPs and limiting points covering the east coast of Great Britain, from Lowestoft to Fraserburgh, and the southern North Sea has been examined to inform the discussion of this sub-section (**Volume 3, Part 3, Figure 25-9 Sea Level Model**). A gazetteer of the sub-sample is included as **Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points**. These SLIPs range in date from <231,000 to 990 BP (MIS 7 to 1).

25.5.96 Modelling of palaeo-coastlines have applied RSL data to illustrate the development of marine boundaries, such as the model produced by Brooks (Ref 25.55). This model, reproduced in part by **Volume 3, Part 3, Figure 25-9 Sea Level Model**, demonstrates the Flandrian marine transgression of the Late Devensian and Early Holocene, concurring largely with the results of Shennan *et al*., (Ref 25.53), although based partly on the results of the same team’s earlier studies (Ref 25.56).

25.5.97 The Wolstonian Complex (MIS 10 to 6) is characterised by a series of rapid temperature fluctuations resulting in sequential stadial and interglacial periods. Temperature variation may have ranged from -9 - 4 Celsius, with stadials lasting longer than interglacials (Ref 25.45). The earliest SLIPs and limiting points may date to the Aveley interglacial (MIS 7; accounting for the widest range in dating uncertainty). The earliest, dated to 207,000 BP ±24 kilo-annum (ka) and situated off the eastern East Anglian coast, provides an RSL of -29.92 m (WALIS ID: RSL_3432; **Volume 3, Part 3, Figure 25-9 Sea Level Model; Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points**). This limiting point may correlate with the earlier part of the Aveley interglacial, reflecting lower sea level of the preceding Early Wolstonian stadial (MIS 8), although the quality of the RSL data was deemed average and that of the dating poor. Three SLIPs, situated in north Norfolk (WALIS ID: RSL_4063; **Volume 3, Part 3, Figure 25-9 Sea Level Model; Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points**), have an

average age (provided by luminescence dating) of 185,000 BP and, although attributed an uncertainty of ±20 ka (MIS 7 to 6), are indicative of beach deposits and an RSL of 1.56 m, suggesting a contemporary coastline similar to that at present. These points relate to the late Aveley interglacial to the Late Wolstonian stadial and, although the RSL data has been deemed average, the dating is rated good. A further limiting point, situated near the East Anglian coast (WALIS ID: RSL_1375), has an age of 175,700 BP ±22.6 ka (MIS 7 to 6) and an RSL of -30.97 m. The dating information is rated poor, however, the RSL data is rated good.

25.5.98 The highest quality limiting points relating to the Late Wolstonian stadial (MIS 6) are dated using chronostratigraphic correlation and are situated offshore in the southern North Sea (**Volume 3, Part3, Figure 25-9 Sea Level Model**). Five of these provide a MIS 6 RSL of 0 m (WALIS IDs: RSL_123, RSL_309, RSL_318, RSL_319, RSL_320; **Volume 2, Part 3, Appendix 25.D: Gazetteer of Sea Level Index Points**). A single contemporary SLIP in the same region relates to an isolation basin and provides an RSL of -53.75 m. Although such features are often considered reliable sources for palaeo-RSL data (Ref 25.57), the study has attributed this SLIP poor RSL quality and good dating quality (Ref 25.54).

25.5.99 Other limiting points, from Flamborough Head (WALIS ID: RSL_3429), are broadly attributed (through good quality data) to the Late Wolstonian through Early Devensian (MIS 6 to 5a), including the Ipswichian interglacial (MIS 5e), however, their RSL data is considered of very poor quality. The average of the dates of these points (from luminescence) provides 120,000 BP ±27 ka (MIS 5e), suggesting, with a considerable degree of uncertainty, that RSL stood at 5.29 m during the early Ipswichian.

25.5.100 Several SLIPs, also from Flamborough Head and similarly attributed to MIS 6 to 5a (averaging 120,000 BP ±27 ka), are indicative of beach deposits and suggest an RSL of 2.29 m (WALIS ID: RSL_1380). The RSL quality is deemed slightly greater (poor), although the dating quality is deemed slightly lesser (average).

25.5.101 MIS 5e is understood to be characterised by global mean temperatures of *c.* 1.5 Celsius warmer than present and polar temperatures 3 - 5 Celsius warmer (Ref 25.58 resulting in widespread higher RSL and marine inundation of the North Sea, similar to, or perhaps slightly greater, than at present (Ref 25.59) (Ref 25.60). Several WALIS limiting points and SLIPs, from the southern North Sea, Flamborough Head and Coningsby, are dated to MIS 5e to 5d, with an average to good quality rating (WALIS IDs: RSL_1380, RSL_3429, RSL_3736, RSL_311, RSL_317, RSL_380, RSL_381). The RSL ranges from -2.75 to 5.29 m, correlating with the current broad understanding of MIS 5e sea level. The RSL quality of these data is greater for those chronostratigraphically dated (good) compared to those dated by luminescence (good to very poor).

25.5.102 No SLIPs or limiting points examined were dated to MIS 4 to 3. The database used by Shennan *et al*., (Ref 25.53) starts in England at *c.* 19,500 BP (MIS 2), indicating an RSL of -17.85 m around the middle of the Dimlington stadial (Sample ID: AA34281) and correlating with the anticipated lower sea level during a glacial period. A pattern of rising sea level through the remainder of the Dimlington stadial is expressed by a single SLIP, indicating an RSL of 1.81 m around 15,744 BP (Sample ID: AA34199).

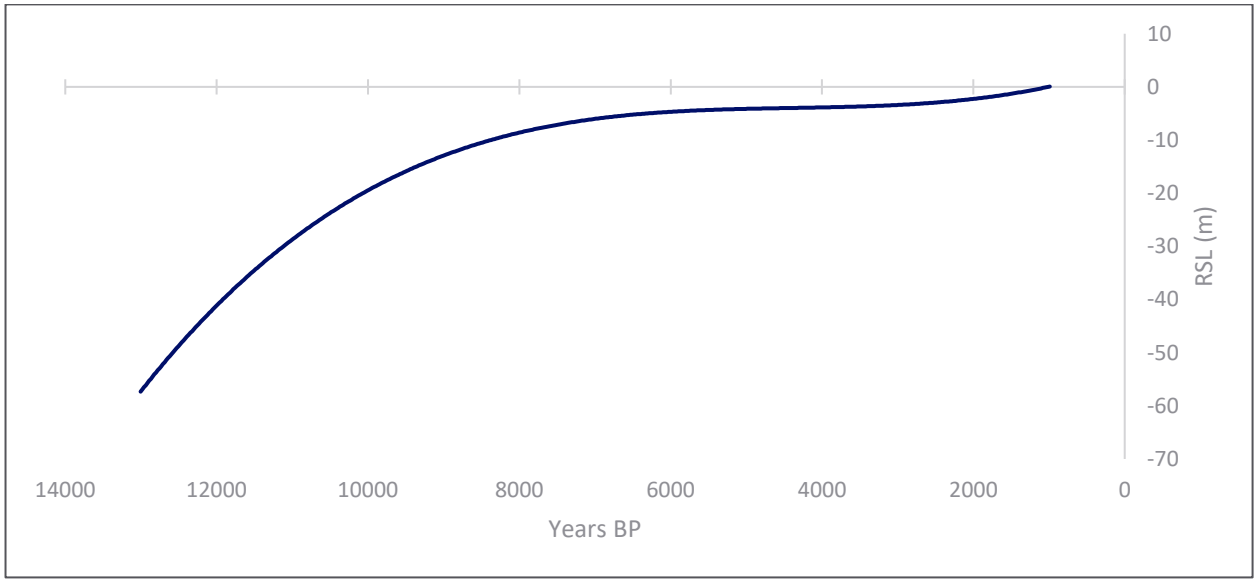
25.5.103 Palaeo-coastline modelling produced by Brooks (Ref 25.55) demonstrates a broad pattern of falling RSL in the central North Sea. In English waters, some localised fluctuation of RSL is demonstrated between 18,000 - 16,000 BP, although this is not expressed as significant marine transgression of the southern North Sea landscape (**Volume 3, Part 3, Figure 25-9 Sea Level Model**).

25.5.104 A series of SLIPs and limiting points from northeast England, relating to the middle of the Windermere interstadial (13,900 BP) to Early Holocene (11,456 BP), more closely relate to the pattern in Scottish waters but are also relevant to the northern part of the study area. From an RSL of 0.39 m at the height of the Windermere interstadial (Sample ID: AA25598) to an average RSL of -4.79 m 12,289 - 11,456 BP (Sample IDs: AA27227, OxA11936, OxA12824, OxA12825, Ox13370), these data reflect the warmer climate and higher sea level of the interstadial followed by a decrease in sea level during the Loch Lomond stadial (MIS 2; 12,900 - 11,700 BP) and Early Holocene (MIS 1). The northerly location of these points and associated data also reflects the GIA resulting from the Late Devensian British-Irish Ice Sheet.

25.5.105 In the southern North Sea during the latter part of the Windermere interstadial, one SLIP (Sample ID: AA25602) and two limiting points (AA23945 and AA27137) provide an average RSL of 49.29 m 13,267 - 13,005 BP. This suggests that a combination of water locked in the glaciers and uplift from GIA contributed to the marine lowstand, illustrated by **Volume 3, Part 3, Figure 25-9 Sea Level Model**.

The sea level curve shown by **Plate 25-6** was produced using the sub-sampled SLIPs within England and correlates with the pattern illustrated by local curves produced by Shennan *et al*., (e.g., the Humber, Lincolnshire and East Anglia) (Ref 25.53). The SLIP data ranges from *c.* 13,000 - 1,000 BP, correlating with the Loch Lomond stadial (at the end of the Devensian) through much of the Holocene. The curve demonstrates a steady sea level rise after the Windermere interstadial, gradually plateauing from *c.* 6,000 BP. The Loch Lomond (or Younger Dryas) stadial was largely confined to the western Scottish Highlands and, although temperatures in England were likely cooler than during the preceding Windermere interstadial, conditions were not comparable in extent and effect to earlier glaciations (Ref 25.61).

Plate 25-6 Sea level curve for the east coast of England (based on Shennan *et al.,* 2018)



25.5.106 The northern section of the study area (KP 288 to the marine boundary between English and Scottish adjacent waters) is shown to have been inundated by *c.* 16,000 BP (**Volume 3, Part 3, Figure 25-9 Sea Level Model**). Further south, the landscape remained sub-aerially exposed. At the start of the Holocene (11,700 BP), the southern North Sea was characterised by a terrestrial landscape, forming a vast land bridge between Britain and continental Europe (Ref 25.62). This landscape was eventually inundated 10,000 - 8,000 BP, with two key phases of sea level increase identified around

8,440 ±410 BP and 8,220 ±650 BP (Ref 25.63). The British coastline as at present had largely formed by 6,000 BP, although the coastlines of Yorkshire, Lincolnshire, the Humber estuary and The Wash had yet to fully adopt their present form.

Palaeolandscape assessment and prehistoric archaeological potential

25.5.107 This section considers the potential for submerged prehistoric remains, including archaeological sites, palaeolandscape elements and palaeoenvironmental evidence, to be present within the study area.

25.5.108 The prehistoric archaeological record of the UK covers the period from the earliest hominin occupation, potentially as far back as 970,000 BP, to the "end" of the Iron Age and the Roman invasion of Britain in AD 43. The coastline of the UK changed drastically during early prehistory and large tracts of what is now the seabed were once sub-aerially exposed.

25.5.109 Prehistoric archaeological potential is gauged with reference to evidence for human activity in Britain during each period and the contemporary environment of the area under scrutiny, also considering depositional and post-depositional factors through interpretation of geological deposits present. Deposits with potential are generally those laid during periods of sub-aerial exposure or by fluvial process, rather than sub-glacial or marine deposits. However, there is also potential for archaeological material to be redeposited or reworked within secondary contexts resulting from fluvial erosion or glacial processes (Ref 25.64).

Lower and Middle Palaeolithic (970,000 - 60,000 BP; MIS 19 to 4)

25.5.110 The Lower and Middle Palaeolithic span most of the known human history of the British Isles (*c.* 970,000 - 57,000 BP; MIS 25 to 4). Pre-dating the earliest recorded modern human remains, these periods witnessed the occupation of the British Isles and associated palaeolandscape by human ancestors, such as homo heidelbergensis and h. neanderthalensis.

25.5.111 No Quaternary geological units pre-dating MIS 2 have been identified within the available SBP data and provisional interpretations.

25.5.112 There is a potential for earlier deposits, in and around the Inner Silver Pit (Block B02). Here, the archaeological review of SBP data identified a reduced penetration depth. Other projects examining this environment have identified outcrops and subcrops (beneath modern sediments and slump deposits) of deposits pre-dating the MIS 2 Bolders Bank Formation, which have been attributed through detailed analysis to the Brown Bank, Egmond Ground, Sand Hole and Swarte Bank formations (Ref 25.39 and Ref 25.65).

25.5.113 The Brown Bank Formation in this area has been shown to represent an intertidal depositional environment. The upper and lower facies of the Sand Hole Formation are interpreted as having formed under fluvial to coastal and estuarine conditions, respectively, during the Hoxnian Interglacial (MIS 11), with progressive cooling, thereafter, based on work carried out at Triton Knoll Offshore Wind Farm (Ref 25.66). This recent work has identified remnants of terrestrial and coastal palaeolandscapes beneath parts of the Bolders Bank Formation exposed on the flanks of the Inner Silver Pit. These deposits represent periods within the early Middle Palaeolithic, during which there is evidence for human occupation of the surrounding landmasses.

25.5.114 With increasing data from offshore windfarm developments, understanding of these deposits is improving and beginning to update earlier BGS interpretations. In light of this, improved imaging of the flanks of the Inner Silver Pit is recommended where the presence and extent of these units cannot be adequately constrained by the available geotechnical samples.

Upper Palaeolithic (60,000 - 11,700 BP; MIS 3 to 1)

25.5.115 The Upper Palaeolithic (57,000 - 11,700 BP; MIS 3 to 2) spans the Mid to Late Devensian, including the Dimlington and Loch Lomond stadials. There is evidence of hominin activity in Britain in the Mid to Late Devensian, after a period yet to be associated with occupation (180,000 - 60,000 BP). Flint artefacts and skeletal remains indicating the presence of *h. neanderthalensis* or *h. sapiens* (modern humans) have been identified in Kent's Cavern (Devon) (Ref 25.67), Dartford (Kent) (Ref 25.68), Gower (Wales) (Ref 25.69) and Creswell (Derbyshire) (Ref 25.70).

