The Great Grid Upgrade

Eastern Green Link 3 (EGL 3) and
Eastern Green Link 4 (EGL 4)

Preliminary environmental information report (PEIR)

Volume 1, Part 3, Chapter 26 Marine Archaeology
May 2025

nationalgrid

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26.1 Introduction

26.1.1 This chapter presents the preliminary findings of the Environmental Impact Assessment (EIA) undertaken to date for the Eastern Green Link 3 (EGL 3) and Eastern Green Link 4 (EGL 4) English Offshore Scheme, with respect to 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 Projects provided in **Volume 1, Part 1, Chapter 4: Description of the Projects**.

26.1.2 This chapter describes the methodology used, the datasets that have informed the preliminary assessment, baseline conditions, environmental measures, and the preliminary Marine Archaeology effects that could result from the English Offshore Scheme during the construction and operation (and maintenance) phases. Specifically, it relates to the English offshore elements of EGL 3 and EGL 4 (the English Offshore Scheme) seaward of MHWS.

26.1.3 The English Offshore Scheme is expected to have a life span of more than 40 years. If decommissioning is required 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 works, albeit with a lesser duration of two years.

26.1.4 Acknowledging the complexities of completing a detailed assessment for decommissioning works up to 40 years in the future, based on the information available, the Projects have concluded that impacts from decommissioning would be no greater than those during the construction phase and decommissioning effects are not discussed in detail in this chapter. 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.

26.1.5 This chapter should be read in conjunction with:

- **Volume 1, Part 1, Chapter 4: Description of the Projects;**
- **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology;**
- **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes; and**
- **Volume 1, Part 2, Chapter 7: Cultural Heritage.**

26.1.6 This chapter is supported by the following figures:

- **Volume 3, Part 3, Figure 26-1: Marine Archaeology Study Area;**
- **Volume 3, Part 3, Figure 26-2: UKHO records (1 of 5);**
- **Volume 3, Part 3, Figure 26-3: UKHO records (2 of 5);**
- **Volume 3, Part 3, Figure 26-4: UKHO records (3 of 5);**
- **Volume 3, Part 3, Figure 26-5: UKHO records (4 of 5);**
- **Volume 3, Part 3, Figure 26-6: UKHO records (5 of 5);**

- **Volume 3, Part 3, Figure 26-7: Glacial extents;**
- **Volume 3, Part 3, Figure 26-8: Sub-seabed geomorphology;**
- **Volume 3, Part 3, Figure 26-9: Sea level model;**
- **Volume 3, Part 3, Figure 26-10: Distribution of archaeological anomalies;**
- **Volume 3, Part 3, Figure 26-11: Distribution of high potential archaeological anomalies;**
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- **Volume 3, Part 3, Figure 26-14: Medium potential EGL3_39;**
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- **Volume 3, Part 3, Figure 26-17: Medium potential EGL3_507;**
- **Volume 3, Part 3, Figure 26-18: Medium potential EGL3_529;**
- **Volume 3, Part 3, Figure 26-19: Medium potential EGL3_571;**
- **Volume 3, Part 3, Figure 26-20: Medium potential EGL3_681;**
- **Volume 3, Part 3, Figure 26-21: Medium potential EGL3_1551;**
- **Volume 3, Part 3, Figure 26-22: Medium potential EGL3_1571;**
- **Volume 3, Part 3, Figure 26-23: Medium potential EGL4_729;**
- **Volume 3, Part 3, Figure 26-24: Medium potential EGL4_786;**
- **Volume 3, Part 3, Figure 26-25: Medium potential EGL4_789;**
- **Volume 3, Part 3, Figure 26-26: Medium potential EGL4_790;**
- **Volume 3, Part 3, Figure 26-27: Medium potential EGL4_791;**
- **Volume 3, Part 3, Figure 26-28: Medium potential EGL4_844;**
- **Volume 3, Part 3, Figure 26-29: Medium potential EGL4_885;**
- **Volume 3, Part 3, Figure 26-30: Medium potential EGL4_916;**
- **Volume 3, Part 3, Figure 26-31: Medium potential EGL4_1263;**
- **Volume 3, Part 3, Figure 26-32: Medium potential EGL4_1308;**
- **Volume 3, Part 3, Figure 26-33: Medium potential EGL4_1433;**
- **Volume 3, Part 3, Figure 26-34: High potential EGL3_240;**
- **Volume 3, Part 3, Figure 26-35: High potential EGL3_293;**
- **Volume 3, Part 3, Figure 26-36: High potential EGL3_506;**
- **Volume 3, Part 3, Figure 26-37: Distribution of magnetic anomalies by amplitude (nT);**

- **Volume 3, Part 3, Figure 26-38: Distribution of magnetic anomalies by mass (kg); and**
- **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area.**

26.1.7 This chapter is supported by the following appendices:

- **Volume 2, Part 3, Appendix 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries; and**
- **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records;**
- **Volume 2, Part 3, Appendix 3.26.C: Gazetteer of Geophysical Anomalies;**
- **Volume 2, Part 3, Appendix 3.26.D: Gazetteer of Sea Level Index Points;**
- **Volume 2, Part 1, Appendix 1.5.C: Outline Construction Environmental Management Plan;**
- **Volume 2, Part 1, Appendix 1.2.A: Regulatory and Planning Context; and**
- **Volume 2, Part 1, Appendix 1.5.A: Outline Register of Design Measures.**

26.1.8 As set out in **Volume 1, Part 1, Chapter 1: Introduction**, cable installation and some associated activities beyond 12 nautical miles (NM) are exempt under the Marine and Coastal Access Act 2009. This chapter presents an assessment of the cable route from MHWS at the Anderby Creek Landfall to the border with Scottish Adjacent Waters. This is to provide a holistic view of the English Offshore Scheme and any associated impacts; however, consent is not being sought for the exempt cable and only cable protection and dredging for sand wave levelling would be included in the Deemed Marine Licence (dML) beyond 12 NM.

Limitations

26.1.9 The information provided in this PEIR is preliminary, the final assessment of potential significant effects will be reported in the ES. The PEIR has been produced to fulfil National Grid Electricity Transmission plc's (NGET) 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.

26.1.10 Any limitations associated with data quality are outlined in **Section 26.4** below.

26.1.11 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

26.1.12 The preliminary marine archaeology assessment presented in **Section 26.10** onwards has concluded that the potential significant effects assessed are either **Negligible** or **Minor** adverse effects and are considered to be **Not Significant**. These 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.

26.2 Relevant technical guidance

26.2.1 The legislation and planning policy which has informed the assessment of effects with respect to Marine Archaeology is provided within **Volume 2, Part 1, Appendix 1.2.A: Regulatory and Planning Context**. Further information on policies relevant to the English Offshore Scheme is provided in **Volume 1, Part 1, Chapter 2: Regulatory and Policy Overview**. Relevant technical guidance, specific to Marine Archaeology, that has informed this PEIR and will inform the assessment within the ES, is summarised below.

Technical Guidance

26.2.2 A summary of the technical guidance for Marine Archaeology is given in **Table 26-1**

26.2.3 Table 26-1

Table 26-1 - Technical Guidance Relevant to the Marine Archaeology Assessment

Technical guidance document	Context
Military Aircraft Crash Sites (English Heritage, 2002, REF 26.1)	Guidance document relating to the identification and management of aircraft crash sites.
Code of Practice for Seabed Development (Joint Nautical Archaeology Policy Committee, 2006, REF 26.2)	Provides guidance to developers relating to risk management and legislative implications of developing within the offshore environment in the UK. It also outlines the responsibility of developers in protecting the UK's marine heritage.
Historic Environment Guidance for the Offshore Renewable Energy Sector (Wessex Archaeology, 2007, REF 26.3)	A generic guidance note on the survey, and appraisal and monitoring of the historic environment during the development of offshore renewable energy projects in the UK. The guidance is applicable to the offshore 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.
Aircraft Crash Sites at Sea (Wessex Archaeology, 2008, REF 26.4)	Guidance regarding the management and understanding of sites that include aviation remains within marine environments.
Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology with George Lambrick Archaeology and Heritage, 2008, REF 26.5)	A guidance note 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 offshore environment and the coastal environment adjacent to any development, encompassing the inter-tidal area, coastal margin and those areas further

Technical guidance document	Context
	inland likely to be affected by offshore renewable energy developments.
Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble, 2011, REF 26.6)	A guidance note on the aims of offshore geotechnical investigations and the resulting analysis undertaken during the development of offshore renewable energy projects in the UK. The guidance is applicable to the offshore 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.
Assessing Boats and Ships 1860-1950 (Wessex Archaeology, 2011, REF 26.7)	Guidance on the assessment of shipwrecks from the mid-19th to mid-20th centuries.
Marine Geophysics Data Acquisition, Processing and Interpretation, Guidance Notes (English Heritage, 2013, REF 26.8)	Guidance on the archaeological requirements for the acquisition, processing and interpretation of geophysical and hydrological data. Under review at the time of writing.
Protocol for Archaeological Discoveries (PAD) (The Crown Estate, 2014, REF 26.9)	Guidance document relating to the reporting procedure of archaeological discoveries in the offshore environment
Standard and guidance for historic environment desk-based assessment (Chartered Institute for Archaeologists, 2020, REF 26.10)	A generic guidance note 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.
Archaeological Written Schemes of Investigating: Offshore Renewables Projects (The Crown Estate, 2021, REF 26.11)	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.

26.3 Consultation and engagement

Overview

26.3.1 The 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 3, Chapter 5: PEIR Approach and Methodology**.

Scoping Opinion

26.3.2 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 05 September 2024. A summary of the relevant responses received in the Scoping Opinion in relation to Marine Archaeology and confirmation of how these have been addressed within the assessment to date is presented in **Table 26-2.**

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

Table 26-2 - Summary of EIA Scoping Opinion Responses for Marine Archaeology

Consultee	Consideration	How addressed in this PEIR
The Planning Inspectorate	No matters have been proposed to be scoped out of the assessment.	All potential impacts have been scoped into the assessment (**Section 26.7**).
The Planning Inspectorate	The Scoping Report describes the study area but does not explain why the area chosen is sufficient to reflect the likely Zone of Influence (ZoI) for the Proposed Development. The ES should be based on a defined study area, which is sufficient to identify the potential significant effects of the Proposed Development, including any potential effects caused by changes to marine physical processes. The ES should also confirm whether the study area aligns with relevant policy and guidance and provide justification for any divergences.	Section 31.1 of the Scoping Report provides the rationale for the extent of the study area by explaining "*This Study Area is considered suitable for characterising the offshore archaeological resource of the Projects, as it will examine assets potentially susceptible to direct and/or indirect impacts*". Furthermore, the same section highlighted the mechanism for amendment, by explaining "*Should further information demonstrate a potential for impacts to offshore heritage assets beyond this Study Area, this* [the Study Area] *may be amended in agreement with the Applicant and key stakeholders*". The scope of a 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 (Chartered Institute for Archaeologists, 2020). The extent of the study area for the Projects was approved through consultation with Historic England, the historic environment advisor for England's territorial waters.
The Planning Inspectorate	The Scoping Report states that primary data would be obtained from geophysical and geotechnical surveys and would be subject to archaeological review. Effort should be made to agree the scope and method of surveys with relevant consultation bodies, including Historic England. This	Project specific geophysical, hydrographic, and geotechnical data covering the potential area of impact have been collected. The data have been subject to archaeological assessment, the preliminary results of which are presented within the PEIR (**Section 0**). The data specifications and approach to assessment have been presented to

Consultee	Consideration	How addressed in this PEIR
	applies equally to surveys that are primarily to inform other aspects but would also be used for marine archaeology.	Historic England as part of ongoing stakeholder consultation.
The Planning Inspectorate	For the avoidance of doubt, the Inspectorate understands that the assessment of indirect impacts arising from hydrodynamic changes and sedimentary regimes during construction, operation and decommissioning would include consideration of receptors within the intertidal area.	The potential for indirect impacts has been identified in this PEIR (**Section 26.9 to 26.18**). A robust assessment will be undertaken in the ES, using the results of a detailed marine physical processes assessment.
Historic England	Given the likely divisions and in design, delivery and staffing between archaeological work on land and sea it is important that there is good and ongoing communication and coordination across the intertidal zone in the production of any subsequent PEIR. Given the shifting line between land and seas over millennia it is crucial that artificial splits in methodology and missing areas of assessment and mitigation are avoided.	Engagement between the archaeological consultants for the English Offshore Scheme and English Onshore Scheme is ongoing and is aimed at delivering a seamless approach to the archaeological outcomes of each respective assessment. The scope for each study area includes the intertidal zone (Marine Archaeology up to MHWS, Onshore Archaeology down to Mean Low Water Springs (MLWS), providing an overlap where baseline and impact assessment conclusions will be correlated in the ES. Furthermore, the Marine Archaeology study area extends for 200 m above MHWS, further reducing the potential for gaps in the coverage of results.
Historic England	Table 20-2 outlines the pre-construction activities that would be carried out offshore. This includes a series of geophysical surveys such as Multi Beam Echo Sounder (MBES), Side Scan Sonar (SSS), Sub Bottom Profiler (SBP) and Magnetometry (Mag). Other survey techniques could include visual inspections using ROVs. These techniques provide information of value to characterise and understand the archaeological and palaeoenvironmental potential. We are therefore pleased to see that the data would be shared with specialist archaeologists.	The results of project-specific geophysical surveys have formed a key element of the current baseline assessment (see **Section 26.4**).

Consultee	Consideration	How addressed in this PEIR
Historic England	Several of the pre-construction activities presented in Table 20-2 could result in physical impacts to the seabed and therefore to any surface exposed or buried archaeological remains and deposits that may be present; this includes removal of obstructions and boulders, pre-lay grapnel runs and sweeping sand waves.	The potential for direct impacts to Marine Archaeology receptors during site preparation activities has been discussed in **Section 26.9 to Section 26.18.** A comprehensive assessment shall be undertaken in line with the Project Design Envelope (PDE) as part of the ES.
Historic England	Table 20-4 outlines how the submarine cables may be installed, which would be informed by geophysical and geotechnical studies. Cable burial is the preferred option, but external cable protection is also being considered (e.g. rock protection, concrete mattresses etc.). The potential impact that protection may have on coastal processes would need to be considered to ensure that it didn't inadvertently cause scour/erosion of nearby archaeological deposits and remains.	A robust assessment of potential impacts arising from cable protection will be undertaken in the ES, using the results of a detailed marine physical processes assessment alongside the maximum design parameters of the PDE.
Historic England	Paragraph 20.6.5 describes the different vessels that could be required during the construction of the proposed English Offshore Scheme. The position of anchored vessels and spud-legs would need to be carefully managed to ensure that archaeological remains/ deposits are not inadvertently damaged.	The potential for direct impacts arising from vessel anchoring/jack-up in association with the English Offshore Scheme has been identified in this PEIR. A robust assessment of potential impacts will be undertaken in the ES, using the maximum design parameters of the PDE.
Historic England	We are pleased to see that the marine physical processes are being considered in terms of the potential impacts to Marine Archaeology.	The potential for indirect impacts arising from marine physical processes has been identified in **Table 26-22** of this PEIR. A robust assessment will be undertaken in the ES, using the results of a detailed marine physical processes assessment.
Historic England	**Volume 1, Part 3, Chapter 31 Marine Archaeology Paragraph 31.2.4** outlines the sources used to develop the baseline for known archaeological and cultural	The CITiZAN database was consulted during the production of the current baseline assessment and relevant data incorporated (see **Section 26.5).**

Consultee	Consideration	How addressed in this PEIR
	heritage receptors. The following mapped foreshore heritage should be added to assist production of any PEIR, as produced by the Coastal and Intertidal Zone Archaeological Network (CITiZAN).	
Historic England	Paragraph 31.2.6 states that a DBA will be prepared in due course, which should be included in the PEIR. We also confirm that the DBA exercise should be corroborated by geotechnical and geophysical datasets specifically gathered for the proposed projects (as mentioned in paragraph 31.2.8). We therefore recommend that archaeological specialists are included in the planning and implementation of this work to ensure opportunities are maximised to collect baseline evidence for the historic environment. For example, to inform the collection of geoarchaeological data, it is important that a method statement for retention, storage and assessments is in place, which contains clear objectives in line with relevant research frameworks.	Desk-based study formed a key element of the current baseline assessment (see **Section 26.4**). Archaeologists were involved in the planning of the geophysical and geotechnical surveys campaigns and were invited to review and comment on strategy and survey specifications. The results of these surveys have contributed to the current baseline assessment. A staged process for geoarchaeological input into geotechnical investigations has been established, involving review of geotechnical data, retention of samples of interest and further analysis of these. The results as available at the time will be incorporated into the ES.
Historic England	Paragraph 31.2.9 states that the intertidal area would be assessed in reference to HER data and by a walk over survey. It may be useful to develop a deposit model for the proposed landfall locations to ensure that the path of the HDD does not impact deposits of archaeological or palaeoenvironmental interest.	A walkover survey of the intertidal zone was undertaken in May 2024. The utility of a deposit model at the Landfall will be considered in the ES, incorporating the integrated geophysical and geotechnical survey results.
Historic England	Paragraph 31.5.24 states that impacts to known and potential marine archaeological receptors would be addressed through the application of embedded mitigation. We are pleased to see	A suite of industry standard environmental measures would be implemented during the Projects' lifespan, to mitigate potential impacts to Marine Archaeology receptors (see **Section 26.6**).

Consultee	Consideration	How addressed in this PEIR
	the primary form of mitigation would be to avoid assets through the use of Archaeological Exclusion Zones (AEZs) and Temporary AEZs (TAEZs). It is important to explain the embedded mitigation measures, such as recording archaeology before any loss would not reduce harm or magnitude of impact (the artefacts in question could be permanently destroyed). However, if for justified operational reasons, remains cannot be avoided, the systematic investigation of archaeology at risk of loss or disturbance is essential and should limit the loss of knowledge and understanding, but it cannot reduce the actual harm. We therefore welcome the attention given in paragraph 31.5.26 to the production of a project specific archaeological Written Scheme of Investigation (WSI), which should be produced to support the PEIR.	A WSI accompanies the PEIR as **Volume 2, Part 3, Appendix 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries.**
Historic England	We are pleased to see that both direct and indirect impacts on marine archaeology are scoped into the EIA (Table 31-8). The PEIR would need to set out the possible mitigation strategies that would be implemented for the proposed development and delivery through an outline WSI.	A WSI accompanies the PEIR as **Volume 2, Part 3, Appendix 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries.**

Technical Engagement

26.3.4 Technical engagement with consultees in relation to Marine Archaeology is ongoing. A summary of the technical engagement undertaken to March 2025 is outlined in **Table 26-3**.

Table 26-3 - Technical Engagement on the Marine Archaeology Assessment

Consultee	Consideration	How addressed in this PEIR
Historic England	Is there a separate onshore briefing for Historic England?	Engagement with HE terrestrial is ongoing separately but it is planned to integrate onshore and offshore

Consultee	Consideration	How addressed in this PEIR
		meetings/updates at key project points, particularly for discussion relating to the intertidal/landfall. The scope for each study area includes the intertidal zone, providing an overlap where baseline and impact assessment conclusions will be correlated in the ES. Furthermore, the Marine Archaeology study area extends for 200 m above MHWS, further reducing the potential for gaps in the coverage of results.
Historic England	What techniques were used in surveys?	Full suite, including Multi Beam Echo Sounder (MBES), Side Scan Sonar (SSS), Sub Bottom Profiler (SBP) and Magnetometry (Mag). The results have contributed to the current baseline assessment of this PEIR.
Historic England	Is open cut trenching being considered if HDD should fail?	Open cut trenching has been fully removed from the Projects' design. Final landfall options will be included in the ES, as informed by the PDE.
Historic England	How many cores were taken per project/frequency?	Geotechnical samples were taken every kilometre, alternating between VC and CPT. Up to 6 m of material was recovered per VC, based on penetration and recovery success.

26.3.5 Consultation with Historic England would continue after production of the PEIR and during the production of the ES. A comprehensive register of consultee considerations and how these were addressed would be included within the ES.

26.4 Data gathering methodology

26.4.1 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.

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

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

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

Study Area

26.4.4 The English Offshore Scheme would route from Anderby Creek across the Southern and Central North Sea to the boundary between the English and Scottish Exclusive

Economic Zones (EEZ). The draft Order Limits for the English Offshore Scheme is illustrated in **Volume 3, Part 3, Figure 26-1: Marine Archaeology Study Area**.

26.4.5 The study area for this assessment includes the draft Order Limits and a 2 km buffer measured from the outer boundary, within the offshore zone.

26.4.6 The detailed assessment extends to 200 m above MHWS, 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.

26.4.7 The Marine Archaeology study area is illustrated by **Volume 3, Part 3, Figure 26-1: Marine Archaeology Study Area**.

26.4.8 The English Offshore Scheme installation would use a trenchless solution such as HDD at the landfall, avoiding intrusive works in the intertidal area. The exit point for the HDDs, where the cables transition from the cable ducts to seabed burial would be entirely in the subtidal environment.

Tidal River Works

26.4.9 In addition to the English Offshore Scheme works are proposed within a tidal river. The works consist of the following:

- Tidal river crossing of the River Nene and the River Welland by HDD or trenchless solution beneath the bed of the rivers
- Option for the construction of a Temporary Quay on the River Nene.

26.4.10 In respect to the Tidal River Crossings and in accordance with Article 35 of the 2011 Exempted Activities Order these activities are considered a 'bored tunnel' and exempt from needing a Marine Licence, as works would be carried wholly under the seabed there would be no interaction and no potential for significant adverse effects on the offshore environment. Therefore, these works would not be included in the dMLs. Impacts relating to the drill entry and exit above MHWS are assessed in relevant chapters of the English Onshore Scheme in **Volume 1, Part 2**.

26.4.11 The River Nene Temporary Quay is an option being explored within the Projects' design for delivery of components for the English Onshore Scheme. At this stage feasibility of the temporary quay is still being explored, and insufficient information is available to complete a preliminary assessment. If taken forward, the ES will include a full assessment of effects of the temporary quay. **Section 26.20** outlines the further work that would be undertaken to inform the assessment.

Desk Study

26.4.12 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 26-4.** Project-specific data obtained and used to inform this assessment are presented in the sub-sections below.

Table 26-4 - Data Sources Used to Inform the Marine Archaeology Assessment

Organisation	Data source	Data provided
United Kingdom Hydrographic Office	https://datahub.admiralty.co.uk/portal/apps/sites/#/marine-data-portal/search?tags=GlobalWrecks	Wrecks and obstructions
Historic England	National Record for the Historic Environment (NRHE) https://historicengland.org.uk/research/support-and-collaboration/resources-for-researchers/	Designated and non-designated heritage assets
Lincolnshire Historic Environment Record	https://www.lincolnshire.gov.uk/historic-environment/historic-environment-record	Non-designated heritage assets
Canmore	https://canmore.org.uk/content/data-downloads	Non-designated heritage assets
CITiZAN	https://citizan.org.uk/	Non-designated heritage assets
British Geological Survey	GeoIndex Offshore (https://mapapps2.bgs.ac.uk/geoindex_offshore/home.html?_ga=2.134597047.712401882.1687954764-1795206005.1687954764)	Offshore geology and geotechnical data
	BGS TextViewer (https://webapps.bgs.ac.uk/Memoirs/docs/B01846.html)	UK offshore regional reports
Marine Environmental Data and Information Network	https://portal.medin.org.uk/portal/start.php	Marine geology, geotechnical data and publicly accessible shipwrecks
European Marine	https://emodnet.ec.europa.eu/geoviewer/	Sub-seabed palaeolandforms

Organisation	Data source	Data provided
Observation and Data Network		and palaeolandscapes
UK Government	https://explore-marine-plans.marineservices.org.uk/marine-plans-explorer	Wrecks designated under the Protection of Military Remains Act, 1986

Survey Work

26.4.13 Primary data for the Projects were acquired from a suite of geophysical and geotechnical surveys starting August 2023 and completing November 2024. This included the collection of Multibeam Echosounder (MBES) Bathymetry, Sidescan Sonar (SSS), Magnetometer, and Sub-bottom Profiler (SBP) data, and Vibrocores. Where available, the data were used to inform the PEIR.

- EGL 3:
  - Nearshore Geophysical Survey (NextGeo, 2024a, REF 26.12);
  - Offshore Geophysical Survey (NextGeo, 2024b, REF 26.13);
  - Geotechnical Survey (offshore) (NextGeo, 2023, REF 26.14); and
  - Geotechnical Laboratory Testing (nearshore) (NextGeo, 2025a, REF 26.15).
- EGL 4:
  - Nearshore Geophysical Survey (NextGeo, 2024c, REF 26.16)
  - Geophysical Results Report (offshore) (GeoXYZ, 2024, REF 26.17)
  - Geotechnical Laboratory Testing (nearshore) (NextGeo, 2025b, REF 26.18); and
  - Geotechnical Laboratory Test Results Report (GeoXYZ, 2025 REF 26.19).

26.4.14 A walkover survey of the intertidal zone at the Landfall location was undertaken on 8th and 9th May 2024. The results have been included in Section 26.5, where relevant. In brief, the walkover survey did not identify any sites, artefacts of deposits of known or potential archaeological interest.

26.4.15 The following sub-sections describes 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

26.4.16 The EGL 3 and EGL 4 survey strategy divided the routes into nearshore and offshore blocks, with nearshore categorised as water depths below 30 m and offshore categorised as water depths deeper than 30 m. EGL 3 and EGL 4 nearshore, and EGL 3 offshore blocks were surveyed by Next Geosolutions Ltd (Nextgeo). The EGL 4 offshore survey blocks were surveyed by GEOxyz BVBA (GEOxyz). Survey operations were undertaken during 2023 and 2024.

26.4.17 Survey operations utilised multiple survey vessels, all of which were mobilised with SSS, MBES, Magnetometer, and SBP (combination of Parametric and Sparker). The SSS, Magnetometer, and Sparker were towed behind the vessel, the MBES and Parametric SBP were mounted to the vessels.

26.4.18 The survey was planned with 30 m line spacing for the nearshore blocks, 70 m line spacing for the EGL 3 offshore blocks, and 50 m line spacing for the EGL 4 offshore blocks. The line spacing was planned to achieve 100% coverage of SSS and 100% coverage of MBES data, with sufficient overlap between lines. In addition, SBP and Magnetometer data were collected along each of the survey lines.

26.4.19 The survey equipment used varied between each of the vessels, however all equipment was of a similar specification. An example specification (*Levoli* – EGL 3 offshore) is provided below in **Table 26-5**.

Table 26-5 - Geophysical and Hydrographic Sensor Specifications

Sensor	Manufacturer	Model	Frequency
Sidescan Sonar	Edgetech	4200	300/600 kHz
Multibeam	R2Sonic	2026	450 kHz
Magnetometer	Geometrics	G-882	4 to 6 m altitude
Parametric SBP	Innomar	SES-2000 Standard	6 kHz
Sparker	Geo Marine	GeoSpark Spark	0.3 to 1.2 kHz

26.4.20 The data were collected to a specification appropriate to achieve the following interpretation requirements:

- Sidescan Sonar: ensonification of anomalies > 0.5 m;
- Multibeam Bathymetry: ensonification of anomalies > 1.0 m;
- Magnetometer (TVG): 5.0 nT threshold for anomaly picking;
- Parametric Sub-bottom Profiler (SBP): penetration > 5.0 m was achieved; and
- Sparker: penetration > 25 m was achieved.

Positioning

26.4.21 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 LAT and were reduced to LAT using Vertical Offshore Reference Frames (VORF).

26.4.22 Towed sensors were positioned using an Ultra Short Baseline (USBL) positioning system to ensure positional accuracy throughout the survey. USBL ensures the actual position of the sensor is recorded, as opposed to when the position is estimated based upon the direction of the vessel and the amount of cable out (layback).

26.4.23 Although the accuracy of the USBL system is dependent on the angle, and the distance of the beacon from the transceiver, tolerances of between 0.5 m and 2.0 m can be achieved. Positional accuracy is further increased through the correlation of the SSS dataset with the MBES dataset.

26.4.24 Surface and sub-sea position sensor specifications varied between each of the vessels, however all equipment was of a similar specification. An example specification (*Levoli* – EGL 3 offshore) is provided below in **Table 26-6**.

Table 26-6 - Positioning Sensor Specifications

Sensor	Manufacturer	Model	Accuracy
Surface positioning	iXBlue	Octans 3000	Roll / pitch 0.008°

Sensor	Manufacturer	Model	Accuracy
			Heading 0.02° Position 0.01 m
Sub-sea positioning	Kongsberg	HiPAP	0.06% slant range

Data deliverables

26.4.25 MSDS Marine were provided with the survey deliverables by NGET, including both raw and processed data, alongside interpretations and operations reports. The primary deliverables are detailed in **Table 26-7** below.

Table 26-7 - Data Deliverables to MSDS Marine

Sensor	Data type	Format
Sidescan Sonar	Raw lines (LF and HF)	.xtf
	Processed lines (HF)	.xtf
	Mosaic (HF) 0.25 ppm	.tif
	Contacts	.shp
Sub-bottom Profiler	Raw lines	.sgy
	Processed lines	.sgy
	Isopach	.shp
	Horizons	.tif
Magnetometer (TVG)	Raw lines	.csv
	Grids	.tif
	Contacts	.csv
Multibeam Bathymetry	Raw lines	.xyz
	Grids (at 0.5 m)	.xyz
	Mosaic (at 0.5 m)	.tiff
GIS	Geodatabase	.gdb
Reports	Interpretation report	.pdf
	Operations report	.pdf
	Mobilisation report	.pdf

Data quality and limitations

Sidescan Sonar (SSS)

26.4.26 The SSS data covered the extents of the pre-defined survey blocks, providing coverage of greater than 100%. The data were generally of good quality, with minimal interference or data degradation caused by environmental factors, or the simultaneous use of different sensors.

26.4.27 Some small horizontal offsets were noted in places between the SSS and MBES data, although these were not significant and were within what would be considered normal tolerances. However, where visible the positions of anomalies were taken from the MBES data to ensure positional accuracy.

26.4.28 Prominent features, such as ripples and sand waves, can cause obstructions to the line of sight of sonar data, in particular the SSS, the data from which is collected closer to the seabed. Typically, this is mitigated through the collection of high resolution MBES data which ensonifies the seabed from above.

Multibeam Bathymetry (MBES)

26.4.29 The MBES data covered the extents of the pre-defined survey blocks, providing coverage of 100%. A review of the un-gridded point cloud data shows that the quality is good with no significant height or positioning errors that effect the overall dataset. The data density is good, and the data is able to be gridded to 0.25 m, increasing the ability to identify smaller features. Features identified within the MBES data generally correlate well with those identified in the SSS data.

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

Magnetometer

26.4.31 The Magnetometer data covered the extents of the pre-defined survey blocks and was collected along the pre-defined survey line plan. The data were sampled at 10 Hz and the data were suitable to identify anomalies with a peak-to-peak amplitude of 5 nT. It should be noted that the 30 - 70 m line spacing achieved is too great for the accurate positioning of magnetic anomalies at distances away from the tracklines but can indicate areas of archaeological potential or can be correlated with visible feature on the seabed that lie on the same plane. Due to the line spacing it is likely that buried ferrous material, particularly smaller objects, between the run lines would not have been identified within the data.

26.4.32 However, the magnetometer data is considered be of a sufficient specification to enable a robust assessment to be undertaken for the purposes of EIA.

26.4.33 Magnetic anomalies were visible in the dataset that relate to existing offshore infrastructure such as cables or pipelines. These are typically characterised by long, straight lines of anomalies, with or without a surface expression. Where an anomaly is clearly identifiable as relating to infrastructure it is removed from the dataset.

Sub-bottom Profiler (SBP)

26.4.34 The SBP data covered the extents of the pre-defined survey blocks. The Parametric data generally achieved penetration to > 5.0 m at a vertical resolution of 0.15 m. The Sparker data were collected at a lower frequency (varied throughout the survey), generally achieved penetration to > 25 m at a vertical resolution of 0.15 m.

26.4.35 The data were of good quality, and the combination of the high resolution, shallow penetration and the lower resolution, deeper penetration systems allowed for an effective assessment of the palaeolandscape, and the archaeological potential.

26.4.36 SBP data is collected directly beneath the sensor, in general terms, and outside the identification of the palaeolandscape, SBP is not suited to the prospection for buried material of potential anthropogenic origin due to the wide line spacing. It can however be useful for the corroboration of other datasets where a trackline passes directly over a magnetic anomaly, or a potentially buried feature, visible in the SSS or MBES data.

Summary

26.4.37 The data collected across the extents of the pre-defined survey boundary are of good quality overall, with the MBES provided 100% coverage and the SSS providing 100%. SBP data were collected to a pre-determined line plan, largely providing suitable coverage and penetration for the interpretation of the palaeoenvironment. The Magnetometer data were collected to a pre-determined line plan suitable for the identification of ferrous material with a peak-to-peak amplitude of 5.0 nT, with the minimum detection size increasing with distance from the tracklines.

26.4.38 The data is considered of an appropriate specification, coverage, and quality, to undertake a robust archaeological assessment to inform the EIA process, noting that additional data collection, and interpretation, may be required prior to construction.

Archaeological assessment of data

26.4.39 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.

26.4.40 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 are 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 and obstructions and historic environment assets, 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.

26.4.41 Whilst some of the data 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 were considered.

Sidescan Sonar

26.4.42 SSS is considered the best tool for the identification of anthropogenic anomalies on the seabed due to the ability to ensonify small features and as such forms the basis of any archaeological assessment of data. SSS data in. xtf format were imported into Moga Seaview 6.3 software, navigation and positioning were checked and corrected where required, and optimal gains were applied to ensure the consistent presentation of data.

26.4.43 Data were reviewed on a line-by-line basis, and all anomalies of potential anthropogenic origin identified and recorded. Records include at a minimum an image of the anomaly, dimensions, and a description. Whilst typically only images of medium and high potential anomalies are presented with the assessment report, images of all anomalies are recorded as interpretations can change as the data assessment progresses. A rating of archaeological potential was assigned to the anomaly following the criteria outlined in **Table 26-8** below.

26.4.44 Following assessment of the individual lines, a mosaic was created and a Geotiff exported to allow for the checking of positional accuracy against the MBES data and to identify the extents of any anomalies that may have extended past the limits of individual lines.

Multibeam Bathymetry

26.4.45 Due to the minimum anomaly detection size of MBES data being larger than that of SSS data, the primary use during archaeological assessment, outside of seabed characterisation, is the corroboration of anomalies identified within other datasets and the visualisation of anomalies that may otherwise be obscured by shadow.

26.4.46 Navigation corrected, but unprocessed, MBES data were provide to MSDS Marine as .xyz files, the data were imported into QPS Fledermaus where it was gridded and exported 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.

26.4.47 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 26-8** below. Where the interpretation of an anomaly was unclear, the data were imported into point cloud visualisation software such as Cloud Compare, in order to view the un-gridded data. The gridded surface image was exported as a Geotiff to allow further assessment alongside other datasets.

Magnetometer

26.4.48 Magnetometer data indicates the presence of ferrous, and thus usually anthropogenic, material both on, and under the seabed. Where line spacing allows, typically to a specification for the detection of potential UXO, magnetometer data can provide accurate positions of buried ferrous anomalies. The survey line spacing is between 30 – 70 m which is too great for the accurate positioning of magnetic anomalies at distances away from the tracklines but can indicate areas of archaeological potential. Where possible, magnetic anomalies were correlated with anomalies visible on the seabed.

26.4.49 Magnetometry data were provided as .csv files and as a gazetteer detailing all anomalies greater than 5.0 nT. An assessment was made by MSDS Marine as to the suitability of the gazetteer for archaeological interpretation. Where required the .csv magnetometer data were imported into Moga Seaview 6.3 software where the data were smoothed, and a ‘baseline’ identified and removed from the data to highlight ferrous anomalies whilst taking into account geological variations in the data. Magnetic anomalies identified within the data had the position, amplitude, and dimensions recorded. A rating of archaeological potential was assigned to the anomaly following the criteria outlined in **Table 26-8** below. The data were gridded to visually identify areas where the distribution of anomalies may represent a wider feature such a buried but dispersed wreck, or modern features such as buried cable or chain.

Calculation of mass (kg)

26.4.50 The presentation, and categorisation, of magnetic anomalies by amplitude (nT) provides an effective way to gain a broad understanding of the distribution of ferrous material on, or just below, the seabed. However, to understand the data more comprehensively the ferrous mass needs to be calculated which is based on the amplitude and the distance from the magnetometer. However, with a line spacing of up to 70 m this is not possible to undertake accurately for anomalies that are not visible on the surface or visible on two lines of data, due to the potential distance of an anomaly from the magnetometer ranging from the altitude to the slant range of 50% of the line spacing (50.0 m range is equal to 50.6 m slant range at 7.5 m altitude).

26.4.51 Therefore, all calculations of mass are made using the assumption the anomaly lies directly below the magnetometer, with the distance used for the calculation being equal to the recorded altitude of the magnetometer. Furthermore, calculations are made assuming an anomaly ratio of 1:1. One block of data (EGL 3 Block 08) was missing data recording the altitude of the sensor. An arbitrary altitude of 3.5 m was assigned to these data, derived from the average sensor height in other inshore blocks.

Table 26-8 - 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; or 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, or 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

26.4.52 Whilst the interpretation of the palaeolandscape is based upon the archaeological review of geophysical and hydrographic data, the method of assessment, the assessment criteria and the best practice mitigation strategies differ from those presented in the preceding sections and thus it is detailed separately for clarity.

26.4.53 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 a combination of Parametric and Sparker SBP. Parametric SBP uses a high frequency to produce high resolution data with shallow penetration, whilst the Sparker uses lower frequency to achieve greater penetration, but at a slightly lower resolution.

26.4.54 Sedimentary units have been identified within the seismic data based on their seismic character and likely depositional environment and tentatively correlated with known geological formations in the area, where possible.

26.4.55 Sedimentary unit grids and geological maps derived from the interpretation of surface and sub-surface data were assessed alongside existing studies contributing to the understanding of the palaeolandscape and prehistoric archaeological potential within the region. An archaeological review of the geophysical survey assessment was undertaken by MSDS Marine. This included a review of geophysical survey data reports and raw seismic profiles, including mapped horizons and grids.

26.4.56 Where possible, this assessment has attempted to correlate the results of the project-specific geophysical surveys within the recognised regional geological interpretations of the North Sea presented by the BGS. Such correlations are tentative and would require further examination and integration with the results of ground truthing surveys to confirm.