25.5.116 All Units provisionally identified within the study area likely date wholly or partly to MIS 2, with the exceptions of Units U01 and U09. The postulated depositional environments of these Units span glacial, proglacial, periglacial, fluvial, estuarine and marine conditions.

25.5.117 Units U02b, U05 and U07 have been provisionally correlated with the lower Botney Cut, Bolders Bank and Bolders Bank / Wee Bankie formations, respectively. These formations are generally interpreted as comprising glacial till, laid down beneath glaciers. As such, these have negligible archaeological and palaeoenvironmental potential.

25.5.118 Units U02d, U03, U04 and U08 have been provisionally correlated with Forth, Coal Pit, Dogger Bank and Bolders Bank formations. The Whitehorn / Fitzroy members of the Forth Formation may be represented within Units U02d and U04. The identified elements of these Formations suggest deposition in low energy glaciomarine, marine or glaciolacustrine environments, presenting negligible archaeological potential. A general low to moderate potential for palaeoenvironmental remains is attributed to glaciomarine / glaciolacustrine deposits.

25.5.119 Units U02a and U02c have been provisionally correlated with the upper Botney Cut and Elbow formations. Archaeological review of the seismic data suggested a potential for these to represent estuarine / marginal marine and fluvial deposits, respectively. These Units therefore hold some archaeological potential, as the depositional environments may have been suitable for human occupation or activity. Unit U02a has been identified within an area characterised by other archaeologically focussed projects as sub-aerial between the post-LGM retreat of the British-Irish Ice Sheet and marine inundation of the Late Devensian and Early Holocene.

25.5.120 It is feasible that, given the continued development of the Botney Cut Formation into the Early Holocene, the glaciolacustrine depositional environments gave way to warmer lacustrine conditions. Features such as the Silver Pit were filled with glacial meltwater and continued to be fed by a fluvial network prior to the Flandrian marine transgression (Ref 25.29).

25.5.121 Sea level modelling suggests the English Offshore Scheme south of Block D08 was sub-aerially exposed at *c*. 18,000 BP, with marine transgression encroaching southward, almost reaching Block C09 by *c*. 13,000 BP (**Volume 3, Part 3, Figure 25-9 Sea Level Model**).

25.5.122 The origins of Units U06 and U09 remain uncertain, therefore, archaeological or palaeoenvironmental potential cannot be attributed.

Mesolithic and Neolithic (11,700 - 4,000 BP; MIS 1)

25.5.123 The Mesolithic period (11,700 - 6,000 BP; MIS 1) correlates with the start of the Holocene and the culmination of the last glacial period. As climatic conditions ameliorated during the onset of the Holocene, carr woodland would have developed in stable terrestrial areas which could support a much greater variety and density of fauna. Meltwater from the recently retreated Devensian glaciers shaped the landscape with river valleys and lakes, which, in turn, supported new and extensive flora and fauna. These fluvial and adjacent environments provided ideal conditions for human exploitation. Available resources would have increased as the local flora and fauna became more diverse, and the range of environmental conditions would have presented more varied opportunities for exploitation.

25.5.124 The North Sea Palaeolandscapes Project (NSPP) (Ref 25.29) maps the sub-aerial landscape of this period within a southern part of the study area (Blocks B01 to C07). NSPP mapping illustrates the study area being traversed by a northeast to southwest aligned valley (passing through Blocks B04 to C01), the Silver Pit (as a large lake; Block B03) and a series of small watercourses. One such watercourse, within Blocks C04 and F02, correlates with a channel identified through seismic data, provisionally attributed a Botney Cut Formation infill (Unit U02b). Correlation of this feature with sea level modelling suggests an Early Holocene date.

25.5.125 This represents a small part of the land bridge joining Britain to continental Europe after the LGM, a landscape which has produced evidence of large, Late Pleistocene and Early Holocene faunal populations (Ref 25.71) and human occupation (Ref 25.62). During the mid-Holocene, the Wash would have drained into the Silver Pit, creating a lacustrine environment rich in resources and game to support human occupation (Ref 25.41). This recognised and postulated human presence suggests a potential for evidence of this to be held within Early Holocene elements of Unit U02b. A moderate potential for archaeological and / or palaeoenvironmental remains is considered.

25.5.126 Unit U02a has been provisionally identified as estuarine / marginal marine sediments, dating to the Late Devensian and Early Holocene. The area of this Unit (Blocks NS01 and A01 to A03) correlates with a system of ‘Botney Cut Channels’ mapped by the Humber REC (Ref 25.41).

25.5.127 Although much of Britain’s coastline as at present had formed by 6,000 BP, some areas were still experiencing marine transgression. According to some sea level models (Ref 25.55), one such area was the Lincolnshire coastline, suggesting that by 6,000 BP, and the onset of the Neolithic, the coastline passed along the boundary between Blocks NS01 and A01 and tidally accessible islands were present within and around Blocks A02 and A03 (**Volume 3, Part 3, Figure 25-9 Sea Level Model**).The character of the terrestrial landscape of the study area at this time is suggested by a series of findspots on the beach and investigations into the submerged landscapes of the Lincolnshire coast.

25.5.128 EMODnet data presents a series of submerged forest and submerged peat findspots within the intertidal zone of the study area and nearby (**Volume 3, Part 3, Figure 25-8 Sub-seabed Geomorphology**). These data are derived from research conducted by Clapham (1999, Ref 25.72), which sampled several peat and submerged forest outcrops on the coast. The closest sample location is at Anderby Creek, *c.* 1 km to the south of the English Offshore Scheme and within the intertidal zone. The EMODnet submerged

forest point location data provides a date of *c.* 5,150 BP and cites Clapham, however, this differs from the dates provided by his earlier study.

25.5.129 Clapham's results also informed the creation of Historic England's Intertidal and Coastal Peat Database (Ref 25.25). Samples of submerged forest remains taken at Anderby Creek (precise location unknown) provided radiocarbon dates of 4480 ± 55 and 4625 ± 55 (uncalibrated - presumably BP but not defined).

25.5.130 The CITiZAN database holds a record for chunks of peat found on the beach of the study area close to the Anderby Creek Landfall (TI_001 and TI_002). A wooden fragment, initially thought to be part of an early medieval ship, was found to be of Early Neolithic date (TI_005).

25.5.131 The project-specific intertidal walkover survey (see Paragraph 25.4.11) identified three exposed peat beds and two associated artefacts (EGL5_010 and EGL5_011 - lumps of peat and waterlogged wood). A further piece of wood may also have been eroded from local peat beds (EGL5_002).

25.5.132 These features and artefacts may be associated with the Wolla Bank and / or Anderby Creek submerged forests, which have been identified from beach erosion sited atop glacial till within the study area (Ref 25.72), the former of which has been dated to *c.* 5,300 BP (Ref 25.73) It has been noted that neither submerged forest site has been associated with archaeological remains and postulated that the woodland may have been impenetrable or intimidating to prehistoric groups (Ref 25.72).

25.5.133 Clearance of parts of the forest are indicated by certain pollens, including cereals, within upper peat formations (Ref 25.72) and suggested by the findspot of a Neolithic polished stone axe butt end within the intertidal zone of the English Offshore Scheme (TI_006; **Volume 3, Part 3, Figure 25-28 Terrestrial and Intertidal Records within the Study Area**).

25.5.134 Although no geological units provisionally identified date to the Neolithic period, the peat outcrops and dating of nearby features indicates the presence of deposits dating to this period within the study area. Though these have only been identified within the intertidal zone, there is the potential for these to occur further seaward (Ref 25.74). The potential for archaeological remains is limited, given the paucity of previously recorded remains, however, as demonstrated by previous studies, the peat shelves can provide useful palaeoenvironmental evidence.

25.5.135 Palaeoenvironmental remains typically draw much of their significance from their primary context and, therefore, redeposition can diminish this considerably. Discoveries of peat, both *in situ* and redeposited, within the foreshore zone present a high potential for palaeoenvironmental remains within the study area, primarily within the foreshore zone and, to a lesser extent, the nearshore.

Summary

25.5.136 This section has examined the interpretations of the preliminary ground model, alongside wider evidence, describing a possible 12 geological units within the study area. This examination has informed the assessment of archaeological and palaeoenvironmental potential.

25.5.137 A summary of provisionally identified units and their attributed archaeological and palaeoenvironmental potential is presented by **Table 25-12.** The archaeological and palaeoenvironmental potential of these speculatively identified Units is subject to change

on receipt and review of further analysis of the geophysical data and review of geotechnical data.

Table 25-12 Summary of submerged archaeological potential

Unit	Archaeological potential	Palaeoenvironmental potential
U01	Low	High
U02a	Moderate	High
U02b	Moderate	High
U02c	Moderate	High
U02d	Negligible	Low to moderate.
U03	Negligible	Low to moderate.
U04	Negligible	Low to moderate.
U05	Negligible	Negligible
U06	Uncertain	Uncertain
U07	Negligible	Negligible
U08	Negligible	Low to moderate.
U09	Uncertain	Uncertain

Results of geophysical data assessment

25.5.138 A total of 131 surface anomalies of potential archaeological interest were identified within the geophysical survey data extents, 119 of which are within the English Offshore Scheme and 12 within the survey extents beyond this (defined hereafter as the 'Extents beyond the English Offshore Scheme'). The anomalies are categorised by potential in **Table 25-13**.

Table 25-13 Distribution of archaeological anomalies by potential

Potential	English Offshore scheme	Extents beyond the English Offshore Scheme	Total
Low	107	10	117
Medium	11	2	13
High	1	0	1
Total	119	12	131

25.5.139 The distribution of anomalies is shown in **Volume 3, Part 3, Figure 25-10 Distribution of Archaeological Anomalies**. The distribution is weighted towards the southernmost 25 per cent (80 km) of the study area, potentially due to the survey being closer inshore and closer to the busy harbours of Hull and Grimsby. Further north and further offshore, anomalies are more widely spread and are relatively evenly distributed.

25.5.140 The distribution of anomalies within the geophysical data shows a consistent approach to the assessment. The high, medium and low potential anomalies are discussed below, according to their assessed potential.

Low potential archaeological anomalies

25.5.141 A total of 117 anomalies interpreted as of low archaeological potential were identified within the geophysical survey data extents, 107 of which are in the English Offshore Scheme and 10 beyond this. The anomalies can be categorised as follows in **Table 25-14**.

Table 25-14 Low potential anomaly categories

Anomaly category	English Offshore Scheme	Extents beyond the English Offshore Scheme	Total
Chain, cable or rope.	1	0	1
Fishing gear.	2	0	2
Linear	4	0	4
Likely geological.	61	9	70
Potential debris.	39	1	40
Total	107	10	117

25.5.142 The anomalies interpreted as of low archaeological potential are likely a mixture of small features, often boulder-like, or likely to represent modern debris or small items of debris with no features indicating archaeological potential.

25.5.143 **Table 25-15** provides a brief justification for the interpretation of each category of low potential anomaly. The descriptions below are generalised, and each anomaly is interpreted based on individual characteristics, other anomalies within the wider area and seabed characterisation. Cables and pipelines have not been identified in this report.

Table 25-15 Low potential anomaly descriptions

Anomaly category	Description
Chain, cable or rope.	Such features are long, thin anomalies, likely to represent discarded or lost pieces of chain, cable or rope.
Fishing gear.	Features identified as fishing gear include discarded or lost nets and shellfish pots.

Anomaly category	Description
Linear	Features identified as linear will generally be far longer in one direction than in others, suggesting an anthropogenic origin. The potential will be determined based on the size, associated magnetic anomalies and the surrounding environment.
Potential debris.	Features identified as potential debris will generally display characteristics indicating anthropogenic origin, such as straight or angular edges. Boulder-like features with associated magnetic anomalies can also be categorised as potential debris, particularly in areas with underlying igneous geology.
Likely geological.	Features identified as likely geological are generally precautionary identifications, where the form is indictive of a geological feature but may be of a size, or form, which is unusual in the surrounding area.

25.5.144 Low potential anomalies have been assessed against all available evidence, are deemed unlikely to be of archaeological significance and are not discussed further.

25.5.145 The distribution of low potential anomalies is shown by **Volume 3, Part 3, Figure 25-11 Distribution of Low Potential Archaeological Anomalies**. A gazetteer of low potential anomalies, including positions and dimensions, is presented by **Volume 2, Part 3, Appendix 25.C: Gazetteer of Geophysical Anomalies**.

Medium potential archaeological anomalies

25.5.146 13 anomalies interpreted as of medium archaeological potential were identified within the geophysical survey data extents, 11 of which are within the English Offshore Scheme and two beyond. The anomalies can be categorised as follows in **Table 25-16**.

Table 25-16 Medium potential anomaly categories

Anomaly category	English Offshore Scheme	Extents beyond the English Offshore Scheme	Count
Wreck debris.	6	0	6
Possible wreck.	1	0	1
Debris	3	2	5
Mound	1	0	1
Total	11	2	13

25.5.147 The anomalies interpreted as of medium archaeological potential have characteristics that indicate a likelihood of representing anthropogenic material with the potential to be of archaeological interest or where a precautionary approach has been taken for anomalies where the identification is unclear.

25.5.148 The distribution of medium potential anomalies is shown by **Volume 3, Part 3, Figure 25-12 Distribution of Medium Potential Archaeological Anomalies**. A gazetteer of medium potential anomalies, including positions and dimensions, is presented by **Volume 2, Part 3, Appendix 25.C: Gazetteer of Geophysical Anomalies**.

Medium potential MSDS_002

25.5.149 Medium potential anomaly MSDS_002 (**Volume 3, Part 3, Figure 25-13 Medium Potential Anomaly MSDS_002**) lies 745 m east of KP 0. The anomaly lies adjacent to, and is likely associated with, high potential anomaly MSDS_001 and UKHO record 94757 (W_009).

25.5.150 The anomaly is visible within the MBES data as a sub-rectangular shaped feature within a small scour. The anomaly measures approximately 1.07 m x 0.76 m with a height of 0.4 m. The anomaly likely represents material from the wreck 10 m to the southwest (MSDS_001).

Medium potential MSDS_003

25.5.151 Medium potential MSDS_003 (**Volume 3, Part 3, Figure 25-14 Medium Potential Anomaly MSDS_003**) lies 450 m northeast of KP 0. The anomaly lies close to and may be associated with medium potential anomaly MSDS_029.

25.5.152 The anomaly is visible within the MBES data as a sub-rectangular shaped feature on the seabed. The feature measures approximately 9.08 m x 5.28 m with a height of 0.78 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_009

25.5.153 Medium potential MSDS_009 (**Volume 3, Part 3, Figure 25-15 Medium Potential Anomaly MSDS_009**) lies 150 m south of KP 9.