26.4.57 The results of preliminary geotechnical investigations have also been reviewed and correlated with the seismic data to refine interpretations, where possible and tentatively, and to feed into the archaeological assessment.

26.4.58 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.

26.5 Overall baseline

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

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

26.5.2 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 3.26.B: Gazetteer of UKHO and Heritage Records**).

Chronology

26.5.3 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 2,666 years ago and a date of 1066 AD occurred 959 years ago (correct as of 2025);

- Calibrated radiocarbon dates: these can either be presented as calendar dates or as the number of years before 1st 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 11,775 years ago (correct as of 2025) 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.

26.5.4 This assessment would 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

26.5.5 The main archaeological periods discussed in England are listed in **Table 26-9** and are derived primarily from HE's interpretation of prehistoric and historic periods (Historic England, 2025, REF 26.20).

26.5.6 The Quaternary chronology of the UK is outlined in **Table 26-10**. Marine Isotope Stages (MIS) are alternating warm and cold periods derived from oxygen isotope data taken from deep sea core samples.

Table 26-9 - 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

Archaeological period	Sub-period	Dates
	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 26-10 - Later Quaternary Chronology Based on (Marshall, 2020, REF 26.21) and (Lisiecki, 2005, REF 26.22)

Stage Main	Stage Sub.	Age (ka BP) Start	Age (ka BP) End	Climate	Marine Isotope Stage	Geo. epoch	Sub. epoch	Archaeological period
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			Middle Palaeolithic
	Early	300	243	Stadial?	8			

Stage		Age (ka BP)		Climate	Marine Isotope Stage	Geo. epoch	Sub. epoch	Archaeological period
Main	Sub.	Start	End					
	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

Summary of heritage assets

26.5.7 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 26.4**.

Designated heritage assets

26.5.8 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.

26.5.9 No offshore or onshore designated heritage assets lie within the study area.

Non-designated heritage assets

26.5.10 Non-designated heritage assets comprise assets often of regional or local importance. Whilst they have the potential to contribute to understanding of the past, they have not been considered of the highest value to be formally designated under national policy.

26.5.11 One hundred and seven (107) UKHO records lie within the study area, comprising:

- Fourteen (14) records up to 12 NM:
  - Eleven (11) wrecks or possible wrecks;
  - Two (2) foul ground;
  - One (1) debris;
- Ninety-three (93) records beyond 12 NM:
  - Sixty (60) wrecks or possible wrecks;
  - Twenty-nine (29) foul ground;
  - One (1) aircraft record; and
  - Two (2) possible boulders; and
  - One (1) debris.

26.5.12 The NRHE holds 39 records within the study area, comprising:

- Ten (10) offshore wreck records (all correlating with UKHO records, though the UKHO record for one is situated 15 km west from the NRHE record);
- Four (4) foul ground records (all correlating with UKHO records, though the UKHO record for one is situated beyond the study area);
- Thirteen (13) intertidal sites, monuments or findspots (including one (1) wreck, correlating with a CITiZAN record);
- Six (6) terrestrial sites, monuments or findspots (above MHWS);
- Four (4) documented loss records;
- One (1) offshore record relating to the recovery of two pieces of peat; and
- One (1) record relating to multi-period finds at Wold Farm (likely incorrect location data).

26.5.13 The Canmore database holds ten (10) records within the study area (beyond 12 NM only), comprising:

- Five (5) wrecks (all relating to UKHO records); and
- Five (5) documented losses (with no corresponding UKHO record).

26.5.14 The Lincolnshire HER holds the following records for the intertidal and terrestrial elements of the study area:

- Seven (7) artefact findspots; and
- Four (4) structures (sites of former structures or existing).

26.5.15 The CITiZAN database holds 57 records within the study area, comprising:

- Twenty-five (25) records within the intertidal zone (including one (1) wreck correlating with an NRHE record); and
- Thirty-two (32) terrestrial records for sites or artefact findspots.

26.5.16 Archaeological review of the geophysical and hydrographic data identified 1,303 surface anomalies of potential archaeological interest, comprising:

- Three (3) high potential anomalies;
- Twenty-three (23) medium potential anomalies; and
- One thousand, two hundred and seventy-seven (1,277) low potential anomalies.

26.5.17 Furthermore, a total of 14,928 magnetic anomalies, of which 8,135 are over 5.0 nT and do not correlate with known, or visible, features or infrastructure, were also identified.

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

- **Volume 3, Part 3, Figure 26-2: UKHO records (1 of 5);**
- **Volume 3, Part 3, Figure 26-3: UKHO records (2 of 5);**
- **Volume 3, Part 3, Figure 26-4: UKHO records (3 of 5);**
- **Volume 3, Part 3, Figure 26-5: UKHO records (4 of 5);**
- **Volume 3, Part 3, Figure 26-6: UKHO records (5 of 5);**
- **Volume 3, Part 3, Figure 26-10: Distribution of archaeological anomalies;**
- **Volume 3, Part 3, Figure 26-11: Distribution of high potential archaeological anomalies;**
- **Volume 3, Part 3, Figure 26-12: Distribution of medium potential archaeological anomalies;**
- **Volume 3, Part 3, Figure 26-13: Distribution of low potential archaeological anomalies;** and
- **Volume 3, Part 3, Figure 26-37: Distribution of magnetic anomalies by amplitude (nT);**
- **Volume 3, Part 3, Figure 26-38: Distribution of magnetic anomalies by mass (kg);** and
- **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area.**

26.5.19 A full list of the same records/anomalies is presented within **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**.

Palaeolandscape Assessment and Submerged Prehistory

Introduction

26.5.20 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 26-9, Table 26-10**) 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.

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

26.5.22 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) (Cameron, 1992); and
- The geology of the central North Sea (55° N to 58° N – only up to 57° 30’ N west of 0°) (Gatliff, 1994).

26.5.23 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 3 and EGL 4 and reviewed for this assessment. These reports are listed in **Section 26.4.13**.

26.5.24 The geologic discussion within this Section has been primarily guided by review of the preliminary interpretations of site-specific geophysical and geotechnical data, presented by the reports listed above. 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 geophysical data.

26.5.25 As such, the scope of each of the reports has guided the presentation of the discussion of this Section:

- EGL 3 Nearshore: Blocks B006, B013, B015-016, B018-20, B023, B025-026, B028-031 (KP 0-85);
- EGL 4 Nearshore: Blocks B004, B011/A, B014, B016-018, B021-022 (KP 0-43);
- EGL 3 Offshore: Blocks B036-068 (KP 85-436); and
- EGL 4 Offshore: Blocks 1, 3-4, 8-42, MCZ1-MCZ6 (KP 43-422).

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

- EGL 3:
  - Block plan: P2101_EGL3_BLOCKS_POL_20240521_rev00;
  - KPs: P2601_EGL3_KP_ETRS89_UTM30N_Rev9;
- EGL 4:
  - Block plan: 5728_Offshore_Line_PlanV6.1-block_definitions; and
  - KPs: P2602_EGL4_KP_ETRS89_UTM30N_Rev11.

Pre-Quaternary bedrock

26.5.27 BGS mapping of the bedrock within the study area can generally be categorised as chalk-dominated; mudstone, gypsum-stone and sandstone; or complex. The southern section (and smaller sections further north) and northward branch of the EGL 3 Project are chalk dominated (Chalk Group). The northwest branch of the EGL 4 Project is dominated by broadly north-south aligned bands of Triassic sandstone and Permian mudstone and gypsum-stone. The central section of the EGL 3 Project and the EGL 4 Project traverses a range of geologies, summarised below:

- Cromer Knoll Group (mudstone, sandstone and tuff; or siliciclastic, argillaceous rock);
- Humber Group (mudstone and limestone; or siliciclastic, argillaceous rock with sandstone and limestone);
- Permian and Triassic rocks (mudstone, sandstone and halite);
- Kimmeridge Clay Formation (mudstone);
- Corallian Group (limestone);

- Oxford Clay Formation (mudstone);
- West Sole Group (sandstone and mudstone);
- Lias Group (mudstone and limestone);
- Triassic rocks (siliciclastic, argillaceous rock and sandstone); and
- Palaeocene rocks (mudstone, sandstone and lignite).

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

26.5.29 Geophysical interpretation along the EGL 3 Project (NextGeo, 2024a, REF 26.12) (NextGeo, 2024b, REF 26.13) and EGL 4 nearshore (NextGeo, 2024c, REF 26.16) characterises the bedrock as Permian/Triassic sedimentary bedrock, whereas the EGL 4 Project offshore is more broadly characterised as Mesozoic sandstone, limestone and siltstone (GeoXYZ, 2024, REF 26.17). Throughout the English Offshore Scheme, the bedrock has been identified as Unit 10.

26.5.30 Preliminary geotechnical investigation did not fully penetrate the Quaternary sequence, and the bedrock was therefore not encountered or sampled.

Quaternary deposits

26.5.31 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.

26.5.32 The Quaternary geology of the North Sea is complex, having been influenced by a series of stadials, interglacials and interstadials over the past million years (**Table 26-10**). Archaeological potential for a deposit is therefore attained by correlating several factors, principally:

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

26.5.33 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 (Stoker M. B., 2011, REF 26.23). Equivalency of geological units is described, where applicable, throughout the discussion of Quaternary deposits and in **Table 26-11**.

26.5.34 The interpreted extent of each unit within the Order Limits is subsequently discussed, in relation to the survey blocks. For clarity and reference, the blocks are illustrated by the following figures:

- **Volume 3, Part 3, Figure 26-2: UKHO records (1 of 5)**:
  - EGL 3 Blocks B001 to B026;
  - EGL 4 Blocks 1 to 4;
- **Volume 3, Part 3, Figure 26-3: UKHO records (2 of 5)**:

  - EGL 3 Blocks B026 to B048;
  - EGL 4 Blocks 3 to 16 and MCZ1 to MCZ6;
- **Volume 3, Part 3, Figure 26-4: UKHO records (3 of 5)**:
  - EGL 3 Blocks B046 to B054;
  - EGL 4 Blocks 14 to 24;
- **Volume 3, Part 3, Figure 26-5: UKHO records (4 of 5)**:
  - EGL 3 Blocks B053 to B060;
  - EGL 4 Blocks 23 to 33;
- **Volume 3, Part 3, Figure 26-6: UKHO records (5 of 5)**:
  - EGL 3 Blocks B059 to B068; and
  - EGL 4 Blocks 31 to 41.

Table 26-11 - Identified Geological Units

Unit			Formation	Lithology			Depositional environment	Age
MSDS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		BGS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		
1	1a	U8	Surficial sediments	-	Sand, with gravel in different proportions. Locally containing shells, pebbles or Cobbles/boulders. Occasional clay lenses occur. Potentially mobile sediments.	Sand, gravel and occasional clay, locally containing shells, pebbles, cobbles or boulders.	Marine.	Holocene; MIS 1
2A	1b	U7	St Andrews Bay Member, Forth Formation	West: interbedded sands and clays. East: pebbly muds and shelly sands.	Soft to firm, brown to reddish clay, containing sand and gravel	Sand.	Shallow marine, possibly beach and/or fluviomarine.	Early Holocene; MIS 1
2B	1c				Interbedded sand and clay. Possibly former coastal sandbar.			
2C	Paleochannel	U6	Botney Cut Formation	Upper member: laminated, sporadically pebbly muds. Lower member: stiff diamictons with interbedded sands.	Clays and sands.	Laminated clays and fine sands.	Glaciolacustrine/ glaciomarine. Possibly glacigenic (lower member).	Late Devensian to Early Holocene; MIS 2 to 1

Unit			Formation	Lithology			Depositional environment	Age
MSDS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		BGS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		
2D	1d	U5	Largo Bay Member, Forth Formation	Inshore: muds and silty muds. Offshore: silts and very fine-grained sands, becoming coarser-grained and pebbly seawards, with shell and wood fragments.	Silty, sandy clay, often containing shell fragments, laminated, soft to firm clay, with an occasional gravel component.	Clay with laminae of sand and silt.	Estuarine to offshore marine.	Late Devensian; MIS 2
2E	No equivalent	U4	St Abbs Formation	Weakly laminated muds and silty muds, with sporadic pebbles.	-	Sand and clay, with traces of gravel.	Glaciomarine.	
3	2a	U2	Marr Bank Formation	Sands, with gravelly layers and sporadic wood fragments and clay balls. Muddy sediments to northwest of distribution.	Sand with gravel. Component of firm to stiff clay, with cobbles/boulders.	Firm to stiff clay, with interbedded clays and sand/gravel.	Shallow glaciomarine.	
	2b				Dense sand and gravel. Occasional clay layers/lenses. Cross-laminated relict bedforms similar to sand bars or ridges.			

Unit			Formation	Lithology			Depositional environment	Age
MSDS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		BGS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		
4A	2c		Bolders Bank Formation	Diamictons, with pebble content diminishing to the east.	Bolders Bank Formation: glacial deposit/till. Firm to stiff clay, with sequence of interbedded clays and sandy or gravelly bands.		Sub-glacial/supra-glacial.	
4B	2d	U3	Wee Bankie Formation	Diamiction, with interbeds of sand, pebbly sand and silty clay.	Glacial deposit/till. Unsorted sediment, soft to stiff clay, with interbeds of sand and pebbly sand and layers/lenses of coarse sand and gravel.	Slightly gravelly sand and high-strength, gravelly clay.	Glacigenic.	
5	3	No equivalent	Coal Pit Formation	Upper member: stiff, shell-rich, laminated clay, with scattered pebbles. Lower member: interbedded sand and stiff clay, with shells, pebbles and wood fragments.	Often stratified unit containing usually stiff clay, silt, sand, gravel, pebbles and boulders.	-	Mostly glaciomarine; upper member locally interpreted as intertidal.	Late Wolstonian to Mid-Devensian; MIS 6 to 3

Unit			Formation	Lithology			Depositional environment	Age
MSDS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		BGS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		
6	4a	U1	Egmond Ground Formation	Locally gravelly sands interbedded with silt and clay.	Glacial deposit/till. Unsorted sediment containing usually stiff clay, sand, gravel, pebbles and boulders. The unit is often stratified.	Firm clay, with interbedded sands, fine- to medium-grained sands and gravels.	Temperate, shallow marine.	Hoxnian; MIS 11
7	4d		Sand Hole Formation	Laminated clays.				
8	4		Swarte Bank Formation	Upper member: non-specific marine sediments. Middle member: upward transition from stiff muds to clays. Lower member: stiff diamictons with lenses of coarse-grained sand.			Upward transition from sub-glacial, glaciofluvial, to glaciolacustrine to shallow marine.	Anglian; MIS 12
9	4		Aberdeen Ground Formation	Delta-front facies: sands interbedded with muds. Pro-delta and marine facies: interbedded			Delta-front/pro-delta/nearshore/open marine	Tiglian to Cromerian; MIS 100 to 13

Unit			Formation	Lithology			Depositional environment	Age
MSDS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		BGS	EGL 3 & EGL 4 nearshore	EGL 4 offshore		
				sand, silt, silty clay and clay. Nearshore facies: channel lag deposits and sub-tidal sands.				
10	5	U0	Bedrock	-	Sedimentary bedrock.	Sandstone, limestone and siltstone.	-	Mesozoic

Unit 1: Surficial sediments

26.5.35 Unit 1 represents the surficial seabed sediments, principally comprising marine sands with varying proportions of gravel and clay, shell, pebble, cobble and boulder inclusions. Acoustically, Unit 1 is generally transparent, displaying some laminations.

26.5.36 These surficial sediments were laid down in marine conditions of the Holocene (MIS 1) and there is evidence of active mobility. Sandwaves also frequently characterise Unit 1.

26.5.37 Interpretation of this Unit for the EGL 3 and EGL 4 nearshore and EGL 3 offshore sections suggest the potential for elements of Unit 1 to comprise Forth Formation sediments (NextGeo, 2024a, REF 26.12) (NextGeo, 2024b, REF 26.13) (NextGeo, 2024c, REF 26.16).

EGL 3 Nearshore

26.5.38 Unit 1 sediments were identified throughout the EGL 3 Nearshore section, with acoustic characteristics indicative of a largely sand composition, with silty sand and gravelly sand elements, generally around 0.5 m thick.

26.5.39 Geotechnical investigation within the EGL 3 Nearshore section penetrated up to *c*. 6 m below seabed (BSB), therefore fully penetrated Unit 1 in many locations. The VC and CPT logs recorded a range of lithologies, including sand, gravel, clay, sand or gravel over clay and interbedded sand and clay (NextGeo, 2025a, REF 26.15).

EGL 4 Nearshore

26.5.40 Unit 1 sediments were identified throughout most of the EGL 4 Nearshore section; in several places it has not been identified but is noted to likely be present as a veneer. Unit 1 exhibits acoustic characteristics indicative of a largely sand composition, with silty sand and gravelly sand elements, generally around 0.5 m thick and thicker in areas of possible sandbanks.

26.5.41 Geotechnical investigation within the EGL 4 Nearshore section penetrated up to *c*. 6 m BSB, therefore fully penetrated Unit 1 in many locations. The VC and CPT logs recorded a range of lithologies, including sand, gravel, clay, sand or gravel over clay and interbedded sand and clay (NextGeo, 2024c, REF 26.16).

EGL 3 Offshore

26.5.42 Unit 1 sediments were identified throughout most of the EGL 3 Offshore section, except where bedrock outcrops were present, such as within Blocks 44 to 46, 48 to 51. The thickness of Unit 1 sediments within the EGL 3 Offshore section ranges from *c*. 0.5 to 12 m BSB.

26.5.43 Geotechnical investigation within the EGL 3 Offshore section penetrated up to *c*. 6 m below seabed (BSB), therefore fully penetrated Unit 1 in many locations. The lithology encountered generally comprised of sand, with occasional chalk and gravel, within the southern and central parts of the draft Order Limits and sand over clay closer to the Scottish Adjacent Waters boundary (NextGeo, 2023, REF 26.14).

EGL 4 Offshore

26.5.44 Unit 1 sediments were identified throughout the EGL 4 Offshore section, varying in thickness and comprised of sand and gravel (in varying proportions), often including shells, pebbles, cobbles and/or boulders and occasional clay. Unit 1 sediments generally occur *c*. 0.5 m thick, increasing to up to 7.5 m within mega ripples, ripples and sandwaves. The general thickness gradually increases further offshore, up to *c*. 2.5 m.

26.5.45 Unit 1 has not been identified northward of KP 222 (considering only English waters of the EGL 4 Offshore section), whereafter Unit 2A characterises the uppermost seabed sediments. Outcrops of Unit 4A, Units 6/8/9 and bedrock interrupt the continuity of Unit 1 prior to KP 222, such as those around KP 142 and 147 and between KP 161 to 166.

Unit 2A: St Andrews Bay Member, Forth Formation

26.5.46 Unit 2A has been provisionally correlated with the St Andrews Bay Member of the Forth Formation. Regionally, offshore deposits of the St Andrews Bay Member comprise interlaminated silts and clays. Where occurring as a channel fill, the composition appears as an upward sequence from gravelly, muddy sands to silty clays (Stoker M. S., 1985, REF 26.24). The Member was laid down during the Early Holocene (MIS 1) in fluvial to marine conditions.

26.5.47 The St Andrews Bay Member generally appears within the nearshore zone north of 55° N. A larger deposit is mapped by the BGS within EGL 3 Blocks B060 to B064, transitioning further northward to Forth Formation (undivided) deposits (Gatliff, 1994, REF 26.25). The upper member of the Botney Cut Formation is broadly equivalent to much of the Forth Formation, mapped south of 56° N and east of 0°.