25.5.154 The anomaly has been identified as a broadly ovular ridge measuring 29.1 m x 13.2 m. The measurable height of the ridge is 0.3 m, with the internal area being the same level as the surrounding seabed.

25.5.155 The anomaly is potentially natural in origin, however, the form could be indicative of the hull of a wrecked vessel, and a precautionary medium potential rating has been assigned. Further assessment of SSS and Magnetometer data would be required to establish the origin and archaeological potential to inform the ES.

25.5.156 The anomaly is not associated with any UKHO or other record.

Medium potential MSDS_010

25.5.157 Medium potential MSDS_010 (**Volume 3, Part 3, Figure 25-16 Medium Potential Anomaly MSDS_010**) lies 105 m northwest of KP 9. The anomaly lies close to, and may be associated with, medium potential anomalies MSDS_011 and MSDS_012.

25.5.158 The anomaly is visible within the MBES data as two parallel linear features, with a third at a different angle. The overall anomaly measures approximately 28.20 m x 18.75 m with an overall height of 0.14 m. The three features measure: 15.40 m x 1.36 m x 0.11 m; 14.86 m x 1.20 m x 0.07 m; and 11.26 m x 1.54 m x 0.17 m. The origin of the anomaly is unclear, however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_011

25.5.159 Medium potential MSDS_011 (**Volume 3, Part 3, Figure 25-17 Medium Potential Anomaly MSDS_011**) lies 125 m northwest of KP 9. The anomaly lies close to, and may be associated with, medium potential anomalies MSDS_010 and MSDS_012.

25.5.160 The anomaly is visible within the MBES data as a linear feature in a large area of scour. The feature measures approximately 8.31 m x 1.79 m with an overall height of 0.12 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_012

25.5.161 Medium potential MSDS_012 (**Volume 3, Part 3, Figure 25-18 Medium Potential Anomaly MSDS_012**) lies 128 m northwest of KP 9. The anomaly lies close to, and may be associated with, medium potential anomalies MSDS_010 and MSDS_011.

25.5.162 The anomaly is visible within the MBES data as a linear feature in a large area of scour. The feature measures approximately 7.02 m x 1.43 m with an overall height of 0.06 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_029

25.5.163 Medium potential MSDS_029 (**Volume 3, Part 3, Figure 25-19 Medium Potential Anomaly MSDS_029**) lies 470 m northeast of KP 0. The anomaly lies close to, and may be associated with, medium potential anomaly MSDS_003.

25.5.164 The anomaly is visible within the MBES data as an irregularly shaped feature on the seabed. The feature measures approximately 9.59 m x 6.48 m with a height of 1.25 m, with a smaller piece of debris 25 m to the north, measuring 3.69 m x 2.52 m with a height of 1.27 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_051

25.5.165 Medium potential MSDS_051 (**Volume 3, Part 3, Figure 25-20 Medium Potential Anomaly MSDS_051**) lies 158 m north of KP 56.

25.5.166 The anomaly is visible within the MBES data as a linear feature within a large area of scour. The feature measures approximately 7.33 m x 3.15 m with an overall height of 0.47 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_099

25.5.167 Medium potential MSDS_099 (**Volume 3, Part 3, Figure 25-21 Medium Potential Anomaly MSDS_099**) lies 7.53 km north of KP 62, beyond the English Offshore Scheme.

25.5.168 The anomaly is visible within the MBES data as an irregular feature with a linear tail to the south. The feature measures approximately 9.61 m x 5.55 m with an overall height of 0.88 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_103

25.5.169 Medium potential MSDS_103 (**Volume 3, Part 3, Figure 25-22 Medium Potential Anomaly MSDS_103**) lies 6.35 km southwest of KP 99, beyond the English Offshore Scheme.

25.5.170 The anomaly is visible within the MBES data as a sub-rectangular feature with a smaller fragment off to the south. The feature measures approximately 12.35 m x 7.43 m with an overall height of 0.49 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_108

25.5.171 Medium potential MSDS_108 (**Volume 3, Part 3, Figure 25-23 Medium Potential Anomaly MSDS_108**) lies 279 m southwest of KP 144.

25.5.172 The anomaly is visible within the MBES data as a large feature at the edge of the survey area. The feature measures approximately 5.81 m x 4.12 m with an overall height of 1.05 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_111

25.5.173 Medium potential MSDS_111 (**Volume 3, Part 3, Figure 25-24 Medium Potential Anomaly MSDS_111**) lies 411 m north of KP 245.

25.5.174 The anomaly is visible within the MBES data as a large sub-rectangular feature on the seabed. The feature measures approximately 20.20 m x 14.12 m with an overall height of 1.59 m. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest.

Medium potential MSDS_122

25.5.175 Medium potential MSDS_122 (**Volume 3, Part 3, Figure 25-25 Medium Potential Anomaly MSDS_122**) lies 153 m west of KP 337.

25.5.176 The anomaly is visible within the MBES data as a mound on the seabed. The feature measures approximately 15.11 m x 7.41 m with an overall height of 1.15 m. The origin of the anomaly is unclear; however, mounds can represent buried material of archaeological interest.

High potential archaeological anomalies

25.5.177 One anomaly interpreted as of high archaeological potential was identified within the geophysical survey data extents. The anomaly can be categorised as follows in **Table 25-17.**

Table 25-17 High potential anomaly categories

Anomaly category	English Offshore Scheme	Extents beyond the English Offshore Scheme	Count
Wreck	1	0	1
Total	1	0	1

25.5.178 The anomaly interpreted as of high archaeological potential has characteristics that indicate a likelihood of representing anthropogenic material with the potential to be of archaeological interest or where a precautionary approach has been taken for anomalies where the identification is unclear. Ground truthing of the anomaly by diver or ROV may establish the archaeological potential.

25.5.179 The distribution of high potential anomalies is shown by **Volume 3, Part 3, Figure 25-26 Distribution of High Potential Archaeological Anomalies**. A gazetteer of medium potential anomalies, including positions and dimensions, is presented by **Volume 2, Part 3, Appendix 25.C: Gazetteer of Geophysical Anomalies**.

High potential MSDS_001

25.5.180 High potential MSDS_001 (**Volume 3, Part 3, Figure 25-27 High Potential Anomaly MSDS_001**) lies 369 m southwest of KP 1.

25.5.181 The anomaly represents the remains of a wrecked vessel measuring 26.83 m x 8.89 m with a measurable height of 0.66 m. The wreck is orientated northwest to southeast, with the bow to the northwest. The wreck appears to be upright with scour visible to the south. One medium potential anomaly (MSDS_002) lies directly to the north, provisionally interpreted as a piece of debris measuring 1.07 m x 0.76 m with a height of 0.40 m.

25.5.182 The anomaly is clearly identifiable as a wreck, with the shape indicating wooden construction. Further interpretation based on the geophysical data alone is not possible.

25.5.183 The wreck is associated with UKHO record 94757 (W_009), listed as an unknown wreck identified by multibeam sonar survey.

Coastal and maritime archaeology

Introduction

25.5.184 This section considers the potential for remains relating to coastal and maritime cultural landscapes to be present within the study area, defined as evidence of *"human utilisation of maritime space by boat, settlement, fishing, hunting, shipping and its attendant subcultures, such as pilotage, lighthouse and seamark maintenance"* (Ref 25.75). Remains considered range from shipwrecks or other durable evidence, such as cargo and ballast, to features including navigational aids, sailing marks, ports, harbours and jetties. Navigational hazards such as shallow reefs or sand banks influence archaeological potential (particularly for wrecks), as does the preservation environment. All can inform understanding of the archaeological potential.

25.5.185 Other coastal remains which do not necessarily relate to boat use are also considered, including fish traps and other evidence of human interaction with the sea. In addition, other coastal features are reported on where they inform the archaeological potential of the study area, such as eroded remains from nearby coastal features or settlements.

Preservation Environment

Seabed characteristics

25.5.186 The physical characteristics of an area can determine the rate of preservation of materials and thus archaeological potential. The *Areas of Maritime Archaeological Potential 2 – Characterising the Potential for Wrecks (AMAP2)* project assessed the environmental factors affecting the preservation of maritime archaeological remains on the seabed (Ref 25.76). These factors included: sediment type; sediment thickness; water depth; and sediment transport. The project concluded that the best preservation environment was burial in fine-grained sediments. However, it was also concluded that this environment can cause instability in archaeological materials, as even low-energy sediment transport can cause repeated covering and uncovering of remains by shifting sediment.

25.5.187 On the scale provided by the AMAP2 project, 1 represents the best preservation environment (i.e., finest grain sediments) and 19 the least favourable (greater gravel inclusions).

25.5.188 The study area encompasses a range of preservation levels, from 1 to 15. The area of anticipated least favourable preservation lies in the region surrounding the 12 NM limit (*c.* KP 30 to 60), within scores of 15 (*c.* 80 per cent gravel). Northwards of this area (*c.* KP 60 to 177) the route is generally represented by scores of 9 (*c.* 5 to 30 per cent gravel) to 14 (*c.* 30 to 80 per cent gravel), indicating moderate preservation conditions.

25.5.189 The remainder of the study area further north (from *c.* KP 177 to 411) is generally characterised by scores of 1 to 8 corresponding to *c.* 1 to 5 per cent gravel, indicating more favourable preservation conditions. No AMAP2 data is available for nearshore area of the study area, some 12 km from the coastline.

Historic coastline development

25.5.190 The National Library of Scotland online historic map viewer (Ref 25.77) was examined for evidence of coastal erosion or remodelling at Anderby Creek. Ordnance Survey maps dating from the late 19th to late 20th centuries illustrate little change to the coastline at the Anderby Creek Landfall.

25.5.191 Maps up to the mid-20th century do illustrate a series of clay outcrops within the otherwise sand-dominated beach, possibly indicating the upper surface of glacial till of the Bolders Bank Formation or its onshore equivalent. A series of groynes are depicted from 1965 to 1971, indicating active erosion within the foreshore.

25.5.192 The historical maps illustrate a largely agricultural hinterland with several small farms and other properties. Other depictions such as a brick yard, coastguard station and caravan park, suggest other activities undertaken in the study area.

Prehistoric (*c.* 8,000 BC to AD 400)

25.5.193 The following sub-sections provide a chronological discussion of the potential for maritime and coastal remains from each period, specifically focusing on human interaction with the marine environment and the potential for physical evidence of these activities. This sub-section relating to prehistory begins with the Mesolithic period, at a time when the English coastline lay much further north (**Volume 3, Part 3, Figure 25-9 Sea Level Model**). Discussion relating to the pre-transgression prehistoric landscape

and archaeological potential therein is presented by the palaeolandscape assessment and submerged prehistory sub-section, above.

25.5.194 While trade networks and maritime travel are evidenced throughout prehistory by the movement of ideas, goods and people, faunal assemblages indicate that maritime activities, such as fishing, took place in coastal areas during the prehistoric periods from the Mesolithic onwards. Maritime transport was also undertaken, as suggested by the Mesolithic and later occupation of offshore islands, such as the Outer Hebrides. Evidence also indicates that some of these activities were not consistently practiced, for example, the sharp decrease in marine-sourced food which marked the onset of the Neolithic period (Ref 25.78) (Ref 25.79).

25.5.195 Whilst it is largely recognised that prehistoric groups had the understanding and ability to construct and use maritime craft suitable for use in the nearshore zone, physical evidence of vessels and related artefacts is extremely rare. This may be partly attributed to the materials used and their poor survivability, such as skins, bark and reeds (Ref 25.80).

25.5.196 Prehistoric groups may have utilised the intertidal zone for foraging and launching of small craft, however, no evidence is currently available to indicate which activities, if any, were undertaken and during which period. Prehistoric vessels were likely employed in near-shore activities, such as fishing and transportation, and are unlikely to have traversed deeper water areas of the study area. Available evidence for prehistoric activity in the study area is sparse and confined to isolated findspots of a Lower Palaeolithic flint blade (TI_004) and the butt end of a Neolithic axe (TI_006), both encountered within the intertidal zone.

25.5.197 Although there have been no recorded finds of prehistoric vessels within the study area, the counties of Yorkshire and Lincolnshire have an unusually rich record for Bronze Age and Iron Age vessels. This assemblage includes the Bronze Age, sewn-plank boat known as the “Brigg Raft” and the three Bronze Age, plank-built boats from North Ferriby. The latter have been credited with being the earliest known seagoing craft in Europe (Ref 25.81).

25.5.198 The onshore cultural heritage assessment (**Volume 1, Part 2, Chapter 7: Cultural Heritage**) does not suggest any greater likelihood for prehistoric finds associated with maritime or intertidal activity, limited to examples of funerary and enclosure monuments or stray lithic finds as recorded above.

Roman (AD 43 to 410)

25.5.199 Extensive maritime activity in the North Sea during the Iron Age (approximately 800 BC to 43 AD) and the Roman occupation of Britain (43 to 410 AD) are well documented and there is good evidence of regular trade with continental Europe, including Roman trade between Britain and the Rhine provinces.

25.5.200 Roman ports developed along the eastern coast of England to facilitate trade and protect the exposed shore of the province. The scale of shipping during this period is poorly represented by the remains in the archaeological record but discoveries of artefact concentrations on the seabed point to the survival of lost cargoes and shipwrecks from the Roman period. It is likely that many more vessels were lost than the available archaeological evidence suggests, increasing the potential that remains from this period are present.

25.5.201 The overall likelihood of their survival, however, is limited and ship remains from the Roman period are extremely rare. Whilst a slight Roman presence in the study area is indicated by individual findspots of potsherds (TI_007-8, TI_010) and an urn (TI_009) within the intertidal zone and immediate hinterland, this background presence is not currently suggestive of potential for evidence of interaction with the marine environment.

25.5.202 This is supported by the onshore cultural heritage assessment (**Volume 1, Part 2, Chapter 7: Cultural Heritage**), which identifies concentrations of Roman period terrestrial activity only within the vicinity of Alford and Bilsby, *c*. 8 km above MHWS.

Early medieval and medieval (AD 410 to 1536)

25.5.203 Post-Roman Britain was characterised by political, economic and cultural decline, with urban centres abandoned as populations moved to rural locations. Maritime activity in the southern North Sea and in the vicinity of the study area increased during the early medieval period, in part due to the raiding, trading and migration of Scandinavian and Germanic peoples and the growth of several major ports on the east coast.

25.5.204 During the later part of the early medieval period (*c.* 750 to 1066 AD), the Scandinavian presence and influence along the eastern seaboard involved the control of rivers and estuaries, such as the Humber, which secured access to trade routes and passage across the North Sea as well as to the north and east coasts of England.

25.5.205 The medieval period in Britain saw an increase in overseas trade and the expansion of some towns and villages into larger trading centres, facilitated in part by the development of new shipbuilding techniques and technologies ((Ref 25.82) (Ref 25.83)). Improvements in shipbuilding and seafaring technology, coupled with expanding trade, fishing and commercial activity, gave rise to new vessel types, such as cogs, caravels and carracks, in addition to the expansion of fisheries in the medieval period (Ref 25.84).

25.5.206 The Hanseatic League, established in Lubeck in 1169, was a multinational economic alliance encouraging trade between northwestern European nations, utilising seaborne links between the North Sea and the Baltic. At its height, the League represented some 84 cities, including east coast ports such as Newcastle, Hull, King's Lynn, Norwich and Great Yarmouth, all developing rapidly to facilitate the growing trade in coal, timber and wine (Ref 25.83).

25.5.207 The trade links between English towns associated with Hanseatic towns in Northern Europe and development of activities associated with the marine environment suggests an increased potential for evidence of these to be present within the study area. The favourable preservation conditions indicated near to the Humber estuary further suggest that remains may not have experienced severe deterioration. Anaerobic sediments, where present, may aid shipwreck preservation, however, the survival of medieval vessels is limited, and these are extremely rare in the archaeological record.

25.5.208 Available evidence for more general medieval activity within the study area (intertidal and terrestrial sections) is also limited, comprising an isolated findspot for a medieval pot fragment (TI_012), crop mark ditches (TI_011) and sea banks (TI_013).

25.5.209 The most tangible interaction between the medieval hinterland and the sea stems from a need to defend agricultural land against, rather than utilising or engaging with it, as identified within the onshore archaeology assessment (**Volume 1, Part 3, Chapter 7: Cultural Heritage**). This comprises sea defence banks stretching between Anderby and Hutoft along thew coast between *c*. 200 m and 800 m above MHWS. Post-medieval to modern (1536 to present).

25.5.210 The late medieval growth of commercial maritime trade continued and increased in the post-medieval period. From an early date, coal was one of the most important cargoes to pass through the study area, mostly enroute from Newcastle to London and the southeast, and the coal trade was perhaps the single largest contributor to the extensive post-medieval expansion in British shipping. Maritime activities such as trading, fishing and overseas ventures also expanded, increasing the volume of shipping likely to have traversed and exploited the study area.

25.5.211 Hull witnessed the construction of the first large, commercial dockyard in Britain, constructed in the 1770s, and was also the first port to create a dock company to manage maritime activities (Ref 25.83).

25.5.212 Interaction with the seascape during this period is evidenced by several heritage records within the intertidal zone and immediate terrestrial hinterland, generally derived from late 19th and early 20th century Ordnance Survey maps. These include possible landing sites (TI_015 and TI_019), possible oyster beds or fish farms (TI_016 and TI_018), clay pits (TI_017 and TI_020), a signal staff (TI_014) and the site of a former coastguard station and rocket house (for signalling; TI_023) (see **Volume 3, Part 3, Figure 25-28 Terrestrial and Intertidal Heritage Assets within the Study Area** and **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records**). Further evidence for maritime activity of this date in the study area is presented by the discovery of a small assemblage of ship timbers of probable post-medieval date, found in the intertidal zone of the study area (TI_021 and TI_022).

25.5.213 The expansion in maritime trade also resulted in the redevelopment of other small harbours and ports and the construction of new ones, many of which became increasingly prosperous. Hull has been credited with making a significant contribution to the financing of the Parliamentarian cause during the English Civil War, through continental trade, which expanded later in the 17th century through Baltic trade and local industrial and mineral exports (Ref 25.83).

25.5.214 A database of historic ports and coastal routes in England and Wales highlights several key coastal settlements near to the study area, including Chapel St Leonards, Sutton-on-Sea, Trusthorpe, Mablethorpe and Theddlethorpe (Ref 25.85). Coastal routes linking these to other small, coastal settlements and regional hubs would have traversed the nearshore part of the study area and routes overseas would have crossed the offshore parts.

25.5.215 The North Sea also witnessed an increasing level of naval activity, particularly after the Tudor period and with the establishment of new maritime institutions, such as the Royal Navy in the 16th century. The Anglo-Dutch Wars span a period 1652 - 1784, during which several naval engagements took place in the vicinity of the study area, including the Battle of Dogger Bank in 1781.

25.5.216 The increase in maritime activity was concomitant with an increase in maritime casualties and a greatly increased potential for post-medieval maritime archaeological sites and material in the study area. Material from the Tudor and Stuart periods (1485 - 1714) is rare and discoveries of such sites are of potentially great significance.

25.5.217 During the 19th century, the UK reached the height of its global power, supported by a vast merchant and military shipping fleet. By the mid-19th century, coastal and international maritime trade continued to be dominated by wooden sailing vessels, while the zenith of sailing naval vessels was reached in the ‘wooden walls’ of the Nelsonian and other navies of the early to mid-19th century. Rapid industrialisation in the 18th to 19th centuries revolutionised shipbuilding, introducing the steam engine, iron hulls and

the screw propeller, followed by the turbine engine and alternative fuels. Together, these technological changes encouraged the construction of larger, self-propelled vessels, particularly for ocean-going transports and naval vessels, although the use of traditional, often wooden, vessel types continued at a local level long into the 20th century.

25.5.218 During the First World War, the east coast of England was heavily mined by the German navy. Designated civilian shipping routes close to the coast known as 'War Channels' were swept for mines, marked with buoys and protected by British minefields. Further offshore, large areas of the southern North Sea were mined. This pattern was repeated during the Second World War (Ref 25.86).

25.5.219 Several UKHO wreck records in the study area are dated to the First and Second World Wars close to or within the War Channels. Details of these records often attribute the cause of loss to sea mines or submarine attack (see below and **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records** for further details).

25.5.220 Further Second World War activity within the study area is represented by a large number of heritage records within the intertidal and terrestrial parts, principally relating to defensive and support structures (TI_024 – TI_038 and TI_040) (see **Volume 3, Part 3, Figure 25-28 Terrestrial and intertidal Heritage Assets within the Study Area** and **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records**).

25.5.221 During the modern period (1901 - present), shipping traffic across the southern North Sea increased exponentially, making the region one of the busiest shipping areas in the world. Much of the traffic was associated with local and international trade, but a large percentage was linked to the commercial fishing industry and, more recently, oil and gas exploration and development associated with renewable energy production.

25.5.222 Knowledge of historical shipping casualties during this period is enhanced by the development of centralised recording of ship losses from the late post-medieval period onwards, such as the Lloyd's List. The increasing incorporation of metal structural elements into vessel designs during this period means that wrecks from the 19th and early 20th centuries are also often more visible to common detection methods on the seabed than their wooden predecessors. They are visible to bathymetric and geophysical survey and generate strong, magnetic anomalies; this greater visibility being reflected in the increased number of located wrecks for the modern period, in contrast to earlier periods.

25.5.223 Based on the information presented above, there is a high potential for late post-medieval and modern maritime archaeological sites and material on the seabed of the study area. A low potential is considered for earlier post-medieval remains, accounting for their overall rarity and variable preservation conditions within the study area. A slightly greater potential may be considered for areas exhibiting more favourable preservation environments.

Wreck records and documented losses

25.5.224 This sub-section examines the known wreck and documented loss records within the study area. Data derived from the UKHO, Trove and CITiZAN databases and the NMHR has provided information for a minimum of 55 maritime losses within the study area from the 19th and 20th centuries, however, the actual figure is likely higher, due to variation in the quality of sources and record keeping.

25.5.225 The Lincolnshire Historic Environment Record (HER) did not hold any records for documented losses or wreck locations within the study area.

25.5.226 Where wrecks and / or losses are identifiable across multiple records, these have been condensed into a single entry for the purposes of this assessment. A small number of instances occur where multiple records exist and have been retained for the same wreck or loss, as there remains some doubt as to the true location or multiple parts of the same vessel have been identified.

25.5.227 The recording of maritime history became common practice by the 19th century, and our knowledge of contemporary and later maritime activity is therefore much more robust than for earlier periods. It is feasible that vessels were lost within the study area prior to the 19th century but are not recorded as such. Furthermore, one or more of the wrecks of unknown date may pre-date the 19th century. Documentary evidence of vessels lost during known periods provides evidence of maritime activity in the waters surrounding, and within, the study area.

25.5.228 Several records represent 'documented losses' – maritime losses recorded often from coastguard or witness reports, or even floating or beached wreckage, often attributed a very broad location. Documented losses can be used to glean broad understanding of maritime activity, however, they are unlikely to indicate the location of physical remains or provide definitive loss numbers.

25.5.229 The project-specific intertidal walkover survey (see Paragraph 25.4.11) identified a length of rope (EGL5_016) and a heavily eroded post (EGL5_017). The rope is considered of likely modern origin. The post may represent a post-medieval or modern feature, such as a mooring post, or may comprise a remnant of the submerged forest.

25.5.230 The UKHO holds records for 53 wreck or possible wreck locations (including two duplicates), 22 foul ground locations, two boulder locations and one debris. Two named vessels, however, are each attributed two UKHO records, where the available evidence cannot identify the true location or multiple parts of the same vessel may lie some distance apart. Accounting for these duplications, the UKHO dataset for the study area comprises (for a total of 78 records):

- 51 wreck or possible wreck locations (excluding two duplicates);
- 22 foul ground locations; and
- Three other locations (see Paragraph 25.5.11).

25.5.231 The Trove database holds records for five maritime losses within the study area, comprising:

- Three records with corresponding 'live' UKHO records; and
- Two documented losses, represented within the Trove dataset only.

25.5.232 Two of the three Trove records with corresponding UKHO records relate to the same named vessel for which there is only one UKHO record (W_010).

25.5.233 The NRHE / NMHR holds 26 records within the study area, comprising:

- 10 offshore wreck records (eight of which correspond to UKHO records within the study area and two (W_082 and W_081) relate to UKHO records situated beyond the study area, lying 15 km west and 22 km southeast from their respective NMHR record);
- Eight intertidal sites, monuments or findspots;
- Seven terrestrial sites, monuments or findspots (above MHWS); and
- One offshore record relating to the recovery of two pieces of peat.

25.5.234 The CITiZAN database holds two records (TI_021 and TI_022) relating to postulated ship's timbers, joined by metal pins or wooden treenails, illustrating a broad potential for miscellaneous wreckage within the study area.

25.5.235 **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records** present the full gazetteer for the study area, correlating all UKHO, Trove, CITiZAN and NMHR records for wrecks, possible wrecks, documented losses, foul ground positions and other records. **Table 25-18** presents the range of vessel types represented within the dataset, highlighting past activities undertaken within the study area (excluding multiple records for the same vessel). Vessel types are presented by period of loss, where this is recorded. In a small number of instances, the written record demonstrates that the vessel was built in the 19th century but lost in the 20th century.

Table 25-18 Vessel types indicated by documented losses and wrecks

Vessel type / rig	19th century	20th century	Unknown	Total
Carrier	0	1	0	1
Fishing vessel	0	1	0	1
Motor vessel	0	2	0	2
Sailing vessel	7	0	0	7
Steam ship	0	13	1	14
Trawler	0	7	2	9
Torpedo-boat destroyer	0	1	0	1
Unknown	1	1	18	20
Total	8	26	21	55

25.5.236 Of the records summarised above, the number of documented losses overall is rather low at three (W_079, W_080 and W_082) and include reference to a 19th century vessel (W_080) and two 20th century vessels (W_079 and W_082). One such record, W_082, relates to the sinking of the trawler *Aphelion,* which is recorded by the UKHO beyond the study area, some 22 km southeast of the loss location recorded by the NMHR.

25.5.237 It is likely that many losses prior to and during the early 19th century went unrecorded, due to undeveloped local maritime administration and record keeping practices at this time. With so few documented losses captured in the study area, alone they cannot be examined to reveal broad patterns of maritime activity within the study area and its surrounding seascape.

25.5.238 The remainder of this sub-section summarises the wreck records within the study area associated with physical remains, illustrated by:

- **Volume 3, Part 3, Figure 25-2 UKHO and wreck records (1 of 5)**;
- **Volume 3, Part 3, Figure 25-3 UKHO and wreck records (2 of 5)**;
- **Volume 3, Part 3, Figure 25-4 UKHO and wreck records (3 of 5)**;
- **Volume 3, Part 3, Figure 25-5 UKHO and wreck records (4 of 5)**; and

- **Volume 3, Part 3, Figure 25-6 UKHO and wreck records (5 of 5)**.

25.5.239 With the exception of a record for (His Majesty's Sloop of War) HMS *Falcon* (W_081) recorded by the NMHR, these are exclusively derived from the UKHO dataset, as Trove and the NMHR typically source their wreck locations (known wrecks, rather than documented losses) from the Admiralty database. UKHO records are also more likely to relate to physical remains, having mostly been identified as such at the given locations. The location of HMS *Falcon*, as recorded by the NMHR (W_081), should be considered with a degree of scrutiny given that the correlating UKHO record (UKHO 6687) lies some 15 km west of the NMHR location, beyond the study area. The UKHO record details a partially intact wreck of the stern section of the vessel, suggests that the likelihood of wreck remains relating to the HMS *Falcon* in the NMHR location (also relating to the stern section of the vessel) is unlikely.

25.5.240 UKHO data typically, where known, lists information about the wreck, the circumstances of its loss, surveying details and whether the record is considered "live", "dead" or "lifted". "Live" records are those which have indicated remains of wreck (or other obstruction) from multiple surveys. "Lifted" records relate to wreck or obstructions which have been recovered from the seabed.

25.5.241 "Dead" records are those which have not produced results indicative of wreck at a location from subsequent surveys. Whilst the decision to amend a wreck to "dead" is based on data available from repeat surveys, records can be amended for several reasons, including:

- Deterioration of the wreck to such a degree that it no longer exists on the seabed;
- Continual burial of the wreck so that the presence is not detected over repeat surveys;
- The identification of the wreck as a natural feature; and / or
- The wreck not existing at the listed location, due to inaccurate reporting or positioning at the period of identification.

25.5.242 Whilst UKHO records may have been amended to "dead" for navigational purposes, material of archaeological interest may feasibly persist at the location, atop or below the seabed. Therefore, a "dead" UKHO record is not necessarily of no archaeological interest.

25.5.243 The UKHO dataset for the study area included 53 wreck records. This comprised:

- 34 "live" records;
- 16 "dead" records; and
- Three "lifted" records.