EGL 3 Nearshore

26.5.48 Unit 2A has been identified within Blocks B019, B023 and B025 of the EGL 3 Nearshore section (considering only English waters), its basal horizon demarcating a series of minor incisions in the underlying Unit 2B, sometimes fully truncating this to incise the unit beneath.

26.5.49 Unit 2A appears up to 1.1 m thick within Block B019. Geotechnical investigation within the EGL 3 Nearshore section penetrated up to *c*. 6 m BSB, therefore potentially fully penetrating Unit 2A in several locations. The VC and CPT logs recorded a range of lithologies, including sand, gravel, clay, sand or gravel over clay and interbedded sand and clay (NextGeo, 2025a, REF 26.15), possibly representing Unit 2A, in part.

26.5.50 Unit 2A within the EGL 3 Nearshore section is more likely to correlate with the Botney Cut Formation, as the St Andrews Bay Member is not used in geologic nomenclature south of 55° N. This interpretation also correlates with the BGS sub-division of the Botney Cut Formation into two members: an upper member comprising sandy and pebbly muds and a lower member comprising diamicton with interbedded sand (Gatliff, 1994, REF 26.25), probably correlating with identified Units 2A and 2B, respectively.

EGL 4 Nearshore

26.5.51 Unit 2A sediments were identified in Block B017 of the EGL 4 Nearshore section, only, adjacent to Block B019 of the EGL 3 Nearshore section. In Block B017, the composition is interpreted as sandy gravel, exhibiting lamination and a maximum thickness of 4.7 m. It is noted here that the acoustic characteristics of Unit 2A are similar to those of the underlying Unit 2B.

26.5.52 Geotechnical investigation within the EGL 4 Nearshore section penetrated up to *c*. 6 m BSB, therefore may have fully penetrated Unit 2A in several locations. For example, VC_663, at KP 14, identified a sequence of clayey/silty sand to 4.3 m BSB, followed by interbedded sandy clay and clayey/silty sand to the maximum penetration at 6 m BSB (NextGeo, 2024c, REF 26.16)

26.5.53 As previously noted, Unit 2A likely correlates with the upper member of the Botney Cut Formation, rather than the St Andrews Bay Member of the Forth Formation, though the upper member Botney Cut Formation is broadly equivalent to much of the Forth Formation (Gatliff, 1994, REF 26.25).

EGL 3 Offshore

26.5.54 Unit 2A sediments were identified within Blocks B037, B038 and northward from Block B057 within the EGL 3 Offshore section, characterised by a discontinuous basal reflector. From Block B057 to B068, Unit 2A appears variably as a blanket-like geometry or infill of minor incisions.

26.5.55 In Blocks B037 and B038, Unit 2A appears at *c*. 12 m BSB, beyond the depth of preliminary geotechnical investigations. Within these Blocks, Unit 2A more likely correlates with the upper member of the Botney Cut Formation (see **Section 26.5.50**).

26.5.56 Within the northern part of the EGL 3 Offshore section, Unit 2A is identified closer to the seabed, between *c*. 0.6 to 10 m BSB. Many VC and CPT logs record sand over clay, such as VC_260 (KP 316) which records sandy clay from 0.66 to 2.09 m BSB, the clay element likely relating in part to Unit 2A.

EGL 4 Offshore

26.5.57 Northward from KP 222 (Block 21), Unit 2A occupies the uppermost geologic unit, replacing Unit 1, and is broadly present, except for areas of outcropping bedrock. Unit 2A ranges in thickness from *c*. 0.5 to 6 m.

Unit 2B: St Andrews Bay Member, Forth Formation

26.5.58 Unit 2B sediments have been provisionally correlated with the St Andrews Bay Member of the Forth Formation through initial interpretation of the geophysical survey results. As previously discussed, this Member typically falls under the nomenclature north of 55° N and west of 0°, being broadly equivalent to the Botney Cut Formation further south and east (see **Section 26.5.47**).

EGL 3 Nearshore

26.5.59 Unit 2B sediments within the EGL 3 Nearshore section have been identified within Blocks B019, B020, B023 and B025. Its suggested lithology is interbedded sand and clay, possibly representing former coastal sandbars. Unit 2B lies beneath Units 1 and 2A, often incised by the basal horizon of the latter. Similarly, Unit 2B lies atop till deposits of Unit 4A, separated by an irregular horizon suggestive of a series of earlier incisions.

26.5.60 Within Block B019, a maximum thickness of 2.6 m is demonstrated, and within this Block and Blocks B020 and B023, Unit 2B is presented directly beneath a veneer of Unit 1 sediments. It is therefore likely that Unit 2B elements were encountered by geotechnical investigations.

EGL 4 Nearshore

26.5.61 Unit 2B was identified within Blocks B011/A, B017, B018 and B021 of the EGL 4 Nearshore section. Its thickness is not identifiable across these Blocks, where acoustic blanking masks the basal reflector. In consideration of this limitation, the measurable average thickness of Unit 2B is 3.4 to 4.5 m.

26.5.62 Unit 2B is encountered beneath Unit 1, the latter often appearing as a veneer. It is therefore likely that Unit 2B elements were encountered by geotechnical investigations. These deposits have been interpreted as relict sandbars, exhibiting internal reflections suggestive of recurring deposition and erosive events.

EGL 3 Offshore

26.5.63 Unit 2B sediments were identified between Blocks B053 to B064 of the EGL 3 Offshore section, traversing an area mapped by the BGS as outcropping St Andrews Bay Member (Gatliff, 1994, REF 26.25). Unit 2B typically appears beneath Unit 2A sediments and overlying Unit 2D or bedrock.

26.5.64 Unit 2B, in some places, such as within Block B061, appears to subcrop a veneer of Unit 1 sediments and in others appears beyond 1 m BSB, beneath Units 1 and 2A. It is therefore possible that geotechnical investigation encountered Unit 2B, such as within VC_227 (KP 349), which recorded sandy clay with fine gravel from 0.55 to 3.23 m BSB.

EGL 4 Offshore

26.5.65 No sub-division of the St Andrews Bay Member was made within the EGL 4 Offshore section. See **Section 26.5.57** for a description of this Member.

26.5.66 Further analysis of the St Andrews Bay Member within the EGL 4 Offshore section may inform future sub-division, as demonstrated within the EGL 3 Offshore section.

Unit 2C: Botney Cut Formation

26.5.67 The Botney Cut Formation appears as a channel fill, mapped by the BGS as outcropping extensively north of 55° N and east from 0° and less commonly south of 55° N. The Formation is sub-divided into two members: a lower member of stiff diamicton with interbedded sand and an upper member of soft to firm, sandy and pebbly muds (Gatliff, 1994, REF 26.25).

26.5.68 Each member relates to a distinctive phase of the Formation's development. The lower member comprises till of the Late Devensian, is equivalent to the Wee Bankie Formation (north from 55° N and west from 0°) and has a very similar lithology to the underlying Bolders Bank Formation (Cameron, 1992, REF 26.26). The upper member has Late Devensian to Early Holocene origins and was laid down partly in glaciomarine and glaciolacustrine conditions. The upper member is equivalent to the St Abbs Formation and much of the Forth Formation (north from 55° N and west from 0°).

EGL 3 Nearshore

26.5.69 Unit 2C has been identified within Blocks B006, B013, B015, B016, B019 and B031 of the EGL 3 Nearshore section, as the fill of a series of palaeochannels. Here, Unit 2C sediments are described as glaciolacustrine, glaciomarine and interglacial marine in origin, predominantly comprising clay and sand.

26.5.70 The basal reflector of Unit 2C is interpreted as the channelling event and features steep sides, up to *c*. 5 m deep. A thin layer of Unit 1 is presented atop the Unit 2C deposits, suggesting that the latter may be represented within the preliminary geotechnical results. Two examples of possible representation of Unit 2C within the geotechnical results are as follows:

- VC_680/CPT_680: located at the landward end of Block B006 and on the edge of an identified palaeochannel; principally recorded sand over clay to 4.7 m BSB; and
- VC_593/CPT_593: located within a palaeochannel in Block B016; principally recorded interbedded sand, clay and gravel to 6.07 m BSB.

26.5.71 Unit 2C may be more widely present where preliminary interpretation of the geophysical data has identified St Andrews Bay Member deposits within the EGL 3 Nearshore section (see **Sections 26.5.48** to **26.5.50** and **26.5.59** to **26.5.60**).

26.5.72 Although the identified Unit 2C deposits do not correlate with localised Botney Cut Formation deposits mapped by the BGS, the distribution of the latter does not preclude feasibility of the former.

EGL 4 Nearshore

26.5.73 Unit 2C has been identified within Blocks B004, B014 and B016 of the EGL 4 Nearshore section, as the fill of a series of palaeochannels. See **Sections 26.5.69** to **26.5.72** for further description.

26.5.74 The north-south aligned palaeochannel crossing Blocks B004 (and adjacent B006) reaches up to 5 m BSB and incises the underlying Bolders Bank Formation (Unit 4A).

EGL 3 Offshore

26.5.75 The Botney Cut Formation has not been identified within the EGL 3 Offshore section, correlating with BGS mapping, however, future identification of Unit 2C within this section may not be unlikely.

EGL 4 Offshore

26.5.76 Unit 2C has been identified sporadically in Blocks 1, 3-4, 8-12, and MCZ1 to MCZ6 (KP 43 to 149) and Block 16 (KP 179.5 to 189.5) within the EGL 4 Offshore section, ranging in thickness from 1 to 7 m. The Unit is generally encountered immediately beneath Unit 1 sediments. Although not clarified within the interpretative report, it is assumed that horizon H75 and "IR/channel" features presented by the accompanying charts correlated with Unit 2C and its basal horizon.

26.5.77 This distribution correlates in part with BGS mapping, which illustrates sporadic valleys infilled with Botney Cut Formation sediments south of 55° N, however, the geophysical interpretation places these features further west than the BGS.

26.5.78 The EGL 4 Offshore geophysical interpretation presents the Botney Cut Formation as laminated clays and fine sand, with a well-laminated, parallel bedded acoustic profile, fully or partially infilling a series of glacial valleys (GeoXYZ, 2024, REF 26.17). It is further interpreted as principally comprising glaciolacustrine sediments, with capping glaciomarine sediments atop some infills. Geotechnical investigation may have encountered Unit 2C deposits in CPT_B01_003 (Block 1), as loose to medium dense sand, with closely spaced, thick laminae of clay in the final 0.2 m before termination (5.3 to 5.51 m BSB) (GeoXYZ, 2025, REF 26.19)

Unit 2D: Largo Bay Member, Forth Formation

26.5.79 The Largo Bay Member of the Forth Formation is mapped by the BGS principally within 12 NM, with a widespread presence in the Firth of Forth (including its namesake, Largo Bay, which provided the type section). Inshore deposits generally comprise interbedded muds and silty muds, whereas the offshore deposits comprise silts and very fine sands, with occasional pebbles, shell fragments and, more rarely, wood fragments (Stoker M. S., 1985, REF 26.24).

26.5.80 Largo Bay Member sediments are interpreted as estuarine to offshore marine in origin, dating to the Late Devensian and Early Holocene, spanning a period including the Windermere interstadial and Loch Lomond stadial (*c*. 13,500 to 10,000 BP) (Stoker M. S., 1985, REF 26.24). These are equivalent to the St Abbs Formation, which are in turn equivalent to the Botney Cut Formation.

EGL 3 Nearshore

26.5.81 Unit 2D within the EGL 3 Nearshore section has been provisionally interpreted as possibly relating to the Largo Bay Member of the Forth Formation (NextGeo, 2024a, REF 26.15). Unit 2D has been identified within Block B019, only, overlain by Unit 2B and incised in places by channels infilled with Unit 2A sediments. Geotechnical logs were not available for review for this section, and it is likely that Unit 2D would have only been present at the base of investigations, due to its depth BSB and relatively shallow penetration within this Block (*c*. 2.6 m BSB).

26.5.82 The provisional interpretation of Largo Bay Member deposits here is unusual, as this nomenclature is only used north of 55° N (Block 19 generally lies across 53°20’ N) and the interpreted lithology (silty, sandy clay, often containing shell fragments and clay, with occasional gravel) differs from the BGS description of the Member.

26.5.83 In consideration of the trans-regional equivalency, Unit 2D deposits may likely represent the Botney Cut Formation (see **Section 26.5.80**).

EGL 4 Nearshore

26.5.84 Unit 2D has not been identified within the EGL 4 Nearshore section.

EGL 3 Offshore

26.5.85 Unit 2D within the EGL 3 Offshore section has been identified between Blocks 41 to 68 (and further north beyond the Scottish Adjacent Waters boundary). Its basal horizon varies greatly, exhibiting discontinuity between Blocks (sometimes parallel to the seabed, sometimes suggestive of a channel fill or incision event) and occasionally absent from Blocks within this range. The irregularity of the horizon is apparent from Block 53 northward (north of 55° N).

26.5.86 Although generally interpreted as silty, sandy clay, Unit 2D deposits within the northernmost part of EGL 3 Offshore section are interpreted as medium to high strength clay (Blocks 67 and 68).

26.5.87 An example of Unit 2D sediments in from the geotechnical investigation is presented within CPT_148, in Block B068 (KP 429). The log interprets medium dense to dense sand from 0.75 to 6 m BSB, where the geophysical interpretation charts illustrate a depression up to 6 m BSB filled with Unit 2D sediments. Although this lithology does not correlate with the generalized description of Unit 2D given by the interpretative report, it closely correlates with the BGS description for the Largo Bay Member (see **Section 26.5.79**).

EGL 4 Offshore

26.5.88 Unit 2D has been identified sporadically within Block 25 and Blocks 29 to 42 of the EGL 4 Offshore section (continuing further north beyond the Scottish Adjacent Waters boundary). It ranges in thickness from generally less than 1 m to 2 m, often as a veneer.

26.5.89 Unit 2D is encountered beneath Unit 2A and is interpreted as Late Devensian glaciomarine to marine clay, with laminae of sand and silt.

Unit 2E: St Abbs Formation

26.5.90 The St Abbs Formation is mapped by the BGS largely within 12 NM north of 55° N, comprising soft to stiff, weakly laminated muds and silty muds, with sporadic pebbles and rare sand/silt interbeds, no greater than 20 m in thickness (Gatliff, 1994, REF 26.25)

26.5.91 The St Abbs Formation is equivalent to lower parts of the Forth Formation (Largo Bay and Fitzroy members) and the upper member of the Botney Cut Formation, having been laid down in Late Devensian to Early Holocene glaciomarine conditions.

EGL 3 Nearshore

26.5.92 Unit 2E has not been identified within the EGL 3 Nearshore section.

EGL 4 Nearshore

26.5.93 Unit 2E has not been identified within the EGL 4 Nearshore section.

EGL 3 Offshore

26.5.94 Unit 2E has not been identified within the EGL 3 Offshore section.

EGL 4 Offshore

26.5.95 Unit 2E has been identified within Blocks 32 to 40 of the EGL 4 Offshore section, ranging in thickness from 1 to 9 m and situated between the St Andrews Bay Member (Units 2A and 2B) and Wee Bankie Formation (Unit 4B). Its lithology is interpreted as glaciomarine to marine sand, clay and traces of gravel.

26.5.96 This interpretation differs from both the BGS lithological description of the St Abbs Formation and its mapped distribution (Stoker M. S., 1985, REF 26.24) (Gatliff, 1994, REF 26.25).

Unit 3: Marr Bank Formation

26.5.97 The Marr Bank Formation is mapped by the BGS between 55°50’ to 57°20’ N and 1°55’ W to 0°30’ E, outcropping extensively. The basal reflector within the eastern part of its distribution is noted for becoming discontinuous on its eastward progression, making the Formation acoustically indistinguishable from the upper part of the Coal Pit Formation, into which it locally grades laterally (Gatliff, 1994, REF 26.25).

26.5.98 The Marr Bank Formation has been attributed a Late Devensian date and comprises well-sorted, very fine- to coarse-grained sands, occasionally grading into silt and gravel, laid down in shallow, glaciomarine environments, characterised by high boreal to arctic in temperature and inner shelf to estuarine in character (Thomson, 1978, REF 26.27). Inclusions of clay balls, discrete gravel bands, isolated clasts and wood fragments are suggestive of depositional events such as storms and associated rapid burial (Stoker M. S., 1985, REF 26.24).

EGL 3 Nearshore

26.5.99 Unit 3 has been generally identified as a distinct unit within the EGL 3 Nearshore section, however, no detail of its distribution or specific identification was given by the interpretation report (NextGeo, 2024a, REF 26.12). Herein, it is sub-divided into two facies:

- An upper facies, characterised by sand with gravel, firm to stiff clay, cobbles and boulders; and
- A lower facies, characterised by dense sand and gravel, with occasional clay lenses and cross-laminated relict bedforms similar to sand bars or ridges.

26.5.100 Given the BGS mapping of the Marr Bank Formation, Unit 3 is not likely to occur within the EGL 3 Nearshore section.

EGL 4 Nearshore

26.5.101 See **Section 26.5.99** for a description of Unit 3 within the EGL 4 Nearshore section.

26.5.102 Given the BGS mapping of the Marr Bank Formation, Unit 3 is not likely to occur within the EGL 4 Nearshore section.

EGL 3 Offshore

26.5.103 See **Section 26.5.99** for a description of Unit 3 within the EGL 3 Offshore section.

26.5.104 Given the BGS mapping of the Marr Bank Formation, Unit 3 may occur within Blocks B063 to B068.

EGL 4 Offshore

26.5.105 The Marr Bank and Bolders Bank formations have been merged by the EGL 4 Offshore geophysical interpretation, which may complicate the archaeological assessment of Unit 3. As such, for the purposes of this assessment, these Units have been discussed separately, however, their distribution and lithology as interpreted from the geophysical results cannot be separated.

26.5.106 Furthermore, the Marr Bank Formation has not been identified by the BGS south of 55°50’ N and is not nomenclature used south of 55° N. As the Marr Bank/Bolders Bank formations sediments identified within the EGL 4 Offshore section are not present north of this latitude, these are likely rather to represent Bolders Bank Formation deposits.

26.5.107 Whilst the presence of Unit 3 deposits remains unclear, the BGS mapping suggests that these may be present within Blocks 35 to 40. The initial interpretation of geophysical data identifies a primary concentration of Marr Bank Formation sediments around KP 431 (Block 42) (GeoXYZ, 2024, REF 26.17), just beyond the Scottish Adjacent Waters boundary and beyond the scope of this assessment.

Unit 4A: Bolders Bank Formation

26.5.108 The Bolders Bank Formation is mapped widely by the BGS between 53° and 55° N, west of 2° E. North of 55° N and west of 0° it continues as the Wee Bankie Formation.

26.5.109 The Bolders Bank Formation comprises stiff diamictons, characteristic of a terrestrial or sub-glacial till of Late Devensian age and is generally no greater than 5 m thick, however, this may extend to 20 m closer to the Lincolnshire coast (Cameron, 1992).

This Formation has experienced widespread erosion and has in some areas been scoured to the underlying bedrock.

EGL 3 Nearshore

26.5.110 Unit 4A has been identified throughout the EGL 3 Nearshore section, in Blocks B006, B013, B015, B016, B019, B020, B023, B025 to B028, B030 and B031, correlating with the widespread mapping of the Bolders Bank Formation in this area by the BGS (Stoker M. S., 1985, REF 26.24) (Lott .G. 1986, REF 26.28) An absence of Unit 4A within the centre of Block B029 correlates with a linear area mapped by the BGS as having been scoured of Bolders Bank Formation deposits.

26.5.111 Unit 4A generally occurs beneath Units 1 and 2B, although it is found to outcrop close to the shore where Unit 1 is absent, e.g. within Block B006. Within this Block, Unit 4A is incised by a north-south aligned palaeochannel (filled by Unit 2C). The full depth of Unit 4A is masked by a seabed multiple.

26.5.112 Two internal horizons within Unit 4A were provisionally identified within the EGL 3 Nearshore section. These are suggestive of varying lithologies within the Unit and raise the potential for further sub-division. The upper facies is interpreted as containing a greater proportion of sandy sediments, with a higher potential for cobbles and boulders.

26.5.113 Within Block B031 (and further north into the EGL 3 Offshore section), “Reflector 2”, as shown by the alignment sheet charts, may indicate this internal reflector, however, it may alternatively illustrate the basal horizon of Unit 4A. Client-provided GIS shapefile data illustrates Reflector 2 within Blocks B020, B023 and B025 to B030, however, alignment sheet charts for Blocks prior to B031 were not available. Correlation between the two datasets, therefore, was not possible at the time of writing. Reflector 2 is discussed in further detail in regard to the EGL 3 Offshore section, below.

26.5.114 As a unit close to the seabed throughout parts of the EGL 3 Nearshore section, Unit 4A has been encountered through the preliminary geotechnical survey. For example, within Block B006, CPTs 680, 679 and 598 encountered an uppermost layer of gravelly sand, *c*. 0.3 m thick, atop sandy/gravelly clay to the maximum depth of penetration (*c*. 6 m BSB), the latter lithology likely representing Unit 4A.

EGL 4 Nearshore

26.5.115 Unit 4A has been identified widely throughout the EGL 4 Nearshore section, within Blocks B004, B014, B016, B021 and B022. The Quaternary sequence and lithological description of the Unit is the same as within the neighbouring EGL 3 Nearshore section (see **Sections 26.5.110** to **26.5.114**).

EGL 3 Offshore

26.5.116 The geophysical interpretation of Unit 4A within the EGL 3 Offshore section describes its lithology as firm to stiff clay, with a sequence of interbedded clays and sandy or gravelly bands, correlating with the Bolders Bank Formation (NextGeo, 2024b, REF 26.13). No further discussion is presented within the report. Further analysis for the purposes of this assessment was made using GIS data deliverables and alignment sheet charts, where possible.

26.5.117 Unit 4A is linked partly to Reflector 2, illustrated in Blocks B036 to B038 and B039, up to KP 99 (Block B039), of the EGL 3 Offshore section. Unit 4A appears much more widely than suggested by Reflector 2, however, appearing in the alignment sheet charts further north up to and including Block B043. This discrepancy may demonstrate the difficulty in defining Reflector 2 further north and the acoustic similarity between Unit 4A and the underlying unit(s). The location at which Unit 4A is last identified on the alignment sheet charts (KP 114.5) correlates with the start of an area of absence of Bolders Bank Formation mapped by the BGS. Recurrence of the Formation further north, as mapped by the BGS, may fall within an area of difficulty discerning Unit 4A within the seismic data.

26.5.118 Reflector 2 appears on the alignment sheet charts as a gently undulating horizon from KP 85 to 99, parallel to the underlying basal horizon of Unit 6 from KP 87. After KP 101.5, Unit 4A is shown directly overlying the bedrock, demarcated by an irregular horizon. The reflector defining Unit 4A from the underlying bedrock ceases to be picked from KP 133.5, possibly indicating difficulty in picking from the seismic data.

26.5.119 As a frequently outcropping unit and otherwise close to the seabed beneath a thin layer of Unit 1 sediments, Unit 4A has likely been encountered during the preliminary geotechnical survey. For example, VCs 500 to 515 demonstrate a thin layer of shelly sand atop clay, often sandy, to the maximum depth of penetration, the latter likely representing Unit 4A. This stratigraphy and lithology continue further north, supporting the interpretation of Bolders Bank Formation beyond Reflector 2.

EGL 4 Offshore

26.5.120 Within the EGL 4 Offshore section interpretation of geophysical data, the Marr Bank and Bolders Bank formations have been merged, which may complicate the archaeological assessment of Unit 4A.

26.5.121 Unit 4A is mapped throughout the EGL 4 Offshore section, up to KP 222 (Block 21), ranging from less than half a metre to up to almost 10 m. It outcrops frequently and can reach up to 25 m in thickness. After KP 222, the basal reflector of Unit 4A is replaced by that of Unit 4B. This distribution broadly correlates with that of the Bolders Bank Formation, as mapped by the BGS, although this extends to 55° N – further north than interpreted from the geophysical data.

26.5.122 Unit 4A is acoustically characterised by a structureless appearance, with some internal reflectors, comprising firm to stiff clay with interbedded clays and sandy or gravelly bands.

Unit 4B: Wee Bankie Formation

26.5.123 The Wee Bankie Formation is mapped by the BGS as a broad swathe off the northeast coast of England and east coast of Scotland, ranging from 55° N to the north coast of Aberdeenshire (Gatliff, 1994, REF 26.25). It is overlain in the Firth of Forth by the St Abbs Formation and offshore partly by the Marr Bank Formation, although the Wee Bankie Formation outcrops frequently elsewhere.

26.5.124 The Wee Bankie Formation is interpreted as a basal till, laid down beneath glaciers of the Late Devensian. The Formation generally comprises very fine- to coarse-grained sands, occasionally grading into silty and gravelly lithologies and may also contain shell fragments and lithic clasts (Stoker M. S., 1985, REF 26.24). Tills of the Wee Bankie Formation are equivalent to those of the Bolders Bank Formation.

EGL 3 Nearshore

26.5.125 Unit 4B has not been identified in the EGL 3 Nearshore section. Bolders Bank Formation deposits (Unit 4A) have been identified herein, equivalent to Unit 4B.

EGL 4 Nearshore

26.5.126 Unit 4B has not been identified in the EGL 4 Nearshore section. Bolders Bank Formation deposits (Unit 4A) have been identified herein, equivalent to Unit 4B.

EGL 3 Offshore

26.5.127 Unit 4B has not been identified in the EGL 3 Offshore section. Bolders Bank Formation deposits (Unit 4A) have been identified herein, equivalent to Unit 4B.

EGL 4 Offshore

26.5.128 Unit 4B has only been identified within the EGL 4 Offshore section north of KP 222 (Block 21). South of this point is its equivalent: Unit 4A (see **Section 26.5.121**). Unit 4B has been mapped continuously north of KP 222, up to and beyond the Scottish Adjacent Waters boundary, correlating largely with the mapping of the Wee Bankie Formation by the BGS.

26.5.129 Unit 4B infrequently outcrops and in other places is covered only by a thin layer of Unit 2A or 2B deposits. An example is presented by CPT_158, undertaken at KP 383 (Block 38), recording 0.7 m of medium dense to dense sand (likely Unit 2A or 2B) atop dense to very dense sand, recorded to the maximum penetration depth (6.02 m BSB) (GeoXYZ, 2025, REF 26.19). The dense sand likely represents Unit 4B.

Unit 5: Coal Pit Formation

26.5.130 The Coal Pit Formation occurs widely across the central North Sea, outcropping infrequently west of 0° and much more commonly to the east. It has been interpreted as a Late Wolstonian to Mid-Devensian glaciomarine formation and has been sub-divided into upper and lower parts. The lower part generally comprises interbedded sand and stiff clay, with shells, pebbles and wood fragments. The upper comprises laminated, shell-rich clay, with occasional pebbles, which can be locally indistinguishable from Marr Bank Formation sediments (Gatliff, 1994, REF 26.25). Although much of the Coal Pit Formation has been interpreted as glaciomarine in origin, the upper part identified in BGS borehole BH81/27, situated *c*. 6.8 km north of the Scottish Adjacent Wates boundary where this intersects the draft Order Limits offshore, was interpreted as intertidal (Stoker M. S., 1985, REF 26.24).

26.5.131 The Coal Pit Formation ranges in thickness from 10 to 120 m, occurring at its thickest where infilling Wolstonian channels. As the infill of tunnel valleys, the depositional process may be complex, however, a general interpretation describes the basal deposits as glaciogenic in origin, often containing diamictons, whereas later fills are more varied, also exhibiting laminated clays and silts of distal glaciomarine and glaciolacustrine environments (Kirkham, 2024, REF 26.29).

EGL 3 Nearshore

26.5.132 Unit 5 has not been identified in the EGL 3 Nearshore section.

EGL 4 Nearshore

26.5.133 Unit 5 has not been identified in the EGL 4 Nearshore section.

EGL 3 Offshore

26.5.134 Unit 5 has been identified between KP 393 to 407 (Blocks 65 and 66) and KP 416 to 436 (Blocks 67 and 68), continuing further north beyond the Scottish Adjacent Waters boundary. A palaeochannel has been identified between these two interpreted areas of Unit 5 deposits, the fill of which may also represent the Unit.

26.5.135 Unit 5 is not known to outcrop within the EGL 3 Offshore section, however, in areas where it is covered by a veneer of Unit 1 or Unit 2A/2D deposits it can appear closer to the seabed. VCs and CPTs taken within the area of interpreted Unit 5 deposits, however, generally demonstrate a silty, fine-grained sand lithology, with occasional shell fragments: more suggestive of Largo Bay Member sediments (see **Section 26.5.79**). Much of Unit 5 likely lies beyond the depth of penetration of preliminary geotechnical surveys.

EGL 4 Offshore

26.5.136 Unit 5 has not been identified in the EGL 4 Offshore section. It is possible that Unit 5 deposits are situated beneath the depth of interest and therefore were not interpreted.

Unit 6: Egmond Ground Formation

26.5.137 The Aberdeen Ground, Egmond Ground and Swarte Bank formations have been grouped by each of the geophysical data interpretative reports into a single “unit”. Acoustically, these three formations have demonstrated similar characteristics: the Aberdeen Ground and Egmond Ground formations both display strong, even, parallel reflectors and the principal part of the Swarte Bank Formation exhibits parallel to sub-parallel reflectors, hence the grouping. The basal elements of the Swarte Bank Formation, however, are characterised by chaotic reflectors (GeoXYZ, 2024, REF 26.17)

26.5.138 For the purposes of this assessment, the formations are examined individually.

26.5.139 The Egmond Ground Formation comprises fine- to medium-grained sands and gravels, laid down in marine environments of the Hoxnian interglacial (MIS 11), measuring < 20 m thick. The BGS maps the Egmond Ground Formation as a group of amorphous bodies west of 2° E and more contiguous further east (Cameron, 1992, REF 26.26).

EGL 3 Nearshore

26.5.140 Unit 6 within the EGL 3 Nearshore section has been broadly interpreted as glacial till, comprising unsorted stiff clay, sand, gravel, pebbles and boulders. Further investigation of the Unit would likely result in a clearer lithological definition from nearby glacial deposits.

26.5.141 The Egmond Ground Formation has been identified within Blocks B026 to B032, underlying Unit 4A. The basal horizon atop the bedrock has been interpreted within Blocks B027 to B030, suggesting a thickness of 2 to 10 m. The BGS maps the Egmond Ground Formation within Blocks B023 and B025 to B031 (Cameron, 1992, REF 26.26), correlating partly with the geophysical interpretation.

EGL 4 Nearshore

26.5.142 Unit 6 has not been identified within the EGL 4 Nearshore section, although BGS mapping of the Egmond Ground Formation suggests such deposits may be present from KP 43 to 77(Cameron, 1992, REF 26.26).

EGL 3 Offshore

26.5.143 Unit 6 was identified within Blocks B036 to B039 of the EGL 3 Offshore section. Although not directly correlating BGS mapping (Cameron, 1992, REF 26.26), the identified areas lie between two spreads of mapped Egmond Ground Formation deposits.

EGL 4 Offshore

26.5.144 Interpretation of the geophysical data acquired within the EGL 4 Offshore section has not separated the Egmond Ground, Aberdeen Ground and Swarte Bank formations. For the purposes of this assessment, provisional distinction has been made between these formations primarily on the basis of BGS mapping.

26.5.145 The combined “unit” was identified from KP 42.5 to 114, around KP 151, sporadically between KP 195 and 219 and continuously from 219 to 285. The thickness ranges from 3.5 to 11 m and overlies the bedrock. In line with the BGS mapping, the deposits between KP 42.5 to 77 most likely correlate with the Egmond Ground Formation, although this may extend further north than previously mapped.

26.5.146 As the Egmond Ground Formation is a rather concise unit, the Swarte Bank Formation is sporadic and sparse west of 1° E and the Aberdeen Ground Formation not mapped (nor in geological nomenclature) south of 55°30’ N, it is unclear how provisional correlation between these formations and the geophysical data has been made across much of the EGL 4 Offshore section. It is possible that reassessment of the seismic data and consideration of the Egmond Ground Formation as a standalone unit would allow further refinement of its distribution.

Unit 7: Sand Hole Formation

26.5.147 The Sand Hole Formation is mapped by the BGS as a concise infill of the Silver Pit, from just within 12 NM of the Lincolnshire coast to almost 1° E. The acoustic signature of the Sand Hole Formation is very similar to much of the Swarte Bank and Egmond Ground formations, below and above it, respectively: closely spaced, parallel and even reflectors (Cameron, 1992, REF 26.26)

26.5.148 The Sand Hole Formation comprises laminated clays understood to have been laid down in warm, shallow, sheltered marine environments of the Early Hoxnian (Fisher, 1969, REF 26.30).

EGL 3 Nearshore

26.5.149 Unit 7 has been identified as a highly localised deposit within the EGL 3 Nearshore section, at the eastern edge of the Silver Pit, from KP 65.5 to 67.5, measuring 2 to 9.5 m thick.

26.5.150 This partly correlates with BGS mapping of the Sand Hole Formation, which suggests associated sediments may be encountered from KP 35 to 74.5. Sediments adhering to the edge of the Silver Pit may, however, only appear as a veneer.

EGL 4 Nearshore

26.5.151 Unit 7 has not been identified within the EGL 4 Nearshore section. The BGS mapping suggests that it may be present between KP 38 and 71.

EGL 3 Offshore

26.5.152 Unit 7 has not been identified within the EGL 3 Offshore section, correlating with BGS mapping.

EGL 4 Offshore

26.5.153 Unit 7 has not been identified within the EGL 4 Offshore section, correlating with BGS mapping.

Unit 8: Swarte Bank Formation

26.5.154 As previously noted, the Swarte Bank Formation has been grouped in the preliminary geological interpretation with the Egmond Ground and Aberdeen Ground formations (see **Section 26.5.137**).

26.5.155 The Swarte Bank Formation represents the earliest unequivocal evidence of ice intrusion into the southern North Sea and fills a series of fan-like valleys principally south of 55° N. These valleys are considered to have formed either through sub-glacial, pressurised meltwater or jökulhlaup events.

26.5.156 The Swarte Bank Formation comprises three identified members. The basal infill is characterised by diamictons, occasionally with lenses of coarse-grained, glaciofluvial sand. The middle member comprises well-stratified, glaciolacustrine muds, with BGS borehole BH79/08, *c*. 106 km east from the Projects, recording an upward transition from lacustrine clays to marine muds. The sporadic upper member comprises marine interglacial sediments (Cameron, 1992, REF 26.26).

26.5.157 The Swarte Bank Formation has been correlated with the Dutch Peelo Formation and attributed a Late Anglian age, or locally an Early Hoxnian age, at the very latest (Gibbard P. e., 1991, REF 26.31).

EGL 3 Nearshore

26.5.158 Unit 8 has not been explicitly identified within the EGL 3 Nearshore section, however, it may be represented within deposits broadly identified as Egmond Ground Formation (see **Section 26.5.141**).

26.5.159 BGS mapping suggests that a localised deposit of Swarte Bank Formation sediments, likely filling a shallow, scaphiform valley, may be encountered from KP 50 to 55, beneath Sand Hole Formation deposits at the base of the Silver Pit (Tappin, 1991, REF 26.32)

EGL 4 Nearshore

26.5.160 Unit 8 has not been identified within the EGL 4 Nearshore section, although BGS mapping of the Swarte Bank Formation suggests such deposits may be present from KP 50.5 to 53 (Cameron, 1992, REF 26.26)

EGL 3 Offshore

26.5.161 Unit 8 has not been explicitly identified within the EGL 3 Offshore section.

26.5.162 BGS mapping also does not illustrate any Swarte Bank Formation deposits within the EGL 3 Offshore section, however, small, filled valleys are shown near to Blocks 31 and 42.

EGL 4 Offshore

26.5.163 As the initial geophysical interpretation did not separate the Swarte Bank, Egmond Ground and Aberdeen Ground formations within the EGL 4 Offshore section, it has only been broadly possible to separate these for the purposes of this assessment using BGS maps.

26.5.164 For a broad description of the distribution of these formations as a grouped “unit”, see **Sections 26.5.144** - **26.5.146**. No deposits have been explicitly identified as Swarte Bank Formation and the BGS mapping does not illustrate any such deposits within the EGL 4 Offshore section (Cameron, 1992, REF 26.26) (Tappin, 1991, REF 26.32((Lott, 1986, REF 26.28)

Unit 9: Aberdeen Ground Formation

26.5.165 Initial interpretation of the Aberdeen Ground Formation has grouped this with the younger Swarte Bank and Egmond Ground formations (see **Section 26.5.137**).

26.5.166 The Aberdeen Ground Formation is mapped widely throughout the central North Sea (north of 55°35’N) by the BGS, equivalent, in part, to the Yarmouth Roads Formation south of 56°N. The Aberdeen Ground Formation was laid down over a long period during the Early to Middle Pleistocene (MIS 100 to 13) and, although dating of the Formation is not fully resolved, the upper parts of the deposit in this region are thought to date to the Middle Pleistocene. The Brunhes-Matuyama (B-M) magnetic boundary, dated to *c*. 780,000 ±5,000 BP, has been identified within the deposit in the central North Sea area, indicating that parts of the Formation post-date this event (Stewart, 2012, REF 26.33) (Stoker M. S., 1983, REF 26.34)

26.5.167 The base of the Aberdeen Ground Formation is associated with a distinctive acoustic reflector considered to correlate with the base of the Quaternary deposits in the central North Sea (Stoker M. B., 2011, REF 26.23) and, like the partly equivalent Yarmouth Roads Formation, covers a period of fluctuating climatic cycles, including warmer and cooler periods. Analysis has demonstrated the presence of clay units with dipping clinoforms, interpreted as evidence of deltaic environments (Buckley, 2014, REF 26.35) Analysis has also shown that sub-aerial conditions may have been present during the later Early Pleistocene, though the Middle Pleistocene was dominated by increasingly glacial conditions.