25.5.244 Of those records summarised above, two relate to duplicate records with two conflicting statuses. For example, the Lancaster (W_062 and W_052) is recorded as both "live" and "dead" respectively. Although both records have been retained for completeness, W_052 is recorded as a dead wreck, the records of which are based on the sinking location and retained by the UKHO for filing purposes only. This suggests that remains for this vessel are more likely to be found in the vicinity of the charted location of W_062. A further duplication exists for *Scotia* (W_054 and W_069), with each of these records having the same "live" status.

25.5.245 One UKHO record within the study area was found to correlate with a geophysical anomaly during the archaeological review of site-specific survey data. High potential archaeological anomaly MSDS_001 is interpreted as a clearly identifiable as a wreck, with the shape indicating a wooden construction. The wreck is associated with UKHO record 94757 (W_009), where it is listed as an unknown wreck. The remaining UKHO records and their descriptions are included in **Volume 2, Part 3, Appendix 25.B: Gazetteer of UKHO and Heritage Records**.

Coastal and maritime archaeological remains and potential

25.5.246 UKHO and heritage records present a broad view of historic use of the English Offshore Scheme and, more widely, the North Sea. The types of vessels represented by the loss records indicate activities such as fishing, trawling and transportation were undertaken, principally during the 20th century (see **Table 25-18**). Evidence of these activities may be present within the English Offshore Scheme, as exemplified by the UKHO record correlating with an identified geophysical anomaly. Remains relating to historic maritime activity may also be encountered within the intertidal zone, ranging in date from prehistory to the modern period, as demonstrated by existing records.

25.5.247 Identified remains likely represent only a small percentage of the wider coastal and maritime archaeological resource within the English Offshore Scheme and study area. Further remains, relating to 19th and 20th century activities, and possibly those of earlier centuries, may be preserved in varying degrees within or beneath seabed sediments and bedforms. The number of “dead” records (16 within the study area) suggest that active reworking of seabed sediments may affect the visibility and identification of potential archaeological remains.

Aviation archaeology

25.5.248 Aviation technology has been available since the early 20th century, though air travel became more prevalent after the First World War. During the inter-war years, commercial air travel boomed and, during the Second World War, the skies were dominated by military aircraft. After the war, commercial aviation steadily increased and improved. The remains of thousands of aircraft casualties, both civil and military, are present in UK waters.

Aviation archaeological remains and potential

25.5.249 There are no known aviation remains within the study area. A single documented aircraft loss record is however recorded beyond the study area, located *c.* 3.2 km north of KP 68, 700 m north of the study area. The record relates to an F15 fighter jet ditched over the North Sea in 1990 (UKHO 9088). This location is not known to correlate with physical remains.

Summary

25.5.250 No aviation remains have been identified within the study area. There is very limited potential for remains to be present in consideration of the documented loss record.

Assessment of significance

Submerged prehistory

25.5.251 No *in situ* findspots or sites relating to prehistoric hominin activity have been identified within the study area. A series of Quaternary units have been speculatively identified, generally indicating a succession of glacigenic, glaciomarine and marine environments, however, some deposits may have been laid down in environments suitable for hominin occupation.

25.5.252 A combination of factors suggests that elements of Units U02a, U02b and U02c may have estuarine, marginal marine and / or fluvial origins and that the deposition of these sediments may coincide with human occupation of the surrounding landscape. A moderate potential for archaeological remains has therefore been identified, should such sediments be confirmed within these Units. *In situ* remains therein may be considered of regional or local significance, for their potential to inform understanding of the submerged late Upper Palaeolithic, Mesolithic and Neolithic landscapes of the North Sea and human interaction with them.

25.5.253 A small number of artefacts findspots, recorded by the NMHR, HER and CITiZAN, relate to prehistoric findspots within the intertidal zone, highlighting the potential for artefacts in secondary contexts. Without primary contextual information, the significance of any such remains would be limited.

25.5.254 A high potential for palaeoenvironmental remains has been identified within the intertidal zone, based on the identification, recording and analysis of peat shelves and associated debris. Previous studies have proven the utility of this resource in understanding Lincolnshire's coastal submerged landscapes and further remains may be considered of moderate significance.

25.5.255 Any archaeological or palaeoenvironmental evidence within the study area may be able to contribute to regional research frameworks. Such frameworks include:

- The North Sea Prehistory Research and Management Framework (Ref 25.87);
- A National Mesolithic Research and Conservation Strategy for England (Ref 25.88); and
- East Midlands Historic Environment Research Framework (Ref 25.89); especially the Palaeolithic, Mesolithic and Neolithic and Early to Middle Bronze Age Strategic Objectives.

Coastal and maritime archaeology

25.5.256 Wreck remains can be of high significance, at times warranting designation as Historic Marine Protected Areas. However, this level of significance is dependent on several factors including rarity, age and level of preservation, the latter of which may be influenced by coastal or marine erosion. Further investigation at each identified wreck site would enable further confirmation of this significance. As a precautionary measure all wrecks are therefore considered to be of high significance, until such a time as sufficient detail may be available to inform otherwise. High and medium potential anomalies have been provisionally identified as wrecks or associated wreck material / debris and therefore may hold up to high significance.

25.5.257 Low potential anomalies are a mixture of small features, often boulder-like, or likely to represent modern debris such as chain, cable, or rope, or small items of debris with no features indicating archaeological potential.

25.5.258 Isolated findspots may be encountered for remains dating from the Palaeolithic to Modern periods, which may relate to past human interaction with the marine environment. Isolated findspots typically comprise cultural material which is no longer *in situ*. The key contributors to significance of this material are typically held within its physical fabric, where many other contributors to significance, such as original context, have been lost. While such finds do hold some significance, this is generally limited.

Aviation archaeology

25.5.259 There are no known aviation remains within the study area although a single documented loss record for an aircraft is recorded some 700 m from the study area. This record is not known to relate to physical remains and refers to a broad area rather than a precise location. The overall potential for aircraft material to be present within the study area is very low.

25.5.260 Any physical remains relating to, or suspected to relate to, aircraft losses would automatically fall under the Protection of Military Remains Act 1986 and therefore be considered of the highest significance.

Future baseline

25.5.261 The existing environment for marine archaeology has been shaped by a combination of factors, with the most prevalent being changes in global sea levels and associated climatic and environmental conditions. These conditions have and will continue to affect the burial and preservation of remains.

25.5.262 Marine physical processes, including the cycle of burial and exposure due to storm events, have an ongoing effect on the preservation of archaeological material. Sediment cover provides protection from physical marine processes, reducing the risk of erosion and degradation. It is not possible to assess the effect of this impact upon individual heritage assets as this will be dependent on the nature of the exposed heritage asset and site-specific conditions. The potential increase and violence of storm activity because of climate instability may exacerbate the effects of the burial and exposure cycle on affected assets.

25.5.263 Underwater cultural heritage is also under threat from warming waters caused by climate change. As the sea levels rise, the impact of the tidal activity on heritage assets within and adjacent to the intertidal zone will increase. In addition, warming waters result in the northward migration of invasive species and may include the blacktip shipworm (*Lyrodus pedicellatus*) and great shipworm (*Teredo navalis*). These species are a major threat to wooden wrecks and other wooden structures within the marine environment.

25.5.264 Further marine infrastructure projects within the region will all have the potential to cause adverse impacts on heritage assets or contribute to beneficial impacts. This includes large-scale enhanced understanding of the archaeological resource through large area geophysical / geotechnical survey data released to the public domain or the enhanced knowledge of key characteristics, features or elements derived from site-specific survey and investigations. This is particularly relevant to the study of submerged palaeolandscapes, which may experience limited overall impacts from seabed development on a project-by-project basis but benefit from the accumulation and

analysis of geotechnical data and subsequent geoarchaeological review from a range of projects.

25.5.265 There is the potential for loss or disturbance of possible historic wreck sites arising from discovery and other marine infrastructure projects, however, these are routinely protected from likely impacts by robust, industry-standard mitigation strategies.

25.6 Environmental Measures

25.6.1 As set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, the environmental measures are characterised as design measures or control and management measures. A range of environmental measures would be implemented as part of the English Offshore Scheme and will be secured in the DML and DCO as required. **Table 25-19** outlines how these design and control measures would influence the marine archaeology assessment.

25.6.2 Several management plans will be provided as Outline Management Plans with the DCO application to support the DML. These include an Outline Construction Environmental Management Plan (CEMP) and an Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries. These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme. Final management plans will be submitted in accordance with the DML to discharge the licence conditions. Control and management measures that are relevant to the marine archaeology assessment are denoted by a (C) in the ID reference column in **Table 25-19**. These control and management measures are also included within the Outline CEMP and Outline WSI and PAD that can be found in **Volume 2, Part 1, Appendix 5.D Outline Construction Environmental Management Plan (CEMP)**, and **Volume 2, Part 3, Appendix 25.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**, respectively.

25.6.3 The purpose of the Written Scheme of Investigation (WSI) is to set out the environmental measures and further work of the Project in relation to marine archaeology. The Protocol for Archaeological Discoveries (PAD) sets out the procedure for reporting discoveries of potential archaeological interest during the Project lifetime.

25.6.4 The Outline WSI and PAD will be submitted as part of the DCO application.

Table 25-19 Summary of the environmental measures

Receptor	Potential changes and effects	Environmental measures	ID Reference
All receptors.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	WSI: implementation of a protocol for avoiding, mitigating and managing finds of archaeological interest, following the guidance for the PAD.	MA01 (C)
		Archaeological input into specifications for and archaeological analysis of any further pre-construction surveys, including (but not limited to) unexploded ordnance (UXO), Remotely Operated Vehicle (ROV), diver, geophysical and geotechnical surveys.	MA02 (C)
Known archaeological sites and geophysical anomalies of high or medium archaeological potential.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	Mitigation of unavoidable direct impacts on known sites of archaeological significance. Options include i) preservation by record; ii) stabilisation; and iii) detailed analysis and safeguarding of otherwise comparable sites elsewhere.	MA03 (C)
Sub-seabed deposits of palaeoenvironmental potential.			
Known archaeological sites and geophysical anomalies of high or medium archaeological potential.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	Archaeologists to be consulted in the preparation of site preparation activities or other pre-construction operations and, if appropriate, to carry out archaeological monitoring of such work.	MA04 (C)
Geophysical anomalies of low archaeological potential.			
Unknown archaeological sites and remains.			
Sub-seabed deposits of palaeoenvironmental potential.			

Receptor	Potential changes and effects	Environmental measures	ID Reference
Known archaeological sites and geophysical anomalies of high or medium archaeological potential. Unknown archaeological sites and remains.	Direct and / or indirect impacts resulting in damage to / loss of historic material/remains.	Implementation of Archaeological Exclusion Zones (AEZs) or Temporary Archaeological Exclusion Zones (TAEZs) around identified known or potential Marine Archaeology receptors.	MA05 (C)
All receptors.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	Implementation of a protocol for recording finds of archaeological interest, following the guidance for the PAD.	MA06 (C)
Sub-seabed deposits of palaeoenvironmental potential.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	Obtaining geotechnical cores for archaeological review. Implementation of a staged process of geoarchaeological works, as necessary.	MA07 (C)
Geophysical anomalies of low archaeological potential.	Direct and / or indirect impacts resulting in damage to / loss of historic material / remains.	Operational awareness of the location of geophysical anomalies identified as having a low archaeological potential. Reporting through the PAD will be undertaken should material of potential archaeological interest be encountered.	MA08 (C)

25.7 Scope of the Assessment

25.7.1 This section presents information relating to the current scope of the assessment rather than the scope as set out in the Scoping Report [Ref 25.90], accounting for comments received in the Scoping Opinion [Ref 25.19] and ongoing stakeholder engagement.

Spatial scope and study area

25.7.2 The spatial scope of the impact assessment for marine archaeology covers the area of the English Offshore Scheme, together with the study area. The study area for marine archaeology is shown by **Volume 3, Part 3, Figure 25-1 Marine Archaeology Study Area**.

25.7.3 The study area comprises the English Offshore Scheme and a 2 km buffer measured from its boundaries, within the marine zone. The study area extends to 200 m above MHWS, including the intertidal zone. This overlaps with the English Onshore Scheme, which extends to Mean Low Water Springs (MLWS). This study area formed the scope of the current baseline assessment and is considered appropriate to encapsulate all potential marine archaeology receptors. All direct impacts are anticipated to occur within the English Offshore Scheme and indirect impacts are, at this stage, considered unlikely to result in potential significant effects to marine heritage assets beyond 2 km from the causal activity (see **Table 25-22**).

25.7.4 A preliminary assessment of marine physical processes has been undertaken, and the initial findings can be found in **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**. Review of these initial results has informed the preliminary indirect impact assessment for marine archaeology receptors has been undertaken (see below, Sections 25.10 to 25.13 and Sections 25.14 to 25.17). The ES will include a detailed review of marine physical processes and ascertain from this the extent and character of potential indirect impacts to marine archaeology receptors. A review of the suitability of the 2 km study area for impact assessment will be informed by the results and amended, if necessary.

Temporal scope

25.7.5 The temporal scope of the assessment of marine archaeology is consistent with the period over which the English Offshore Scheme would be carried out. It assumes construction of the English Offshore Scheme will commence in 2030 and cover a period of 5 years. Operation would commence in 2035, with periodic maintenance required during the operation and maintenance phase of the English Offshore Scheme. It is assumed that maintenance and repair activities could take place at any time during the life span of the English Offshore Scheme.

25.7.6 The English Offshore Scheme is expected to have a life span of more than 40 years. If decommissioning requires full or partial removal of the English Offshore Scheme at this point in time, then activities and effects associated with the decommissioning phase are expected to be of a similar level to those during the construction phase, albeit with a lesser duration. The Project could also remain operational for a period after the 40 years or be taken out of service and left within the draft Order Limits after 40 years. Acknowledging the complexities of completing a detailed assessment for decommissioning works up to 40 years in the future, based on the information available, the Project has concluded that impacts from decommissioning would be no greater than those during the construction phase. Furthermore, should decommissioning take place

it is expected that an assessment in accordance with the legislation and guidance at the time of decommissioning would be undertaken. In addition, it is expected that the DCO will include a requirement for a written scheme of decommissioning for approval by the relevant consenting authority.

Identification of receptors

25.7.7 **Table 25-20** summarises the principal marine archaeology receptors that have been identified as being potentially impacted by the English Offshore Scheme.