26.5.168 The muds, pebbles and sandy sediments of the upper Aberdeen Ground Formation are thought to have been deposited in glacial environments of the Cromerian complex (Vaughan-Hirsch, 2017, REF 26.36) Cold water foraminifera identified within this part of the Formation are the product of sub-glacial or pro-glacial environments associated with a tide-water ice sheet. This is the earliest evidence of full glacial conditions in the central North Sea area (Gatliff, 1994, REF 26.25) (Vaughan-Hirsch, 2017, REF 26.36). Four lithofacies have been identified in the upper part of the Aberdeen Ground Formation: sub-glacial facies, proximal glaciomarine facies, distal glaciomarine facies and marine facies - representing a series of different depositional environments during the Early to Middle Pleistocene (Vaughan-Hirsch, 2017, REF 26.36)

EGL 3 Nearshore

26.5.169 Unit 9 has not been identified within the EGL 3 Nearshore section. This correlates with BGS mapping and standard geological nomenclature. The westernmost edge of the Yarmouth Roads Formation, partial equivalent of the Aberdeen Ground Formation, is mapped *c*. 7.5 km east from Block 31(Cameron, 1992, REF 26.26)

EGL 4 Nearshore

26.5.170 Unit 9 has not been identified within the EGL 4 Nearshore section. This correlates with BGS mapping and standard geological nomenclature. The westernmost edge of the Yarmouth Roads Formation, partial equivalent of the Aberdeen Ground Formation, is mapped *c*. 10 km east from Block MCZ3 (Cameron, 1992, REF 26.26)

EGL 3 Offshore

26.5.171 Unit 9 has not been identified within the EGL 3 Offshore section (in English waters). BGS mapping illustrates Aberdeen Ground Formation deposits from KP 351 to 436, continuing northward past the Scottish Adjacent Waters boundary.

EGL 4 Offshore

26.5.172 In consideration of the geological nomenclature, the Aberdeen Ground Formation was provisionally interpreted from the geophysical data to be present from KP 222, north of a bedrock outcrop (GeoXYZ, 2024, REF 26.17) This position lies far south of the most southerly Aberdeen Ground Formation sediments mapped by the BGS (55°30' N). The Yarmouth Roads Formation, partly equivalent to the Aberdeen Ground Formation, is mapped south of 55°N, though the western edge of its distribution lies *c*. 54 km east from KP 222 (Cameron, 1992, REF 26.26).

26.5.173 Unit 9 is broadly interpreted as stiff clays interbedded and interlaminated with silty sands, laid down in an inner shelf environment, present within the EGL 4 Offshore section as subcrops varying in thickness up to *c*. 50 m. From KP 222 to 285, the thickness of Unit 9 varies considerably, and the basal horizon exhibits a highly irregular thalweg, up to 13 m BSB.

Geomorphology

Glaciations

26.5.174 The known history of hominin occupation of Britain is marked by three main stages of glaciation: the Anglian (478,000 to 424,000 BP; MIS 12), the Wolstonian complex (374,000 to 123,000 BP; MIS 10 to 6) and the Devensian (109,000 to 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 (Lamb, 2017, REF 26.37) (Lauer, 2018, REF 26.38) and the latter generally precedes known hominin occupation of Britain.

26.5.175 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 (Batchelor, 2019, REF 26.39) ((Hughes, 2016, REF 26.40) (Gibbard P. a., 2011, REF 26.41).

26.5.176 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 (Hughes, 2016, REF 26.40)

26.5.177 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, Part 3, Figure 26-7: Glacial extents**.

Glacial geology

26.5.178 The Swarte Bank Formation, possibly present locally within the study area as Unit 8, 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 to the Anglian-era geological deposits and landforms.

26.5.179 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. Glacial till dating to the Wolstonian has not been identified, however, lower parts of the Coal Pit Formation (of Wolstonian age and possibly represented within the study area by Unit 5) are attributed to glaciomarine environments. Similar to Anglian deposits, it is likely that Wolstonian deposits have been extensively eroded by Devensian glacial activity and hydrodynamic processes.

26.5.180 The Devensian glaciations are the best understood and most widely studied of the Pleistocene glaciations, particularly the Dimlington (29,000 to 14,700 BP) and Loch Lomond (12,900 to 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 (Gibbard P. e., 1991, REF 26.31). 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) RSL of -17.85 m (AA34281; **Volume 3, Part 3, Figure 26-9: Sea level model**; **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**), indicative of seawater locked up in glacial ice.

26.5.181 Units 2C, 2D, 2E, 3, 4A, 4B and 5 are partly or wholly attributable to Devensian glacial processes.

Glacial landforms

26.5.182 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.

26.5.183 The EMODnet geological database (EMODnet Map Viewer, 2025, REF 26.42) maps a series of tunnel valleys, glacial meltwater channels and fluvial channels both within the study area and nearby, illustrating the impact and aftereffects of glacial ice on the subsea landscape (**Volume 3, Part 3, Figure 26-8: Sub-seabed geomorphology**). The largest tunnel valley is represented by the Silver Pit, crossing Blocks B028, B029 and MCZ1.

26.5.184 The EMODnet data also illustrates moraine formations in parts of the study area.

EGL 3 Nearshore

26.5.185 Blocks B028 and B029 of the EGL 3 Nearshore section transects the Silver Pit, a Devensian tunnel valley formed beneath glacial ice and/or from a jökulhlaup (Wingfield, 1990, REF 26.43). The Silver Pit and associated deposits have been identified within the geophysical data. A parallel fluvial channel crosses Block B030.

26.5.186 A broadly east-west aligned band of moraines is mapped approximately along 53°30’ N, crossing Blocks B013, B018, B020 and B023. These features may indicate the southernmost extent of the British-Irish ice sheet during the LGM and are bisected by a fan-like arrangement of tunnel valleys and fluvial channels, including the Silver Pit, likely formed during glacial retreat and comprise Unit 4A sediments.

EGL 4 Nearshore

26.5.187 A moraine crosses Block B011/A, also crossing several Blocks of the EGL 3 Nearshore section (see **Section 26.5.186)**.

EGL 3 Offshore

26.5.188 A fluvial channel is shown crossing Block B036, continuing southward to cross Blocks MCZ3 and B030. A glacial meltwater channel is illustrated across Block B049.

26.5.189 A series of northeast-southwest aligned moraines crosses Block B055 and either side of Block B053. These may illustrate readvance limits of Devensian glaciers and likely comprise Unit 4B sediments.

EGL 4 Offshore

26.5.190 Fluvial channels are mapped by EMODnet crossing Blocks 3, 8, 11, 12, MCZ3 and MCZ4. The Silver Pit crosses Block MCZ2 and glacial meltwater channels across Blocks 18, 38, 39 and either side of Block 40 and 41.

26.5.191 A series of northeast-southwest aligned moraines lies either side of Blocks 27 to 30 (see also **Section 26.5.189).** The northernmost part of the EGL 4 Offshore section traverses a sub-seabed landscape characterised by a complex of moraines and glacial meltwater channels, likely associated with a Devensian glacial readvance. Moraines are shown crossing Blocks 31, 32, 40 and 41, likely comprising Unit 4B sediments and possibly unidentified elements of Unit 3.

Sea level data

26.5.192 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.

26.5.193 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.

26.5.194 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 (Bagge, 2021, REF 26.44). The British-Irish ice sheet developed outward from the Scottish Highlands during the Dimlington stadial (29,000 to 14,700 BP), extending as far south as the Norfolk coast and the Western Approaches (**Volume 3, Part 3, Figure 26-7: Glacial extents**). Northern parts of Britain were therefore subject to greater depression and rebound, which are to be expected within the RSL record.

26.5.195 Shennan *et al*. (Shennan I. B., 2018, REF 26.45) 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 offshore and onshore 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.

26.5.196 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) (Cohen, 2021, REF 26.46). The WALIS data points are rated qualitatively, each for the RSL data and dating, ranging from 'very poor' to 'excellent'.

26.5.197 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 26-9: Sea level model**). A gazetteer of the sub-sample is included as **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**. These SLIPs range in date from <231,000 to 990 BP (MIS 7 to 1).

26.5.198 Modelling of palaeo-coastlines have applied RSL data to illustrate the development of offshore boundaries, such as the model produced by Brooks *et al*., (Brooks, 2011, REF 26.47). This model, reproduced in part by **Volume 3, Part 3, Figure 26-9: Sea level model**, demonstrates the Flandrian marine transgression of the Late Devensian and Early Holocene, concurring largely with the results of Shennan *et al*. (Shennan I. B., 2018, REF 26.45) although based partly on the results of the same team's earlier studies (Shennan I. B., 2006, REF 26.48).

26.5.199 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 to 4°C, with stadials lasting longer than interglacials (Lauer, 2018, REF 26.38). 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 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 26-9: Sea level model**; **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**). 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 26-9: Sea level model**; **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**), 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.

26.5.200 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, Part 3, Figure 26-9: 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 3.26.B: Gazetteer of UKHO and Heritage Records**). 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 (Long, 2011), the study has attributed this SLIP poor RSL quality and good dating quality (Cohen, 2021).

26.5.201 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.

26.5.202 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).

26.5.203 MIS 5e is understood to be characterised by global mean temperatures of *c*. 1.5°C warmer than present and polar temperatures 3 to 5°C warmer (Rovere, 2016, REF 26.49) resulting in widespread higher RSL and marine inundation of the North Sea, similar to, or perhaps slightly greater, than at present (Streif, 2004, REF 26.50) (Rohling, 2009, REF 26.51). 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).

26.5.204 No SLIPs or limiting points examined were dated to MIS 4 to 3. The database used by Shennan *et al*. (Shennan I. B., 2018, REF 26.45) 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).

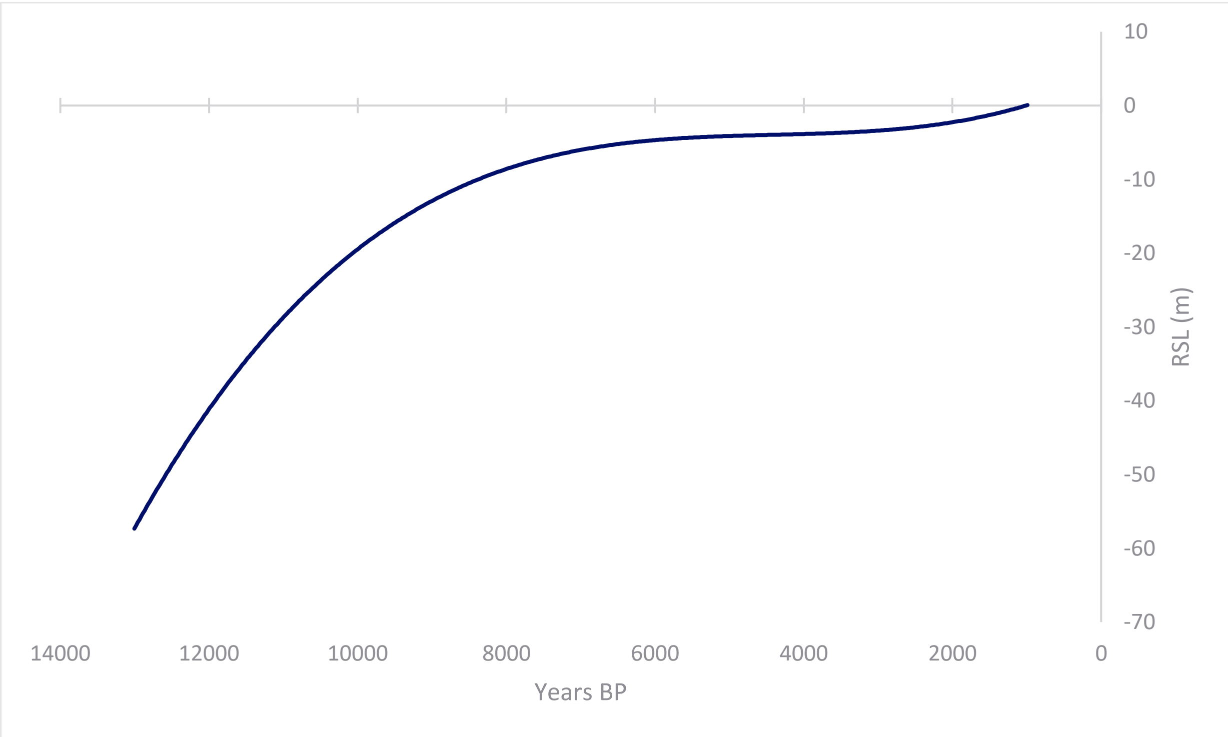
26.5.205 Palaeo-coastline modelling produced by Brooks *et al*. (Brooks, 2011, REF 26.47) demonstrates a broad pattern of falling RSL in the central North Sea. In English waters, some localised fluctuation of RSL is demonstrated between 18,000 to 16,000 BP, although this is not expressed as significant marine transgression of the southern North Sea landscape (**Volume 3, Part 3, Figure 26-9: Sea level model**).

26.5.206 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 from 12,289 to 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 to 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.

26.5.207 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 between 13,267 to 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 26-9: Sea level model**.

26.5.208 The sea level curve shown by **Plate 26-1** 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) (Shennan I. B., 2018, REF 26.45). The SLIP data ranges from *c*. 13,000 to 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 (Benn, 2021, REF 26.52).

Plate 26-1: Sea Level Curve for the East Coast of England (Based on Shennan et al. 2018)



26.5.209 The northern section of the study area (KP 209 to the Scottish Adjacent Waters boundary) is shown to have been inundated by *c*. 16,000 BP (**Volume 3, Part 3, Figure 2-9: 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 (Gaffney, 2009, REF 26.53). This landscape was eventually inundated between 10,000 to 8,000 BP, with two key phases of sea level increase identified around 8,440 ±410 BP and 8,220 ±650 BP (Hijma M. a., 2019, REF 26.54). 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

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

26.5.211 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.

26.5.212 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 (Hosfield, 2004, REF 26.55)

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

26.5.213 The Lower and Middle Palaeolithic span most of the known human history of the British Isles (*c*. 970,000 to 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*.

26.5.214 The oldest postulated Quaternary geological unit within the study area is the Aberdeen Ground Formation (Unit 9). This Formation was laid down through a range of Pleistocene environmental conditions (MIS 100 to 13). The earliest hominin evidence in Britain was derived from the Cromer Forest Beds Formation, the onshore equivalent of the Yarmouth Roads Formation, which is coeval, in part, with the Aberdeen Ground Formation (Ashton, 2014, REF 26.56). The Cromerian Complex (MIS 21 to 13) is relatively poorly understood in terms of climatic cycles and it is therefore unclear if periods of sub-aerial exposure of the Aberdeen Ground Formation coincided with both suitable conditions and hominin presence in Britain.

26.5.215 Correlation of Unit 9 with the Aberdeen Ground Formation had not been confidently ascertained by the time of writing and further geotechnical investigation of this Unit would be required. Furthermore, the Aberdeen Ground Formation comprises several facies, each a product of a particular depositional environment and conditions. With the current limited understanding of Unit 9, it is not possible to postulate the archaeological or palaeoenvironmental potential.

26.5.216 The Swarte Bank Formation is represented within the study area by Unit 8. As this Formation was grouped with the Aberdeen Ground and Egmond Ground formations in initial interpretations, it has not been possible to clearly define Unit 8 deposits, where these may occur.

26.5.217 The Swarte Bank Formation formed during the Anglian glacial stage (MIS 12), demonstrating an upward transition from basal or traction till to glaciofluvial or glaciomarine sediments to shallow marine sediments. Glaciation models suggest that much of the study area lay beneath ice during the Anglian, precluding hominin occupation. Glaciomarine environments would likewise have prevented occupation. There may have been a phase, particularly towards the end on the Anglian, where sub-aerial exposure of parts of the study area occurred prior to marine inundation, where glacial meltwater channels traversed a terrestrial landscape, contributing the glaciofluvial element to the Swarte Bank Formation. Such proglacial environments would, however, have been inhospitable, exhibiting arctic to high boreal conditions and temperatures and offering little forage or game to support hominin populations. Unit 8, if present, is therefore considered to have negligible potential for archaeological remains.

26.5.218 Units 6 and 7 represent the Egmond Ground and Sand Hole formations, respectively. These have been identified with some confidence in the EGL 3 Nearshore section only and though postulated to be present elsewhere this remains unclear. Units 6 and 7 were laid down during the Hoxnian interglacial (MIS 11), which, although warmer climatic conditions and evidence from elsewhere in the UK suggest that hominins were present, sea level models suggest MIS had similar or greater RSL than at present (Hijma M. , 2012, REF 26.57). The study area therefore likely lay in an offshore environment, suggesting negligible archaeological potential.

26.5.219 The Coal Pit Formation (Unit 5) has been identified within the northern part of the study area within the EGL 3 Offshore section. Basal elements of this Formation elsewhere within the North Sea have been attributed a Late Wolstonian (MIS 6) date and deposition is understood to have continued throughout the Early and Mid-Devensian (MIS 5d to 3). The literature and geophysical data suggest that the Coal Pit Formation is almost exclusively comprised of glaciomarine sediments – a depositional environment that would preclude hominin occupation.

26.5.220 An upper part of the Coal Pit Formation, as identified in BGS borehole BH81/27, situated *c*. 6.8 km north from the intersection of the EGL 3 Offshore section and the Scottish Adjacent Waters boundary, has been postulated as intertidal or shallow inner shelf sediments, however, this does not raise the archaeological potential.

26.5.221 Despite the overall negligible potential for Lower and Middle Palaeolithic remains in primary contexts, there is a slight potential for remains within secondary contexts. An example of such an occurrence is recorded within the beach of the study area, *c*. 500 m south of Block B006 and comprising a Lower Palaeolithic flint blade (TI_001; TI_012; **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area**).

26.5.222 Units 5, 6, 7 and 8 were laid down in marine or glaciomarine conditions (with consideration to possible variation in Units 5 and 8). As such, these hold a general low to moderate potential for palaeoenvironmental remains which may be used to infer environmental conditions during the formation of the parent unit. Unit 6 has been attributed a moderate potential for palaeoenvironmental remains, in consideration of pollen remains derived from samples elsewhere within the North Sea (Cameron, 1992, REF 26.26)

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

26.5.223 The Upper Palaeolithic (57,000 to 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 to 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) (Higham, 2011, REF 26.58), Dartford (Kent) (Wenban-Smith, 2010, REF 26.59), Gower (Wales) (Dinnis, 2012, REF 26.60) and Creswell (Derbyshire) (Pike, 2005, REF 26.61)

26.5.224 Several units provisionally identified within the study area date to MIS 2, however, these largely indicate depositional environments unsuitable for hominin occupation.

26.5.225 Units 4A and 4B have been provisionally correlated with the Bolders Bank and 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.

26.5.226 Unit 3 has been provisionally correlated with the Marr Bank Formation, although initial interpretation of the geophysical data did not discern between the Marr Bank and Bolders Bank formations and no sediments explicitly interpreted as the Marr Bank Formation have been identified within the study area.

26.5.227 The Marr Bank Formation was laid down in shallow glaciomarine conditions of the Late Devensian (MIS 2), unsuitable for human occupation and therefore indicating a negligible archaeological potential for Unit 3. Wood fragments have been encountered in samples of the Formation, understood to have been introduced to the depositional environment during storm events (Stoker M. S., 1985, REF 26.24). Such remains, alongside the general potential for diatomic and ostracod remains from marine and glaciomarine deposits, may inform our understanding of Late Devensian proximal marine environments and Unit 3 therefore holds a low to moderate palaeoenvironmental potential.

26.5.228 Units 2C, 2D and 2E have been provisionally correlated with the Botney Cut Formation, Largo Bay Member of the Forth Formation and St Abbs Formation, respectively, a series of Late Devensian formations. Unit 2E was laid down in glaciomarine conditions, therefore presenting negligible archaeological potential. The St Abbs Formation has produced ostracod assemblages (Gatliff, 1994, REF 26.25), presenting a low to moderate potential for further palaeoenvironmental evidence within Unit 2E.

26.5.229 Unit 2D was laid down in estuarine to offshore marine environments and much of the associated Largo Bay Member identified across the wider central North Sea is present within 12 NM. The range of depositional environments and age of the Member suggests that it began to be laid down in estuarine environments after the LGM, when ameliorating climatic conditions and watercourses creating those environments would have allowed the development of vegetation and the theoretical supporting of faunal and human populations. Upper elements, however, exhibit a decreasing faunal diversity, reflecting cooling conditions leading up to the Loch Lomond stadial.

26.5.230 Sea level modelling suggests the area of deposition of Unit 2D experienced marine inundation by 18,000 BP, at the latest, and presenting negligible potential for *in situ* evidence of human occupation (**Volume 3, Part 3, Figure 26-9: Sea level model**). The period from 25,000 to 18,000 BP has not yet been attributed to evidence of human activity in Britain and the earliest evidence in Scotland (the principal part of the Largo Bay Member having been mapped in the Scottish nearshore, with a small element off the northeast coast of England) has been attributed a late Upper Palaeolithic date (*c*. 12,000 to 11,500 BP) (Saville, 2009, REF 26.62) The circumstantial evidence therefore suggests a negligible potential for *in situ* archaeological remains within Unit 2D. It is feasible, however, that humans occupied coastal areas featuring estuarine environments within which elements of Unit 2D may have been laid down. There is a very slight potential, therefore, for translocated evidence of human activity to be present within secondary contexts of Unit 2D, although the overall likelihood may be considered low.

26.5.231 Wood fragments derived from the Largo Bay Member demonstrate the potential for palaeoenvironmental remains and estuarine deposits have the potential to contain palaeoenvironmental evidence derived from inland and coastal environments, all of which may improve our understanding of post-LGM North Sea landscapes. Unit 2D therefore has a moderate potential for palaeoenvironmental evidence.

26.5.232 Unit 2C has been provisionally interpreted as the Botney Cut Formation, comprising a glacial till lower member and glaciolacustrine/glaciomarine upper member. As with the till deposits of Unit 4A and 4B, lower elements of Unit 2C are considered to have negligible archaeological and palaeoenvironmental potential. Similarly, the cold, marine depositional environments of the upper part of Unit 2C were not suitable for human occupation and the surrounding terrestrial environments were likely inhospitable during deposition.

26.5.233 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 (University of Birmingham, 2011, REF 26.63).

26.5.234 A negligible overall potential for archaeological and/or palaeoenvironmental remains within till elements of Unit 2C may be considered, whilst a higher low to moderate potential for palaeoenvironmental remains is attributed to glaciomarine/glaciolacustrine elements. The potential of subsequent elements of the Unit is discussed below.

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

26.5.235 The Mesolithic period (11,700 to 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.

26.5.236 It is feasible that Early Holocene elements of Unit 2C may have been laid down in lacustrine and fluvial conditions characterised by warmer climatic conditions. The North Sea Palaeolandscapes Project (NSPP) (University of Birmingham, 2011, REF 26.63) maps the sub-aerial landscape of this period within a southern part of the study area (Blocks B026 and B028 to B031 of the EGL 3 Nearshore section; Blocks B036 to B044 of the EGL 3 Offshore section; and Blocks 3, 4, 8 to 12 and MCZ1 to MCZ6 of the EGL 4 Offshore section.

26.5.237 NSPP mapping illustrates the study area being traversed by a northeast-southwest aligned valley, the Silver Pit (as a large lake) and a series of small watercourses. 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 (Mol, 2003, REF 26.64) and human occupation (Gaffney, 2009, REF 26.53). This recognised human presence suggests a potential for evidence of this to be held within Early Holocene elements of Unit 2C. A moderate potential for archaeological and/or palaeoenvironmental remains is considered.

26.5.238 Units 2A and 2B, both provisionally correlated with the St Andrews Bay Member of the Forth Formation, were laid down during the Early Holocene. Their lithology suggests a broadly shallow marine depositional environment; however, some parts are suggestive of beach and/or fluviomarine sediments. Sea level modelling suggests that the part of the North Sea where the St Andrews Bay Member is recognised (north of 55° N) was inundated to a greater extent by 18,000 BP, prior to known human occupation of Scotland and northeast England after the LGM. Units 2A and 2B have been provisionally identified extensively throughout the study area (except for Unit 2B absence from the EGL 4 Offshore section), however, much of this south of 55° N is more likely associated with the Botney Cut Formation, whose upper member is equivalent to much of the Forth Formation.

26.5.239 As Units 2A and 2B were laid down in marine environments, a negligible potential for archaeological and a general low to moderate potential for palaeoenvironmental evidence is considered.

26.5.240 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 (Brooks, 2011, REF 26.47), on such area was the Lincolnshire coastline, suggesting that by 6,000 BP, and the onset of the Neolithic, the coastline passed through Blocks B014 and B015. The nature of the terrestrial landscape of the study area at this time is suggested by a series of findspots on the beach.

26.5.241 The CITiZAN database holds records for two discoveries of lumps of peat on the beach in Blocks B003 and B005 (CITiZAN IDs: 82914 and 84817), whilst a portion of *in situ* peat shelf has been recorded further south, at the edge of the study area (CITiZAN ID: 82916). 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 to the south of Block B006 (Clapham, 1999, REF 26.65), the former of which has been dated to *c*. 5,300 BP (Clarke, 2000, REF 26.66) 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 (Clapham, 1999, REF 26.65). Furthermore, two pieces of peat were recovered during an otter trawl slightly southeast of Block B016 (NRHE ID: 1595672).

26.5.242 Clearance of parts of the forest are indicated by certain pollens, including cereals, within upper peat formations (Clapham, 1999, REF 26.65) and the findspot of a polished stone axe butt end at the western end of Block B006 (TI_002; TI_013; **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area**). Other Neolithic flint axes were recovered from the foreshore slightly further north, at Mablethorpe and Trusthorpe (HER refs: MLI41427 and MLI41449, respectively).

26.5.243 Unit 1 comprises Holocene marine sediments and post-dates marine inundation of the North Sea palaeolandscape. Although *in situ* archaeological remains are highly unlikely to be present, artefacts eroded from their primary contexts and redeposited within Unit 1 may exist, as exemplified by previously detailed findspots. Such occurrences, however, are very difficult to predict and a low overall potential can be considered.

26.5.244 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

26.5.245 This Section has examined the interpretations of the preliminary ground model, alongside wider evidence, describing a possible 14 geological units within the study area. This examination has informed the assessment of archaeological and palaeoenvironmental potential.

26.5.246 Most identified units have been provisionally interpreted as marine or glaciomarine in origin, thus precluding the potential for *in situ* archaeological remains relating to prehistory prior to or during the Flandrian marine transgression.

26.5.247 A low potential for redeposited archaeological remains has been identified for Unit 1, particularly in the foreshore zone.

26.5.248 A moderate potential for archaeological remains has been identified for Unit 2C, should parts of this Unit be found to have been laid down in non-marine conditions. Further geotechnical investigation and archaeological analysis of the results would be required to refine this understanding. A moderate potential for palaeoenvironmental remains in Unit 2C has been identified under the same circumstances.

26.5.249 A moderate potential for palaeoenvironmental remains has been identified for Units 2D and 6 and a high potential for Unit 1. Non-glacigenic deposits hold a broad potential for evidence such as diatoms, ostracods and dinoflagellates, which can be used to infer palaeoenvironmental conditions. Units 2A, 2B, 2C, 2E, 3, 5, 7 and 8 have therefore been attributed a low to moderate potential for palaeoenvironmental remains.

26.5.250 A summary of provisionally identified units and their attributed archaeological and palaeoenvironmental potential is presented by **Table 26-12**.

Table 26-12 - Summary of Submerged Archaeological Potential

Unit	Present within				MIS	Depositional environment	Potential	
	EGL 3 Nearshore	EGL 4 Nearshore	EGL 3 Offshore	EGL 4 Offshore			Prehistoric archaeology	Palaeoenvironmental
1	Y	Y	Y	Y	1	Marine	Low	High
2A	Y	Y	Y	Y		Shallow marine, possibly beach and/or fluviomarine	Negligible	Low to moderate
2B	Y	Y	Y	N			Negligible	Low to moderate
2C	Y	Y	N	Y	2 to 1	Partly glaciolacustrine/ glaciomarine. Possibly glacigenic (lower member)	Moderate potential should lacustrine or fluvial elements be identified. Negligible to moderate otherwise.	
2D	Y	N	Y	Y	2	Estuarine to offshore marine	Low	Moderate
2E	N	N	N	Y		Glaciomarine	Negligible	Low to moderate
3	N	N	N	?		Shallow glaciomarine	Negligible	Low to moderate
4A	Y	Y	Y	Y		Sub-glacial/supra-glacial	Negligible	Negligible
4B	N	N	N	Y		Glacigenic	Negligible	Negligible
5	N	N	Y	N	6 to 3	Mostly glaciomarine; upper member locally interpreted as intertidal	Negligible	Low to moderate
6	Y	N	Y	Y	11	Temperate, shallow marine	Negligible	Moderate
7	Y	N	N	N			Negligible	Low to moderate
8	N	N	N	Y	12	Upward transition from sub-glacial,	Negligible	Low to moderate

Unit	Present within				MIS	Depositional environment	Potential	
	EGL 3 Nearshore	EGL 4 Nearshore	EGL 3 Offshore	EGL 4 Offshore			Prehistoric archaeology	Palaeoenvironmental
						glaciofluvial, to glaciolacustrine to shallow marine		
9	N	N	N	Y	100 to 13	Delta-front/pro-delta/nearshore/open marine	Uncertain	Uncertain

Results of Geophysical Data Assessment

26.5.251 A total of 1,303 surface geophysical anomalies of potential archaeological interest were identified within the geophysical survey data extents. The anomalies are categorised by potential in **Table 26-13**.

Table 26-13 - Distribution of Archaeological Anomalies by Potential

Potential	EGL 3	EGL 4	Total
Low	316	961	1,277
Medium	9	14	23
High	3	0	3
Total	328	975	1,303

26.5.252 The distribution of anomalies is shown in **Volume 3, Part 3, Figure 26-10: Distribution of archaeological anomalies**, as can be noted the distribution is weighted towards the southernmost 50% of the study area. Much of this is potentially due to the survey being closer inshore and closer to busy harbours such as those at Hull, Grimsby, Hartlepool and Middlesborough. Further north and further offshore anomalies are more widely spread and are relatively evenly distributed.

26.5.253 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

26.5.254 A total of 1,277 anomalies interpreted as of low archaeological potential were identified within the geophysical survey data extents. The anomalies can be categorised as follows in **Table 26-14**.

Table 26-14 - Low Potential Archaeological Anomaly Categories

Category	EGL 3	EGL 4	Total
Chain, cable or rope	9	47	56
Fishing gear	1	12	13
Infrastructure	1	0	1
Likely geological	37	6	43
Linear	3	20	23
Mound	2	2	4
Potential debris	262	874	1,136
Seabed disturbance	1	0	1
Total	316	961	1,277

26.5.255 The anomalies interpreted as being of low archaeological potential (see **Table 26-14**) are 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. Each anomaly was reviewed by MSDS Marine and interpreted to be of low archaeological potential.

26.5.256 **Table 26-15** below provides a brief justification for the interpretation of each category of low potential anomalies. To note, the descriptions below are generalised, and each anomaly is interpreted based on individual characteristics, other anomalies within the wider area, seabed characterisation, etc.

Table 26-15 - Low Potential Archaeological Anomaly Descriptions

Anomaly category	Description
Chain, cable or rope	Features identified as chain, cable or rope are, as the name suggests, long thin anomalies likely to be caused by discarded or lost pieces of chain, cable or rope.
Fishing gear	Features identified as fishing gear include discarded or lost nets and shellfish pots.
Infrastructure	Features identified as infrastructure are modern features associated with undersea cables and pipelines. Please note that the cables and pipelines themselves have not been reported in this report.
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.
Linear	Features identified as linear would generally be far longer in one direction than in others, suggesting an anthropogenic origin. The potential would be determined based on the size, associated magnetic anomalies, and the surrounding environment.
Mound	Features identified as mounds are where the main characteristic is a raised area of the seabed surface that may indicate either low lying material, or partially buried material. The potential would be determined based on the size, associated magnetic anomalies, and the surrounding environment.
Potential debris	Features identified as potential debris would generally display characteristics indicating anthropogenic origin, such as straight or angular edges. Boulder like features, with

Anomaly category	Description
	associated magnetic anomalies can also be categorised as potential debris.
Seabed disturbance	Features identified as seabed disturbances are where the main characteristic is a change in the seabed surface that may indicate either low lying material, or partially buried material. The potential would be determined based on the size, associated magnetic anomalies, and the surrounding environment.

26.5.257 Low potential anomalies have been assessed against all available evidence and are deemed unlikely to be of archaeological significance and as such are not discussed further within the results section of this report.

26.5.258 The distribution of low potential anomalies is shown in **Volume 3, Part 3, Figure 26-13: Distribution of low potential archaeological anomalies**. A gazetteer of low potential anomalies, including positions and dimensions, can be found in **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**.

Medium potential archaeological anomalies

26.5.259 Twenty-three (23) anomalies interpreted as of medium archaeological potential were identified within the geophysical survey data extents, all of which (with the exception of one) lie within the EGL 3 and EGL 4 Corridors. The anomalies can be categorised as follows in **Table 26-16**, the distribution is presented in **Volume 3, Part 3, Figure 26-12: Distribution of medium potential archaeological anomalies**.

Table 26-16 - Medium Potential Archaeological Anomaly Categories

Category	EGL 3	EGL 4	Total
Debris	4	9	13
Wreck debris	2	1	3
Anchor	2	1	3
Mound	0	2	2
Seabed disturbance	1	1	2
Total	9	14	23

26.5.260 The anomalies interpreted as of medium archaeological potential have characteristics that indicate a likelihood of representing anthropogenic material that has the potential to be of archaeological interest, or where a precautionary approach has been taken for anomalies where the identification isn't clear. Ground truthing of the anomaly through the use of divers or a Remotely Operated Vehicle (ROV) would establish the archaeological potential.

26.5.261 Each medium potential anomaly is discussed, along with an image, within this section of this report. A gazetteer of medium potential anomalies, including positions and dimensions can be found in **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**.

Medium potential EGL3_242 and EGL3_507

26.5.262 Medium potential EGL3_242 and EGL3_507 (**Volume 3, Part 3, Figure 26-15: Medium potential EGL3_242** and **Volume 3, Part 3, Figure 26-17: Medium potential EGL3_507**) are related to high potential EGL3_240 and EGL3_506 (both wrecks) respectively and are discussed in the following high potential section of this report.

Medium potential EGL3_39

26.5.263 Medium potential EGL3_39 (**Volume 3, Part 3, Figure 26-14: Medium potential EGL3_39**) lies outside the EGL3 Corridor and study area approximately 10.7 km west of KP 88. The anomaly is visible in the SSS data only and has no corresponding magnetic anomaly. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_072 6.9 km to the southwest.

26.5.264 The anomaly is visible in the SSS data as a single feature measuring approximately 12.3 m x 8.3 m with a depth of 0.6 m. The origin of the feature is unclear; however, the overall size and form of the anomaly may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL3_282

26.5.265 Medium potential EGL3_282 (**Volume 3, Part 3, Figure 26-16: Medium potential EGL3_282**) lies within the EGL 3 Corridor approximately 420 m north of KP 209. The anomaly is visible in both the SSS and MBES data and has no corresponding magnetic anomaly. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS_006 1.9 km to the southwest.

26.5.266 The anomaly is visible in the SSS data as an area of potential debris measuring 17.9 m x 6.2 m with a measurable height of 0.6 m. The anomaly is characterised by linear features orientated northwest-southeast. Within the MBES data the anomaly is visible as a raised linear feature with a peak visible towards the centre. The origin of the anomaly is unclear; however, the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL3_529

26.5.267 Medium potential EGL3_529 (**Volume 3, Part 3, Figure 26-18: Medium potential EGL3_529**) lies within the ELG 3 Corridor approximately 795 m northeast of KP 1. The anomaly is visible in both the SSS and MBES data, with a corresponding magnetic anomaly of 39.5 nT, which gives a calculated mass of 78 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_106 299 m to the south.

26.5.268 The anomaly is visible in the SSS data as an anchor measuring 3.6 m x 1.7 m with a measurable height of 0.3 m. Within the MBES data the anomaly is visible as a small, raised area of seabed. The anomaly is likely an anchor, morphologically similar to an Admiralty pattern anchor, lying flat on the seabed (i.e. with no visible stock). As an object of archaeological interest and as the anchor may have associated archaeological deposits in the vicinity, a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the significance of the anchor and the presence or absence of associated deposits, and therefore the archaeological potential.

Medium potential EGL3_571

26.5.269 Medium potential EGL3_571 (**Volume 3, Part 3, Figure 26-19: Medium potential EGL3_571**) lies within the EGL 3 Corridor approximately 2.1 km north of EGL 4 KP 5. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 37.0 nT, which gives a calculated mass of 163 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_104 2.9 km to the southwest.

26.5.270 The anomaly is visible in the SSS data as an anchor measuring 2.5 m x 1.9 m with a measurable height of 0.1 m. Within the MBES data the anomaly is visible as a small, raised area of seabed. The anomaly is likely an anchor, morphologically similar to an Admiralty pattern anchor, lying flat on the seabed (i.e. with no visible stock). As an object of archaeological interest and as the anchor may have associated archaeological deposits in the vicinity, a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the significance of the anchor and the presence or absence of associated deposits, and therefore the archaeological potential.

Medium potential EGL3_681

26.5.271 Medium potential EGL3_681 (**Volume 3, Part 3, Figure 26-20: Medium potential EGL3_681**) lies within the draft Order Limits approximately 1.3 km west of KP 24. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 656 nT, which gives a calculated mass of 1,685 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_054 2.7 km to the northwest.

26.5.272 The anomaly is visible in the SSS data as an area of potential debris measuring 2.7 m x 1.5 m with a measurable height of 0.1 m. The anomaly is characterised by a collection of short linear features with a large acoustic shadow. Within the MBES data the anomaly is visible as an amorphous raised area. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL3_1551

26.5.273 Medium potential EGL3_1551 (**Volume 3, Part 3, Figure 26-21: Medium potential EGL3_1551**) lies within the EGL 3 Corridor approximately 150 m northwest of KP 80. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 62 nT, which gives a calculated mass of 6,162 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_071 410 m to the northwest.

26.5.274 The anomaly is visible in the SSS data as an area of potential debris measuring 11.3 m x 7.5 m with a measurable height of 0.5 m. The anomaly is characterised by a linear feature with a large acoustic shadow, with smaller features alongside on the seabed. Within the MBES data the anomaly is visible as a sub circular raised area with a higher point on its western edge. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL3_1571

26.5.275 Medium potential EGL3_1571 (**Volume 3, Part 3, Figure 26-22: Medium potential EGL3_1571**) lies within the EGL 3 Corridor approximately 810 m north of KP 79. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 667 nT, which gives a calculated mass of 18,743 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_071 725 m to the southwest.

26.5.276 The anomaly is visible in the SSS data as an area of potential debris measuring 3.9 m x 2.1 m with a measurable height of 0.4 m. The anomaly is characterised by a tangle of features, possibly relating to the feature itself or snagged fishing gear. Within the MBES data the anomaly is visible as a round feature with an associated linear feature to the east. There is a small scour to the north. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_729

26.5.277 Medium potential EGL4_729 (**Volume 3, Part 3, Figure 26-23: Medium potential EGL4_729**) lies within the EGL 4 Corridor approximately 335 m north of KP 32. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 176 nT, which gives a calculated mass of 2,450 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_062 1.7 km to the southeast.