Table 25-20 Marine archaeology receptors subject to potential effects

Receptor	Reason for consideration
Known archaeological sites and geophysical anomalies of high or medium archaeological potential.	Baseline has identified numerous wreck sites and anomalies of high or medium archaeological potential, which may experience direct / indirect impacts.
Geophysical anomalies of low archaeological potential.	Baseline has identified numerous anomalies of low archaeological potential, which may experience direct / indirect impacts.
Unknown archaeological sites and remains.	Baseline has identified potential for hitherto unidentified archaeological sites and / or remains to be present within the English Offshore Scheme and study area, which may experience direct / indirect impacts.
Sub-seabed deposits of palaeoenvironmental potential.	Baseline has identified geological units within the English Offshore Scheme and study area with the potential to contain palaeoenvironmental remains of archaeological interest, which may experience direct / indirect impacts.

Potential effects considered within this assessment

25.7.8 The effects on marine archaeology receptors which have the potential to be significant and have been taken forward for detailed assessment are summarised in **Table 25-21**.

Table 25-21 Marine archaeology receptors scoped in for further assessment

Receptor	Likely significant effects
Known archaeological sites and geophysical anomalies of high or medium archaeological potential.	Damage to / loss of historic material / remains and diminishment of heritage value of affected assets.
Geophysical anomalies of low archaeological potential.	Damage to / loss of historic material / remains and diminishment of heritage value of affected assets.
Unknown archaeological sites and remains.	Damage to / loss of historic material / remains and diminishment of heritage value of affected assets.
Sub-seabed deposits of palaeoenvironmental potential.	Damage to / loss of material / remains of interest and diminishment of heritage value of affected assets.

25.8 Key Parameters for Assessment

Realistic worst-case design scenario

25.8.1 The assessment has followed the Rochdale Envelope approach as outlined in **Volume 1, Part 1, Chapter 4: Description of the Project** and **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**. The assessment of effects has been based on the description of the English Offshore Scheme and parameters outlined in **Volume 1, Part 1, Chapter 4: Description of the Project** and **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**. Where there is uncertainty regarding a particular design parameter, the realistic worst-case design parameters are provided below with regards to marine archaeology, along with the reasons why these parameters are considered the worst-case (**Table 25-22**).

25.8.2 The preliminary assessment for marine archaeology has been undertaken on this basis. Effects of greater adverse significance are not likely to arise should any other development scenario, based on details within the Rochdale Envelope (e.g., different infrastructure layout within the English Offshore Scheme), to that assessed here be taken forward in the final design scheme.

25.8.3 In relation to marine archaeology the following assumptions are made regarding the Project design parameters to ensure a realistic worst-case assessment has been undertaken.

- The activity with the greatest likelihood for resulting in impacts is undertaken;
- The activity with the greatest potential for significant impacts is undertaken; and
- Impacts of the greatest significance will be experienced.

25.8.4 Additional impacts may be experienced from vessel anchoring and jack-up activities. Such activities will adhere to the environmental measures (**Table 25-19**) and any anchoring plans will be subjected to archaeological review before the activity commences.

Table 25-22 Key parameters for the marine archaeology assessment

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
Direct impacts to marine archaeology assets, resulting in damage and / or loss.	✓	✓	✓	**Construction** **Total seabed disturbance = 12.69 km^2.** **Seabed Preparation.** **Boulder clearance** – 8.46 km^2 of seabed disturbance at a depth of ~10 cm for pre-lay SCAR plough with swathe of 20 m across 423 km of the English Offshore Scheme (20 m x 423 km of the route). **Pre-Lay Grapnel Run (PLGR)** – 12.69 km^2 of seabed disturbance at a depth of up to 1 m for pre-lay grapnel with a clearance channel width of 30 m across 423 km of the English Offshore Scheme (30 m x 423 km of the route). **Cable Burial Trial Trenching** – 0.075 km^2 of seabed disturbance at a maximum depth of 3.5 m for a burial tool with a maximum width of 15 m across maximum 5 km of the route (15 m x 5 km of the route). **Sand Wave Clearance (pre-sweeping)** – 1.2 km^2 of seabed disturbance using a combination of a controlled flow excavator and trailing suction hopper dredger with a maximum width of 60 m across 20.04 km of the English Offshore Scheme (60 m x 20.04 km of the route). **Removal of Out of Service cables** – one out of service telecoms cable to be removed	Any disturbance of the seabed during preparation and construction activities could directly impact marine archaeology receptors. These effects are likely to be localised, but should they occur, they could lead to adverse and irreversible damage to heritage assets. The Maximum Design Scenario (MDS) for direct impacts to marine archaeology receptors relates to seabed preparation for pre-installation activities, jack-up vessel and anchoring operations and cable installation (including Anderby Creek Landfall).

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
				- maximum seabed disturbance of 0.01 km^2 to a depth of 2 m by de-trenching grapnel for a section *c*. 100 m long, 50 m either side of centreline (100 m x 100 m). **Jack-Up Vessels and Anchoring Operations.** **Jack-up vessel** - 88.74 m^2 jack-up barge disturbance (Indicative based on four 3 m diameter legs). **Anchoring operations** – 3103 maximum vessel return trips. Anchor plans not available for PEIR. **Cable Installation.** **Cable burial** – 10.575 km^2 of seabed disturbance with a maximum burial depth of 3.5 m using a burial tool with a maximum width of 25 m across 423 km of the English Offshore Scheme (25 m x 423 km). **External Cable protection** – 1.472 km^2 of seabed affected by external cable protection based on an indicative length of 92 km of protection and a width of 16 m (92 km x 15 m). **Infrastructure crossings** – 0.464 km^2 of seabed affected, based on 58 no. crossings with external cable protection measuring 500 x 16 m.	

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
				Cable wet storage – to be used as necessary. No parameters available at the time of writing. **Trenchless technique operations.** **Exit pit excavation** – up to two exit pits with a maximum excavated area of 750 m^2. **Trenchless technique depth** – up to 40 m.	
				<u>Operation and maintenance.</u> **Cable maintenance.** **Cable repair** – maximum of 13 repairs over Project lifetime for a maximum total length of 13,000 m and a total external cable protection area of 208,000 m^2 for repairs. Each repair will require a maximum of 5 vessels. **Cable remediation** – maximum of 8 remediations over Project lifetime for a maximum total length of 8,000 m and a total external cable protection area of 128,000 m^2 for remediations. Each remediation will require a maximum of 4 vessels.	Localised repair / replacement works to cables or remedial external cable protection may be required. The MDS for direct impacts to marine archaeology receptors relate to the use of equipment for cable de-burial (if applicable) and the laying back of cables upon the seabed cable repair and / or replacement as part of maintenance activities. Where such impacts occur within the footprint of construction impacts, it is likely that no greater impact will be experienced than has previously occurred. Direct impacts arising from operation and maintenance activities therefore concern where these activities interact with areas of the seabed not previously impacted during the Project.
				<u>Decommissioning</u> Refer to the construction phase MDS.	MDS is similar to (or less than) that of the construction phase.

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
Indirect impacts to marine archaeology assets, resulting in damage, loss, relocation and / or destabilisation.	✓	✓	✓	**Construction** Sandwave clearance, excavation of trenchless technique exit pits and cable trenching operations can all result in suspended sediments within the water column. Coarse sediment will settle <0.4 km from the causal activity and fine sediment plumes can travel up to 19.8 km and will cause light surface smothering of <2 mm.	Seabed preparation and construction activities have the potential to destabilise or compress assets, through sediment removal and deposition. Altered hydrodynamic processes may occur around infrastructure and vessel anchors, potentially resulting in the removal of deposits of palaeoenvironmental interest and destabilising nearby assets (which may lead to subsequent harm). With the exception of sandwave clearance, seabed preparation activities would disturb much less sediment than cable trenching and the consideration of the impact of cable trenching therefore provides a worst-case assessment of sediment plumes from construction activities along most of the route. KP 10 was used for modelling the worst-case scenario for suspended sediment concentration, which has a higher percentage of fines and fast flow speeds.
				Operation and maintenance. **Cable maintenance; total subtidal temporary seabed disturbance -** 0.315 km^2. De-burial and re-burial of cable failure points across 13 km of bundled cables (25 m cable plough footprint x 13000 m length)	Localised repair / replacement works to cables or remedial external cable protection may be required. Indirect impacts arising from such activities have the potential to affect marine archaeological receptors. The MDS for direct impacts to marine archaeology receptors relate to the use of equipment for cable de-burial (if applicable) and the laying back of cables upon the

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
				Cable repair – maximum of 13 repairs over Project lifetime, each requiring a maximum of 5 vessels. **Cable remediation** – maximum of 8 remediations over Project lifetime, each requiring a maximum of 4 vessels.	seabed cable repair and / or replacement as part of maintenance activities. Such activities may result in sediment removal and deposition resulting in destabilisation and damage.
				Decommissioning Refer to the operation and maintenance phase MDS.	If the English Offshore Scheme is left *in situ*, no new suspended sediments are anticipated. Indirect impacts to marine archaeology assets will be the same as or less than operation and maintenance phase. Removal of Project infrastructure, particularly de-burial, may result in indirect impacts.

25.9 Assessment Methodology

Overview

25.9.1 The generic, project-wide approach to the assessment methodology is set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, specifically in Sections 5.4 to 5.6. However, whilst this has informed the approach that has been used in this marine archaeology assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this marine archaeology assessment. Details are provided below.

Receptor sensitivity / value

Sensitivity

25.9.2 The UK Marine Policy Statement (Ref 25.37) indicates that authorities should take account of the particular nature of the interest in the (heritage) assets and the value they hold for this and future generations. The East Inshore and Offshore Marine Plans and North East Offshore Marine Plan conform with the UK Marine Policy Statement.

25.9.3 The overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance and recoverability. This is achieved through applying known research and information on the status and sensitivity of the feature under consideration, coupled with professional judgement and experience.

25.9.4 The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. As a finite resource, heritage assets typically have no ability to recover from direct impacts which result in a loss to their physical fabric. Recovery may be experienced, for example, when impacts arise from temporary changes to their setting. Sensitivity is defined by the following factors:

- Tolerance: the susceptibility (ability to be affected or unaffected) of a receptor to an external factor;
- Adaptability: the ability of the receptor to adapt to, or avoid, an external factor;
- Recoverability: the ability of a receptor to return to a state close to that which existed before the activity or event caused change within a specified period of time; and
- Value: a measure of the receptor's heritage value.

25.9.5 To define the sensitivity of a receptor, the guidelines presented in **Table 25-23** have been adopted in this marine archaeology assessment.

Table 25-23 Sensitivity levels for receptors

Sensitivity of receptor	Definition
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact. Historic environment assets of high sensitivity are typically associated with the highest value, i.e., as assets of national or international importance. Such assets in England include World Heritage Sites, Scheduled Monuments, Grade I or II* Listed

Sensitivity of receptor	Definition
	Buildings, Registered Parks and Gardens, Registered Battlefields, Protected Wreck Sites, some Conservation Areas and non-designated assets that meet the criteria for designation (in the opinion of the assessor). Grade II Listed Buildings may also be considered of high value, where the existing designation does not adequately reflect their value (in the opinion of the assessor).
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact. Historic environment assets of medium sensitivity are typically valued at a regional level. Such assets in England include Grade II Listed Buildings, some Conservation Areas and non-designated assets of similar value (in the opinion of the assessor).
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact. Historic environment assets of low sensitivity are typically valued at a local level. Such assets in England include some Grade II Listed Buildings, some Conservation Areas and non-designated assets (in the opinion of the assessor).
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact. Historic environment assets of negligible sensitivity are typically of limited to no value or archaeological / historical interest.

Value

25.9.6 The UK Marine Policy Statement (Ref 25.37) indicates that authorities should take account of the particular nature of the interest in the (heritage) assets and the value they hold for this and future generations. Therefore, although valuation forms a definitive part of the process, it is not weighed directly against magnitude nor is it used in isolation to determine the potential significance of effect.

25.9.7 Both designated and non-designated heritage assets can hold heritage value. Value considers whether the receptor is rare, has protected status or has importance on a local, regional, national or international scale. Designated heritage assets, such as Protected Wreck Sites, hold high value. For non-designated assets, significance (value) is best defined as a combination of evidential, historical, aesthetic and communal values (Ref 25.6):

- Evidential value: the potential of a place to yield evidence about past human activity;
- Historical value: the ways in which past people, events and aspects of life can be connected through a place to the present - it tends to be illustrative or associative;
- Aesthetic value: the ways in which people draw sensory and intellectual stimulation from a place; and
- Communal value: the meanings of a place for the people who relate to it, or for whom it figures in their collective experience or memory.

25.9.8 High value and sensitivity are not necessarily linked within a particular impact. A receptor could be of high value but have a low or negligible sensitivity to an effect, for example, Lower Palaeolithic stone tools in a secondary context may be considered of high value but would not be highly sensitive to indirect impacts, such as scour. **Table 25-24** provides definitions for the value afforded to a receptor based on importance regarding legislation and guidance.

Table 25-24 Definitions of the value levels for historic assets

Value	Definition
High	Internationally or nationally important. Within a marine or intertidal context, high value heritage receptors include World Heritage Sites, Protected Wreck Sites, Scheduled Monuments, sites designated under the Protection of Military remains Act 1986 and heritage assets of acknowledged international importance or that can contribute significantly to acknowledged international research objectives. Additionally, in line with the UK Marine Policy Statement (Ref 25.37), any remains which are not currently designated but have equivalent significance to a designated asset are also considered to be of high value. Onshore, this would include Heritage Assets valued at national level, such as Scheduled Monuments and Grade I Listed Buildings. Such assets may lie within or extend into the intertidal zone.
Medium	Within a marine or intertidal context, medium value receptors include heritage assets that are not designated and that do not meet the criteria for designation but display a combination of evidential, historical, aesthetic and / or communal value and heritage assets, groups of assets or landscapes that contribute to regional research objectives. Onshore, this also includes Heritage Assets valued at a regional level, such as Grade II Listed Buildings, some Conservation Areas and areas of identified archaeological interest. Such assets may be situated within or extend into the intertidal or marine zone.
Low	Within a marine or intertidal context, low value receptors include heritage assets displaying limited combined or individual value and heritage assets, or groups of assets, that contribute to a limited degree to regional research objectives. Onshore this would include Heritage Assets valued at a local level, such as non-designated assets of local value. Such assets may be situated within or extend into the intertidal or marine zone.
Negligible	Heritage assets with very little or no surviving archaeological interest and little or no combined or individual value and heritage assets, or groups of assets, that cannot appreciably contribute to acknowledged regional research objectives. Onshore this would include badly preserved and / or damaged or very common archaeological features and buildings of little or no value at local or any other scale. Such assets may lie within or extend into the intertidal zone.
Uncertain	Historic assets for which the importance of the resource has not been ascertained and archaeological resources the importance of which cannot be ascertained.

Magnitude of impact

25.9.9 Magnitude is defined in terms of the level of the effect above background conditions and natural variability, by whatever parameters are measurable relative to the baseline. Magnitude considers that effects may be beneficial or adverse, and short-term, long-term or permanent. In relation to cultural heritage, effects are generally adverse and are classified for both direct / indirect (physical) impacts and setting impacts. Beneficial effects may be experienced, for example where suspended sediments redeposit atop a receptor (e.g., a palaeo land surface), enhancing its protection against future impacts.

25.9.10 Direct impacts to heritage assets that result in damage and / or loss to the physical fabric that contributes to that asset's cultural significance are always permanent and irreversible. Magnitude quantifies the extent of change to the asset's cultural significance.

25.9.11 Methods set out in **Table 25-25** align with the wider methods used in this PEIR for judging exposure and magnitude of effect, relating specifically to heritage assets. Definitions have been established with reference to key documentation, including the Marine Policy Statement (Ref 25.37).

Table 25-25 Magnitude criteria

Magnitude criteria	Beneficial effect	Adverse effect
High	Large scale improvement of resource or attribute quality; extensive restoration or enhancement (beneficial). Overwhelming positive changes around the asset that may contribute to the cultural significance of the asset, taking the form of; visual changes to key aspects of the historic landscape.	Substantial loss or harm to the heritage asset / setting and / or integrity of the heritage asset or severe damage to key characteristics, features or elements (adverse), such that the heritage asset is lost or its significance is totally altered. Permanent / irreplaceable change, which is certain to occur, or a total or near complete loss of cultural significance.
Medium	Improvement to, or addition of, key characteristics, features or elements of the resource; improvement to attribute quality (beneficial). Visual changes to key aspects of the historic landscape or improved access, resulting in an enhancement of the understanding or appreciation of the asset.	Loss of, or alteration to, key characteristics, features or elements; measurable change in significance, attributes, quality or vulnerability (adverse), such that the heritage asset and its significance is altered. Appreciable change to setting resulting in a loss of understanding, appreciation or experience of the heritage asset. A notable depreciation of cultural significance.
Low	Minor improvement to, or addition of, one or a small number of characteristics, features or elements; very minor	Minor loss of, or small alterations to, one or a small number of characteristics, features or elements; noticeable change in

Magnitude criteria	Beneficial effect	Adverse effect
	improvement to attribute quality (beneficial).	attributes, quality or vulnerability (adverse). Slight change to setting resulting in a minor loss of understanding, appreciation or experience of the heritage asset. A minor depreciation of cultural significance.
Negligible	No change or unquantifiable change to the receptor and its significance.	

Significance of effect

25.9.12 The significance of an effect upon marine archaeology receptors is determined by correlating the magnitude of impact and the sensitivity of the receptor. The comparative matrix to achieve this is presented by **Table 25-26**. The effects are assessed as negligible, minor, moderate or major significance and can be either beneficial or adverse. **Table 25-27** presents the definitions of each possible resultant significance of effect.

25.9.13 For the purposes of this assessment, any effects with a significance level of major and / or moderate have been deemed significant in EIA terms, while those of minor or negligible level are deemed not significant.

Table 25-26 Significance of effect matrix

		Magnitude of change			
		High	**Medium**	**Low**	**Negligible**
Sensitivity of receptor	**High**	Major (significant)	Major (significant)	Moderate (potentially significant)	Minor (not significant)
	Medium	Major (significant)	Moderate (potentially significant)	Minor (not significant)	Minor (not significant)
	Low	Moderate (potentially significant)	Minor (not significant)	Minor (not significant)	Negligible (not significant)
	Negligible	Minor (not significant)	Minor (not significant)	Negligible (not significant)	Negligible (not significant)

Table 25-27 Significance of effect definitions

Significance of effect	Beneficial	Adverse
Major	Development will deliver a highly positive contribution and / or better reveal the value of a heritage asset of recognised national or international value, such that an application should be treated very favourably.	Substantial harm or total loss of the value of a designated heritage asset (or asset worthy of designation), such that development should not be consented unless substantial public benefit is delivered by the development.
Moderate	Development will deliver a positive contribution and / or better reveal the value of a designated heritage asset (or asset worthy of designation), such that an application should be treated favourably.	Less than substantial harm or total loss of the value of a designated heritage asset or an asset of designable quality, such that the harm should be weighed against the public benefit delivered by the development to determine consent.
Minor	Development will deliver a positive contribution and / or better reveal the value of a non-designated heritage asset.	Less than substantial harm to the value of a designated heritage asset, of a lesser degree than that perceived as moderate adverse, but which should still be weighed against the public benefit delivered by the development to determine consent.
Negligible	No discernible change to the receptor and its significance.	

Preliminary assessment of cumulative effects

25.9.14 At the current stage of the English Offshore Scheme (PEIR stage), design information is insufficient to allow for a robust cumulative assessment to be undertaken. Furthermore, given the current position in relation to baseline data collection, the baseline identified at this PEIR stage cannot be taken as a complete picture of the potential presence and significance of sensitive receptors.

25.9.15 Therefore, a cumulative assessment has not been undertaken at this stage; however, **Volume 1, Part 4, Chapter 27: Cumulative Effects** and **Volume 2, Part 4, Appendix 27.A: Long List of other Developments** present the long and short lists of 'other developments' for the inter-project cumulative effects which will be considered at the ES stage (with updates as necessary), and the methodology which allowed for the identification of these other developments, to allow consultation bodies to form a view and provide comment on the other developments included. The long list will be reviewed and if necessary, updated, in the lead up to the ES, as the Project design further evolves and in response to any comments raised at statutory consultation.

25.10 Preliminary assessment of known archaeological sites and geophysical anomalies of high or medium archaeological potential – construction phase

25.10.1 Construction activities, including seabed preparation, have the potential to result in direct and / or indirect impacts to known archaeological sites and geophysical anomalies of high or medium archaeological potential. Such activities may comprise:

- Pre-Lay Grapnel Run (PLGR);
- Boulder and Unexploded Ordnance (UXO) clearance;
- Cable laying;
- Installation of external cable protection;
- Trenchless installation methods; and
- Vessel anchoring / jack-up.

25.10.2 The pathways for impacts during site preparation comprise use of ploughs, grapnels, grabs, high order UXO clearance and, to a lesser extent, low order clearance and vessel anchoring. Pathways for impacts from construction activities would include trenching / excavation for cable laying, cable laying directly on the seabed and cable installation at Anderby Creek Landfall, along with vessel anchoring / jack-up. Anderby Creek Landfall impacts would be applicable to the nearshore zones only, whilst site preparation, cable laying-related and vessel anchoring / jack-up impacts may occur throughout the English Offshore Scheme. These activities have the potential to damage and disperse archaeological remains.

25.10.3 The potential for impacts to marine archaeology receptors within the intertidal zone would be determined by the final design option, however, trenchless installation would present a limited potential for impacts. The design passes beneath this zone, entering above MHWS and exiting below MLWS. There remains a potential palaeoenvironmental interest here which will be assessed in further detail in the ES, following review of additional data.

25.10.4 Indirect impacts also have the potential to affect this receptor, such as sediment transportation and redeposition resulting from construction activities. The overburden of increased sediment may compress and damage archaeological remains, such as wreck material. Further indirect impacts may occur through removal of sediments supporting wreck material, resulting in destabilisation and damage.

25.10.5 The magnitude of indirect impacts would be experienced on a scale, influenced by the duration and proximity of the causal activity. A detailed assessment will be prepared for the ES using a robust and informed marine physical processes assessment.

25.10.6 Wrecks may be considered of the highest value in terms of cultural significance. Such remains have the potential to possess evidential, historical, aesthetic and communal value, as laid out in industry guidance (Ref 25.6). High and medium potential geophysical anomalies have been identified as having the potential to represent additional wrecks and wreck-related material (such as debris), respectively, and therefore may possess the same value as known wrecks.

25.10.7 The worst-case scenario would see direct and / or indirect impacts from construction phase activities result in the permanent and irreversible damage and / or loss of this receptor or parts thereof, thus diminishing their cultural value which is derived in part from the cohesion of archaeological material and its primary context (equivalent to a maximum high magnitude of impact). Value may also be diminished should activities result in the transportation of archaeological remains from their primary context. Indirect impacts may cause similar damage / loss, resulting in similar change to value. This receptor has no capacity to accommodate or recover from such impacts and therefore holds high sensitivity.

25.10.8 A maximum high sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.10.9 The magnitude of impact would be reduced by environmental measures. The establishment and adherence to Archaeological Exclusion Zones (AEZs) throughout the construction phase would remove the potential for direct impacts to identified archaeological sites and geophysical anomalies of high and medium archaeological potential. A bespoke and appropriately sized buffer will be implemented for each known asset, within which no construction activities will take place. The AEZ would also prevent the removal of material supporting elements of this receptor and remove the potential for indirect impacts to be experienced through this pathway.

25.10.10 AEZs shall be reviewed alongside the marine physical processes assessment of the ES to ensure appropriate sizing and robust protection of known assets from indirect impacts.

25.10.11 Further embedded mitigation provides for the involvement of an archaeologist during the planning of future surveys / activities, to ensure that requirements for marine archaeology are upheld and specifications can consider the collection of additional data to improve understanding of identified anomalies and wrecks. New and improved understanding of this receptor may be used to establish new AEZs and / or alter existing AEZs (through discussion with stakeholders) to minimise potential for impacts. All embedded mitigation and methods for implementation and adherence are laid out in **Volume 2, Part 3, Appendix 25.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

25.10.12 In consideration of the embedded mitigation, direct impacts to known archaeological sites and geophysical anomalies of high and medium archaeological potential would be removed. Indirect impacts would be reduced to levels unlikely to result in damage / loss. Through this action, the cultural value of this receptor would be preserved. The residual change would be of negligible magnitude.

25.10.13 After application of the environmental measures, correlation of **high sensitivity** and **negligible magnitude** of impact would result in a **minor significance of effect (not significant)**. The value of this receptor would be preserved by implementation of environmental measures, removing of the pathway for direct impacts and reducing the potential for indirect impacts to result in a significant effect.

25.11 Preliminary assessment of geophysical anomalies of low archaeological potential – construction phase

25.11.1 Construction activities also have the potential to impact geophysical anomalies of low archaeological potential. Construction activities, their distribution and impact pathways (direct and indirect) would be the same for this receptor as for known archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.10.1 to 25.10.5).

25.11.2 Geophysical anomalies of low archaeological potential have been identified as likely anthropogenic in origin but unlikely to be of high archaeological significance, such as discarded fishing gear, discarded cargo or elements of wreck. The cultural significance of this receptor would be principally determined by its evidential and / or historical value. Such assets have a limited potential to contribute to regional research objectives and would likely be considered of low overall value.

25.11.3 The worst-case scenario would see direct and / or indirect impacts from construction activities result in permanent and irreversible damage and / or loss of this receptor or parts thereof, thus diminishing their evidential and / or historical value, which is derived in part from the cohesion of archaeological material (equivalent to a maximum high magnitude of impact). Indirect impacts may cause similar damage / loss, resulting in similar changes to these values, however, the likely nature of this receptor suggests a greater capacity to resist potential indirect impacts. Likely comprising material of limited to no archaeological significance, this receptor has limited capacity to accommodate or recover from such impacts and therefore holds medium sensitivity.

25.11.4 A maximum medium sensitivity alongside a maximum high magnitude of impact would result in a major adverse significance of effect (Significant in EIA terms).

25.11.5 Although mitigation of impacts to this receptor would not necessarily require the establishment of AEZs, the magnitude of impact would be reduced by other embedded mitigation. Archaeological involvement in further surveys may allow greater understanding of this receptor to be developed. UXO surveys typically target such anomalies and archaeological review of the survey results may enable other embedded mitigation to be implemented to reduce impacts to any identified archaeological remains.

25.11.6 A PAD would also be adhered to during the construction phase, outlining the method of reporting and preserving chance discoveries of archaeological remains through various construction activities, which may derive from geophysical anomalies of low archaeological potential. All embedded mitigation and methods for implementation and adherence are laid out in **Volume 2, Part 3, Appendix 25.A: Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

25.11.7 In consideration of the embedded mitigation, direct impacts to geophysical anomalies of low archaeological potential would be reduced, however, some degree of loss cannot be wholly excluded. Indirect impacts would be reduced to levels unlikely to result in damage / loss. Through this action, the intrinsic values of this receptor would be largely preserved. The residual change would be of maximum low magnitude.

25.11.8 After application of the environmental measures, correlation of **medium sensitivity** and **low magnitude** would result in a **minor significance of effect (not significant)**. The value of this receptor would be largely preserved by implementation of embedded mitigation, reducing the potential for direct and indirect impacts to result in a potential significant effect.

25.11.9 Should further investigations or surveys provide additional data relating to one or more geophysical anomalies of low archaeological potential, this may result in reclassification, for example, if a low potential anomaly is found to represent an element of a wreck. In such cases, the anomaly / asset should be reassessed in accordance with its appropriate receptor group and any additional embedded mitigation applied as necessary.

25.12 Preliminary assessment of unknown archaeological sites and remains – construction phase

25.12.1 Construction activities also have the potential to impact on unknown archaeological sites and remains. Construction activities, their distribution and impact pathways (direct and indirect including through the effects of sediment transport and marine physical processes) would be the same for this receptor as for archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.10.1 to 25.10.5).

25.12.2 The potential for hitherto unidentified wrecks and archaeological remains has been established by the current baseline, presented within Section 25.5. Unknown archaeological remains may comprise:

- *In situ* prehistoric sites, submerged palaeolandforms, isolated prehistoric artefacts and palaeoenvironmental remains;
- *Ex situ* prehistoric artefacts;
- Wrecks and isolated maritime artefacts; and
- Aircraft remains.

25.12.3 *In situ* prehistoric sites, wrecks and aircraft remains may be considered of the highest value, with the potential to possess a combination of evidential, historical, aesthetic and / or communal values. Other remains may hold one or more of these values, however, as an unknown resource, it is not possible to refine further with the data available. Any remains of these types may also be able to contribute to regional, national and international research frameworks and objectives.

25.12.4 The worst-case scenario would see direct and / or indirect impacts from construction activities result in the permanent and irreversible damage and / or loss of this receptor or parts thereof, thus diminishing any value held (equivalent to a maximum high magnitude of impact). Indirect impacts may cause similar damage / loss, resulting in similar change to value. In the worst-case scenario, this receptor would have no capacity to accommodate or recover from such impacts and therefore holds high sensitivity.

25.12.5 A maximum high sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.12.6 Embedded mitigation has been integrated into the Project to minimise the potential significance of effect on unknown archaeological remains. AEZs around identified wrecks and geophysical anomalies of high and medium archaeological potential would also offer protection to unknown artefacts and sites therein (associated with the AEZ target or otherwise). Adherence to the PAD during the construction phase would raise the awareness of others engaged in construction activities which have the potential to encounter unknown archaeological remains.

25.12.7 Archaeological involvement in further surveys may allow greater understanding of this receptor to be developed. UXO, geophysical and geotechnical surveys have the potential to accumulate data which, when reviewed by a competent archaeologist, may indicate hitherto unknown sites of archaeological potential. Any such discoveries may then trigger other embedded mitigation, as appropriate. All embedded mitigation and methods for implementation and adherence are laid out in **Volume 2, Part 3, Appendix 25.A: Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

25.12.8 In consideration of the embedded mitigation, the magnitude of direct impacts to unknown archaeological remains would be reduced, however, some degree of damage / loss cannot be wholly excluded. The process of discovery itself is likely to result in some degree of impact which may equate to the worst-case scenario. Similarly, the magnitude of indirect impacts cannot be determined with confidence and may, in the worst-case scenario, result in damage / loss. Any impact may be of maximum high magnitude.

25.12.9 Correlation of high receptor sensitivity alongside high magnitude of effect produces a major potential significance of effect, which is considered significant in EIA terms. Therefore, further consideration of this receptor is necessary to reduce the potential significance of effect.

25.12.10 Archaeological review of future survey data (as an environmental measure) would reduce the likelihood of archaeological sites of the highest sensitivity remaining undetected and thus reduce the likelihood of these experiencing impacts from construction activities. Identification of new sites would then trigger a process through which appropriate embedded mitigation may be implemented, e.g., AEZs. The identification of new sites and any information gained on discovery and subsequent investigation has the potential to improve understanding of the character, extent and condition of any remains and allow suitable mitigation to be implemented beyond the Project. Long-term awareness and preservation of a newly discovered site would meet the primary objective of policy, legislature and guidance in relation to cultural heritage (i.e., preservation *in situ*) and open the potential for the site to contribute to regional, national and / or international research objectives, as befitting its character and value.

25.12.11 Discovery may be considered to have a maximum high beneficial magnitude of effect (i.e., in the instance of a discovery of the highest value), however, the method of discovery is a key factor in any overall benefit. Discovery by remote methods, such as geophysical survey, may afford the maximum benefit, whereas discovery through interaction with construction activities and the PAD may limit benefit, as direct interaction with previously unknown remains may result in direct impacts.

25.12.12 Where instances of beneficial and adverse change must be compared, industry guidance defers to professional judgement, informed by experience and expertise (Ref 25.6). Unknown archaeological remains cannot meaningfully contribute to understanding or appreciation of the historic environment and thus their value cannot be assessed, whilst remaining unknown. As an unknown resource in an unknown location, they are also vulnerable to natural processes and human activities, the latter in the marine environment including seabed development, fishing and recreation.

25.12.13 Unmitigated impacts to unknown remains may result in total loss. Although discovery of new archaeological remains within the English Offshore Scheme may result in impacts, any subsequent potential impacts will be mitigated. Appropriate preservation and the potential for new discoveries to contribute to research frameworks and objectives would result in a beneficial outcome. It is therefore considered that the maximum high adverse magnitude of effect on discovery would be balanced by a degree of beneficial magnitude

(up to a maximum high beneficial magnitude), thereafter, resulting in an overall negligible magnitude.

25.12.14 After application of the environmental measures, correlation of **high sensitivity** and **negligible magnitude** would result in a **minor significance of effect (not significant)**. The value of this receptor would be preserved as far as reasonably possible by implementation of embedded mitigation, potentially resulting in a beneficial magnitude of effect. Further direct / indirect impacts will be managed through the embedded mitigation, as appropriate.

25.12.15 New archaeological discoveries should be assessed for impacts in accordance with their appropriate receptor group and any additional embedded mitigation applied as necessary.

25.13 Preliminary assessment sub-seabed deposits of palaeoenvironmental potential – construction phase

25.13.1 Construction activities also have the potential to directly impact sub-seabed deposits of palaeoenvironmental potential. Construction activities, their distribution and direct impact pathways may be the same for this receptor as for known archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.10.1 to 25.10.5).

25.13.2 Palaeoenvironmental remains derive their significance from intrinsic and contextual value, for their potential to inform understanding of environmental conditions during the formation of parent geological units. The extent of palaeoenvironmental remains may be determined by the extent and characteristics of the parent unit and may therefore be widespread across a substantial area. The combination of a possible widespread resource and relatively limited footprint (of the Project's worst-case scenario) suggest that the receptor has some capacity to accommodate direct impacts, would be unlikely to experience a significant degree of loss or damage and therefore holds medium sensitivity. The worst-case scenario would result in the loss of palaeoenvironmental evidence of archaeological interest and the loss of all inherent heritage value (equivalent to a maximum high magnitude of impact).

25.13.3 A maximum medium sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.13.4 Archaeological involvement in the planning of future surveys and archaeological review of acquired data is included as embedded mitigation of the Project, as laid out in **Volume 2, Part 3, Appendix 25.A: Written Scheme of Investigation and Protocol for Archaeological Discoveries**. Such activities would be undertaken prior to the commencement of construction activities and the results used to improve understanding of the palaeoenvironmental potential of geological deposits and possible impacts. Undertaking ground truthing activities (boreholes and vibrocores) would introduce a small impact to this receptor, however, this would be offset by the knowledge gained from analysis of any sample and other results. Such knowledge may contribute to regional, national and / or international research objectives. The limited impact from further surveys weighed against the potential benefits of the data acquired would result in a negligible magnitude of effect.

25.13.5 After application of the environmental measures, correlation of **medium sensitivity** and **negligible magnitude** would result in a **minor significance of effect (not significant)**. The value of this receptor would be preserved by implementation of embedded mitigation, offsetting the adverse magnitude of effect experienced during geotechnical investigations by providing the benefit of greater understanding of the receptor.

25.14 Preliminary assessment of known archaeological sites and geophysical anomalies of high or medium archaeological potential – operation and maintenance phase

25.14.1 Activities during the operation and maintenance phase of the Project have the potential to result in direct and / or indirect impacts to known archaeological sites and geophysical anomalies of high or medium archaeological potential. Such activities may include:

- Cable replacement; and
- Cable repair.

25.14.2 The pathway for direct impacts during cable replacement / repair would comprise equipment used for cable de-burial (if applicable) and the laying back of cables upon the seabed. The potential for impacts through this pathway would be applicable throughout the English Offshore Scheme.

25.14.3 The extent of any direct impacts during operation and maintenance would be less than that of the construction phase. Where operation and maintenance impacts occur within the footprint of construction impacts, it is likely that no greater impact will be experienced than has previously occurred. Direct impacts arising from operation and maintenance activities therefore concern where these activities interact with areas of the seabed not previously impacted during the Project.

25.14.4 Indirect impacts arising from operation and maintenance activities also have the potential to affect this receptor, such as sediment transportation and redeposition and removal of sediments supporting wreck material, resulting in destabilisation and damage.

25.14.5 The magnitude of indirect impacts would be experienced on a scale, influenced by the duration and proximity of the causal activity. A detailed assessment will be prepared for the ES using a robust and informed marine physical processes assessment.

25.14.6 The impact assessment for known archaeological sites and geophysical anomalies of high and medium archaeological potential is the same for operation and maintenance activities as for construction activities. Prior to the application of environmental measures, a maximum high sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.14.7 Following the application of environmental measures, a **high sensitivity** combined with **negligible magnitude of impact** would conclude a **minor significance of effect (not significant)** (see Section 25.10 for details).

25.15 Preliminary assessment of geophysical anomalies of low archaeological potential – operation and maintenance phase

25.15.1 Operation and maintenance activities also have the potential to impact geophysical anomalies of low archaeological potential. Such activities, their distribution and impact pathways (direct and indirect) would be the same for this receptor as for known archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.14.1 to 25.14.5).

25.15.2 The impact assessment for geophysical anomalies of low archaeological potential is the same for operation and maintenance activities as for construction activities. Prior to the application of environmental measures, a maximum medium sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.15.3 Following the application of environmental measures, a **medium sensitivity** combined with a **low magnitude of impact** would conclude a **minor significance of effect (not significant)** (see Section 25.11 for details).

25.16 Preliminary assessment of unknown archaeological sites and remains – operation and maintenance phase

25.16.1 Operation and maintenance activities also have the potential to impact unknown archaeological sites and remains. Such activities, their distribution and impact pathways (direct and indirect) would be the same for this receptor as for known archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.14.1 to 25.14.5).

25.16.2 The impact assessment for unknown archaeological sites and remains is the same for operation and maintenance activities as for construction activities. Prior to the application of environmental measures, a maximum high sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.16.3 Following the application of environmental measures, a **high sensitivity** combined with a **negligible magnitude of impact** would conclude a **minor significance of effect (not significant)** (see Section 25.12 for details).

25.17 Preliminary assessment of sub-seabed deposits of palaeoenvironmental potential – operation and maintenance phase

25.17.1 Operation and maintenance activities also have the potential to impact sub-seabed deposits of palaeoenvironmental potential. Such activities, their distribution and impact pathways (direct and indirect) would be the same for this receptor as for known archaeological sites and geophysical anomalies of high and medium archaeological potential (see Paragraphs 25.14.1 to 25.14.5).

25.17.2 The impact assessment for sub-seabed deposits of palaeoenvironmental potential is the same for operation and maintenance activities as for construction activities. Prior to the application of environmental measures, a maximum medium sensitivity alongside a maximum high magnitude of impact would result in a major potential significance of effect.

25.17.3 Following the application of environmental measures, a **medium sensitivity** combined with a **low magnitude of impact** would conclude a **minor significance of effect (not significant)** (see Section 25.13 for details).

25.18 Preliminary assessment of known archaeological sites and geophysical anomalies of high or medium archaeological potential – decommissioning phase

25.18.1 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the receptor is likely to be unchanged. The significance of effect on known archaeological sites and geophysical anomalies of high or medium archaeological potential during decommissioning is therefore assessed as **minor (not significant)**.

25.19 Preliminary assessment of geophysical anomalies of low archaeological potential – decommissioning phase

25.19.1 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the receptor is likely to be unchanged. The significance of effect on geophysical anomalies of low archaeological potential during decommissioning is therefore assessed as **minor (not significant)**.

25.20 Preliminary assessment of unknown archaeological sites and remains – decommissioning phase

25.20.1 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the receptor is likely to be unchanged. The significance of effect on unknown archaeological sites and remains during decommissioning is therefore assessed as **minor (not significant)**.

25.21 Preliminary assessment of sub-seabed deposits of palaeoenvironmental potential – decommissioning phase

25.21.1 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the receptor is likely to be unchanged. The significance of effect on sub-seabed deposits of palaeoenvironmental potential during decommissioning is therefore assessed as **minor (not significant)**.

25.22 Transboundary Effects

25.22.1 The EIA Regulations require an ES to consider the transboundary effects of a development (paragraph 5 of Schedule 4). Given the nature of the English Onshore Scheme and its proposed location, significant transboundary effects are unlikely as there are no pathways for effects to occur outside of the UK.

25.22.2 Similarly, the English Offshore Scheme lies wholly in UK waters. As outlined in the Planning Inspectorate's Advice Note Twelve, the screening process for transboundary effects will be carried out by the Planning Inspectorate. Information to inform this screening assessment will be provided as part of the application for the DCO.

25.23 Further Work to be Undertaken

25.23.1 The information provided in this PEIR is preliminary; the final assessment of potential significant effects will be reported in the ES. This section describes the further work to be undertaken to support the marine archaeology assessment presented in the ES.

Baseline

25.23.2 The current baseline will be enhanced in the ES by the archaeological review of a ground model for the sub-seabed geology within the English Offshore Scheme, integrating both the geophysical and geotechnical data.

25.23.3 At the time of writing, the preliminary geotechnical campaign was underway, and assessment of acquired samples was being undertaken as part of Stage 1 of the geoarchaeological assessment process. By the time of production of the ES, the staged process may have advanced to allow further discussion regarding the palaeoenvironmental and / or geoarchaeological interest within the English Offshore Scheme.

25.23.4 The current baseline will further be enhanced through the review of additional geophysical and hydrographic data. The acquisition of SSS and Magnetometer data will be undertaken to inform the ES. Other data may be collected to support alterations to route alignment and in support of the identification of potential unexploded ordnance (pUXO).

25.23.5 Geophysical survey scheduled to be undertaken within the intertidal zone will inform the requirement for subsequent geotechnical investigation in this environment. Archaeological input has been provided in the planning of these surveys, and the results will be reviewed by a competent archaeologist and conclusions fed into an updated baseline, as appropriate.

25.23.6 Route development remains dynamic at the time of writing. Any micro-routeing will be contained within the draft Order Limits of the English Offshore Scheme, in consideration of the marine archaeology baseline and impact assessment. Any new data acquired as part of micro-routeing shall feed into the revised marine archaeology baseline and impact assessments of the ES.

25.23.7 Activities involving the collection of new data will be accompanied by a specific method statement, to be produced by a competent archaeological contractor in coordination with relevant stakeholders.

Assessment

25.23.8 The impact assessment for marine archaeology receptors in the ES will be enhanced with:

- Results of a comprehensive marine physical processes assessment, to inform a more precise assessment of potential indirect impacts;
- A review of the potential significance of effect on sub-seabed deposits of palaeoenvironmental interest in consideration of the enhanced baseline regarding this receptor; and
- Review of additional geophysical / geotechnical data acquired for the baseline.

Further environmental measures

25.23.9 No environmental measures in addition to those outlined in Section 25.6 and **Table 25-19** are anticipated. Further refinement of existing environmental measures should be undertaken following stakeholder engagement and / or review of additional data, as necessary.

Stakeholder engagement

25.23.10 The programme of ongoing stakeholder engagement and consultation will be structured around key milestones in the design development and assessment process, thereby providing the opportunity to update and consult stakeholders on the evolving design and decision-making process.

25.23.11 Further consultation with relevant statutory consultees will be undertaken to define the scope and extents of the environmental measures set out in the assessment above. If, following stakeholder consultation feedback, further design refinement and further assessment, it is identified that additional measures are required, these will be detailed as part of the ES.

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