26.5.278 The anomaly is visible in the SSS data as an area of potential debris measuring 6.6 m x 6.3 m with a measurable height of 0.2 m. The anomaly is characterised by a series of three parallel linear features, with two more offset to the south. Within the MBES data the anomaly is visible as an east-west oriented feature with a scour to the south. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_786

26.5.279 Medium potential EGL4_786 (**Volume 3, Part 3, Figure 26-24: Medium potential EGL4_786**) lies within the EGL 4 Corridor approximately 500 m northeast of KP 37. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 258 nT, which gives a calculated mass of 712 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_064 4.8 km to the northeast.

26.5.280 The anomaly is visible in the SSS data as an area of potential debris measuring 3.3 m x 0.8 m with a measurable height of 1.3 m. The anomaly is characterised by a linear feature oriented southwest-northeast. Within the MBES data the anomaly is visible as a single sub circular feature. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_789, EGL4_790 and EGL4_791

26.5.281 Medium potential EGL4_789, EGL4_790 and EGL_791 (**Volume 3, Part 3, Figure 26-25: Medium potential EGL4_789, Volume 3, Part 3**, **Figure 26-26: Medium potential EGL4_790** and **Volume 3, Part 3, Figure 26-27: Medium potential EGL4_791**) lie within the EGL 4 Corridor approximately 570 m northeast of KP 40. The anomalies are visible in both the SSS and MBES data and EGL4_789 and EGL4_790 have corresponding magnetic anomalies of 25.8 nT and 28.4 nT, which give calculated masses of 4,229 kg and 423 kg respectively. The anomalies do not correspond with any records identified during the desk-based assessment, the closest being MSDS W_064 1.9 km to the southwest.

26.5.282 The anomalies are visible in the SSS data as an area of potential debris measuring 21.4 m x 20.8 m with a measurable height of 0.9 m. The anomalies are characterised by a series of linear features oriented southwest-northeast. Within the MBES data the anomalies are visible as a spread of several sub circular features. The origin of the anomalies is unclear; however, the associated magnetic anomalies suggest an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_844

26.5.283 Medium potential EGL4_844 (**Volume 3, Part 3, Figure 26-28: Medium potential EGL4_844**) lies within the EGL 4 Corridor approximately 740 m northeast of KP 42. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 17 nT, which gives a calculated mass of 1,226 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_066 1.0 km to the east.

26.5.284 The anomaly is visible in the SSS data as an area of potential debris measuring 6.0 m x 1.5 m with a measurable height of 1.3 m. The anomaly is characterised by an angular piece of debris with a scour to the north and south. Within the MBES data the anomaly is visible as a single sub rectangular feature. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_885

26.5.285 Medium potential EGL4_885 (**Volume 3, Part 3, Figure 26-29: Medium potential EGL4_885**) lies within the EGL 4 Corridor approximately 690 m north of KP 41. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 10 nT, which gives a calculated mass of 3,731 kg. The anomaly directly corresponds to UKHO record 103434 (MSDS W_001) (**See Section Coastal and Maritime Archaeology).**

26.5.286 The anomaly is visible in the SSS data as an area of potential debris measuring 10.0 m x 2.8 m with a measurable height of 0.7 m. The anomaly is characterised by a boat-shaped feature, oriented north-south, with a thin linear feature extending from the stern. Within the MBES data the anomaly is visible as a boat-shaped feature, oriented north-south. The anomaly is interpreted as a small boat or yacht. The associated magnetic anomaly suggests steel frames or a steel hull, indicating a 20th century date. Hence a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_916

26.5.287 Medium potential EGL4_916 (**Volume 3, Part 3, Figure 26-30: Medium potential EGL4_916**) lies within the EGL 4 Corridor approximately 390 m northeast of KP 58. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 51 nT, which gives a calculated mass of 72 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_072 8.4 km to the east.

26.5.288 The anomaly is visible in the SSS data as an area of potential debris measuring 11.4 m x 2.0 m with a measurable height of 1.3 m. The anomaly is characterised by an angular piece of debris with scour to the north and south. Within the MBES data the anomaly is visible as a single sub rectangular feature with scour to the north and south. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_1263

26.5.289 Medium potential EGL4_1263 (**Volume 3, Part 3, Figure 26-31: Medium potential EGL4_1263**) lies within the EGL 4 Corridor approximately 910 m north-northeast of KP 139. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 267 nT, which gives a calculated mass of 9,421 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_033 3.8 km to the southwest.

26.5.290 The anomaly is visible in the SSS data as an area of potential debris measuring 9.6 m x 5.9 m with a measurable height of 0.5 m. The anomaly is characterised by a linear piece of debris, oriented north-south. Within the MBES data the anomaly is visible as a linear piece of debris, oriented north-south. The origin of the anomaly is unclear; however, the associated magnetic anomaly suggests an anthropogenic origin and the overall size and form may represent material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential.

Medium potential EGL4_1308

26.5.291 Medium potential EGL4_1308 (**Volume 3, Part 3, Figure 26-32: Medium potential EGL4_1308**) lies within the EGL 4 Corridor approximately 165 m northeast of KP 189. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 130 nT, which gives a calculated mass of 52,864 kg. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_030 4.8 km to the southwest.

26.5.292 The anomaly is visible in the SSS data as a mound measuring 17.8 m x 12.0 m with a measurable height of 0.8 m. The anomaly is characterised by a sub circular area of seabed disturbance. Within the MBES data the anomaly is visible as a sub-rectangular mound, oriented northeast-southwest. The origin of the anomaly is unclear; however, the size of the associated magnetic anomaly suggests material of archaeological interest, and a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the origin, and therefore the archaeological potential

Medium potential EGL4_1433

26.5.293 Medium potential EGL4_1433 (**Volume 3, Part 3, Figure 26-33: Medium potential EGL4_1433**) lies within the EGL 4 Corridor approximately 345 m northwest of KP 310. The anomaly is visible in both the SSS and MBES data but has no corresponding magnetic anomaly. The anomaly does not correspond with any records identified during the desk-based assessment, the closest being MSDS W_097 1.0 km to the northwest.

26.5.294 The anomaly is visible in the SSS data as an anchor measuring 2.5 m x 1.0 m with a measurable height of 0.1 m. Within the MBES data the anomaly is visible as a small, raised area. The anomaly is likely an anchor, morphologically similar to an Admiralty pattern anchor, lying flat on the seabed (i.e. with no visible stock). It is noted that the anchor has no associated magnetic anomaly. However, it may be heavily corroded or too far from the closest sensor to be detectable. As an object of archaeological interest and as the anchor may have associated archaeological deposits in the vicinity, a medium potential rating is considered appropriate. Further assessment of ROV data would be required to better understand the significance of the anchor and the presence or absence of associated deposits, and therefore the archaeological potential.

High potential archaeological anomalies

26.5.295 Three anomalies interpreted as of high archaeological potential were identified within the geophysical survey data extents, two of which lie within the EGL 3 Corridor, with the third lying just outside. The anomalies can be categorised as follows in **Table 26-17**, the distribution is presented in **Volume 3, Part 3, Figure 26-11: Distribution of high potential archaeological anomalies**.

Table 26-17 - High Potential Archaeological Anomaly Categories

Category	EGL 3	EGL 4	Total
Wreck	3	0	2
Total	3	0	3

26.5.296 The anomalies interpreted as of high archaeological potential have characteristics that indicate a high likelihood of representing anthropogenic material that has a high potential to be of archaeological interest, or where a precautionary approach has been taken for anomalies where the identification isn't clear.

26.5.297 Each high potential anomaly is discussed, along with an image, within this section of this report. A gazetteer of high potential anomalies, including positions and dimensions can be found in **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**.

High potential EGL3_240

26.5.298 High potential EGL3_240 (**Volume 3, Part 3, Figure 26-34: High potential EGL3_240**) lies adjacent to the EGL 3 Corridor, approximately 420 m northwest of KP 169. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 90 nT with a calculated mass of 191 tons. The anomaly directly corresponds with UKHO record 6666 (MSDS W_042) (**See paragraph 26.5.382**).

26.5.299 The anomaly is the remains of a wrecked vessel measuring 29.9 m x 7.1 m with a measurable height of 1.4 m. The wreck is orientated north-south, it is unclear as to whether it lies upright, and the orientation of the bows is not certain. Scour is visible all around the wreck but is less prominent to the east. One medium potential anomaly (EGL3_242) lies directly to the north of the wreck. EGL3_242 is a large piece of debris measuring 9.1 m x 0.9 m.

26.5.300 Whilst the anomaly is clearly identifiable as a wreck, with the significant magnetic anomaly suggesting a steel wreck, further interpretation based on the geophysical data is not possible. The wreck has deteriorated, particularly towards the north where it has collapsed.

High potential EGL3_293

26.5.301 High potential EGL3_293 (**Volume 3, Part 3, Figure 26-35: High potential EGL3_293**) lies within the EGL 3 Corridor approximately 395 km east of KP 233. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 1,427 nT with a calculated mass of 164 tons. The anomaly does not directly correspond with any UKHO record but is 1.4 km from UKHO record 6549 (MSDS W_032).

26.5.302 The anomaly has been interpreted as the remains of a wrecked vessel measuring 31.3 m x 7.5 m with a measurable height of 1.8 m. The anomaly is orientated northwest- southeast, with the bow to the northwest. Scour is visible all around the anomaly. The anomaly is broadly oval in form. It is unclear whether features visible in the data are due to surviving structure or collapsed decking.

26.5.303 Whilst the anomaly is clearly identifiable as a wreck, with the significant magnetic anomaly suggesting a steel wreck, further interpretation based on the geophysical data is not possible.

High potential EGL3_506

26.5.304 High potential EGL3_506 (**Volume 3, Part 3, Figure 26-36: High potential EGL3_506**) lies within the EGL 3 Corridor, approximately 735 m east of KP 0. The anomaly is visible in both the SSS and MBES data and has a corresponding magnetic anomaly of 28 nT with a calculated mass of 364 kg. The anomaly directly corresponds with UKHO record 94757 (MSDS W_106) (**See paragraph 26.5.384**).

26.5.305 The anomaly is the remains of a wrecked vessel measuring 26.4 m x 7.5 m with a measurable height of 0.5 m. The wreck is orientated northwest-southeast, with the bow to the northwest and appears to be upright. Scour is visible to the south of the wreck. One medium potential anomaly (EGL3_507) lies directly to the north of the wreck. EGL3_242 is a piece of debris measuring 1.5 m x 1.3 m.

26.5.306 The anomaly is clearly identifiable as a wreck, with the lack of magnetic anomaly and shape indicating a wooden wreck. Further interpretation based on the geophysical data alone is not possible.

Magnetic Anomalies

26.5.307 14,928 magnetic anomalies, ranging between 1.0 nT and 4,865.8 nT, were identified within the magnetometer data and within the geophysical survey data extents. Of these 8,135 are over 5.0 nT and do not correlate with known, or visible, features or infrastructure and have therefore been taken forward for assessment within this section. The distribution of anomalies by amplitude is shown below in **Table 26-18** with their spatial distribution presented in **Volume 3, Part 3, Figure 26-37: Distribution of magnetic anomalies by amplitude (nT)**.

Table 26-18 - Magnetic Anomalies by Amplitude (nT)

Amplitude (nT)	EGL3	EGL4	Total
5 to 50	3,106	4,694	7,800
50 to 100	80	108	188

Amplitude (nT)	EGL3	EGL4	Total
100 to 200	31	42	73
200 +	26	48	74
Total	3,243	4,892	8,135

26.5.308 Anomalies identified from the magnetometer data are ferrous and thus generally anthropogenic in origin although they can be associated with geological features, however, there is no visual interpretation as with other geophysical data.

26.5.309 The magnetometer data collection methodology across the geophysical survey data extents was to run lines concurrently with the SSS and MBES, thus the line spacing is not sufficient for the detailed assessment of small, ferrous features on or below the seabed. The position for a magnetic anomaly can only be determined from directly below a single sensor, or where lines are run close enough together to be able to confidently position an anomaly seen on two, or more, lines. However, in combination with SSS and MBES data the magnetometer specification is considered sufficient to develop a broad understanding of the potential of the survey area, and to identify larger features of potential archaeological significance.

26.5.310 The positions of magnetic anomalies were viewed in the available datasets and where there was a strong correlation with a seabed anomaly, they were assessed for archaeological potential. All remaining anomalies have been included within this section.

26.5.311 All isolated magnetic anomalies of 50 nT to 100 nT or less are considered to be of limited potential to be of archaeological significance, however this is dependent on the calculated ferrous mass of the anomaly and thus the distance from the sensor.

26.5.312 The distribution of anomalies by estimated mass is shown below in **Table 26-19** with their spatial distribution presented in **Volume 3, Part 3, Figure 26-38: Distribution of magnetic anomalies by mass (kg)**.

Table 26-19 - Magnetic Anomalies by Mass (kg)

Estimated mass (kg)	EGL3	EGL4	Total
1 to 100	2,803	4,155	6,958
100 to 500	305	651	956
500 to 1,000	75	38	113
1,000 +	60	48	108
Total	3,243	4,892	8,135

26.5.313 As can be noted the distribution of anomalies by mass covers a broader range than that by amplitude. This is primarily related to an approximate magnetometer altitude of 3.5 m across the survey extents. At a distance of 3.5 m small fluctuations in amplitude equate to large differences in calculated mass.

26.5.314 Typically, and dependant on the survey specification and the distance from the target, isolated anomalies under 50 to 100 nT or 500 to 1,000 kg are considered to be of limited, or low, potential to be of archaeological significance.

Overview of magnetic anomaly distribution

26.5.315 The distribution of magnetic anomalies is fairly uniform within the extents of the magnetometer data, consummate with survey specifications, with a greater density in inshore waters, and primarily consisting of anomalies <50 nT and <1,000 kg. Due to the 30 m to 70 m line spacing used during data collection this is a typical distribution, both geographically and in terms of recorded amplitude and mass.

26.5.316 The size (in nT) of a magnetic anomaly is dependent on both the mass of ferrous material, and the distance from the sensor. Therefore, unless there is a strong correlation between a magnetic anomaly and a seabed feature perpendicular to the track, it is not possible to accurately position or determine the mass of an anomaly. For example, an anomaly of <50 nT relating to a feature direct below the track could, and often does, represent small pieces of debris, steel cable, fishing gear, etc. whilst an anomaly of <50 nT 20 m from the track could indicate a much larger feature. If that feature is not visible in the other geophysical datasets (potentially due to being buried) then the position is unable to be reconciled. As such, a bias towards anomalies <50 nT is expected as the range to the sensor is greater than 17.5 m for 50% of the seabed at a 70 m line spacing.

Discussion of potential

26.5.317 Magnetic anomalies >100 nT are typically described as large and have the potential to be of archaeological significance. It should be noted that these anomalies, and any interpretations, are based on a magnetic signature rather than a visible image of the anomaly on the seabed. It is often the case that during intrusive investigations these anomalies are identified as modern marine debris, including cable, chain, modern anchors, fishing gear, and parts of modern vessels such as outboard engines, and other detritus either deliberately or accidentally, put overboard. Where anomalies are largely isolated, or relating to a single feature, the most commonly identified material of archaeological interest are isolated anchors, often of indeterminate age. The difficulties in determining the age of anchors exhibiting extensive concretions and the lack of a wider context means these are often classed as of low or medium potential to be of archaeological significance.

26.5.318 However, whilst the chances of isolated magnetic anomalies being of archaeological interest are potentially low, this does not reduce the potential of anomalies to be of archaeological significance.

26.5.319 As discussed, given the vagaries with positioning, size, etc. it would not be proportional to assign potential to all magnetic anomalies where there is no correlating seabed feature - the anomalies to which this section pertains. Therefore, a broad statement of potential is provided below.

26.5.320 A total of 8,135 magnetic anomalies of between 5.0 nT and 2,028.5 nT, and 0.1 kg and 39,220 kg, with no definitive correlation with archaeological anomalies, seabed features, or infrastructure, have been identified within the survey extents. Magnetic anomalies are ferrous and thus generally anthropogenic in origin, anthropogenic material has the potential to be of archaeological significance. Therefore, there is broad potential to identify additional material of potential archaeological interest within the extents of the geophysical survey data. A total of 108 anomalies, all greater than a calculated mass of 1,000 kg have been identified as potentially indicating material of a medium or high potential to be of archaeological interest.

26.5.321 At the line spacing of the survey (up to 70 m) the potential for anomalies of a significant mass to lie, either undetected or underestimated, is high. For example (using Hall's Equation and a minimum reliable detection limit of 5.0 nT) the minimum mass that can be identified at 5.0 nT at a range of 27.0 m is calculated as 10.0 tons, (Holt, 2019, REF 26.67). Holt also notes that the results of field-testing using divers have demonstrated that Hall's Equation can have errors in the calculation of mass in some instances by a factor of three, potentially due to the magnetism of the anomaly, known as permanent or residual magnetism. Therefore, calculations should be considered as estimations of mass, not precise measurements of mass. However, they remain a more robust indication of archaeological potential than the presentation of amplitude with no supporting distance from the anomaly data.

26.5.322 Based on the experience of MSDS Marine within the North Sea, and the visual inspection of a significant number of magnetic anomalies, it is our opinion that a mass range of 500 - 1,000 kg (and above) presents a robust but proportional mass from which mitigation recommendations can be based.

26.5.323 The above discussion highlights the importance of the archaeological assessment of high specification (low altitude, tighter line spacing) magnetometer data, to identify the presence of anomalies of potential archaeological interest in areas that would be directly impacted by development.

Coastal and Maritime Archaeology

Introduction

26.5.324 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"* (Westerdahl, 1992, REF 26.68). 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.

26.5.325 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

26.5.326 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)' assessed the environmental factors affecting the preservation of maritime archaeological remains on the seabed (SeaZone Solutions Ltd., 2012, REF 26.69). These factors included: sediment type, sediment thickness, water depth and sediment transport. It was 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.

26.5.327 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).

26.5.328 The study area encompasses a range of preservation levels, from 1 to 15. The area of anticipated best preservation lies within Blocks 1, 3, 4, B021-B023, B025, B026, B028, including parts of the EGL 3 and EGL 4 Nearshore sections and southernmost parts of the Offshore sections, with scores of 15. Northward from this area, Blocks 8-14, B029-B046 and MCZ1-MCZ6 are generally represented by scores of 9 to 14, indicating moderate preservation conditions.

26.5.329 The remainder of the study area further north is generally characterised by scores of 1 to 8, indicating poor preservation conditions. No data is available for nearshore Blocks south of B021 and B023.

Historic coastline development

26.5.330 The National Library of Scotland online historic map viewer (National Library of Scotland, 2025, REF 26.70) was examined for evidence of coastal erosion or remodelling. Ordnance Survey maps dating from the late 19th to late 20th centuries illustrate little change to the coastline at the Landfall.

26.5.331 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.

26.5.332 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 indicate other activities undertaken in the study area.

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

26.5.333 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 offshore 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 26-9: Sea level model**). Discussion relating to the pre-transgression prehistoric landscape and archaeological potential therein is presented by Section 26.5.

26.5.334 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 (Cramp, 2014, REF 26.71) (Richards, 2003, REF 26.72).

26.5.335 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, including skins, bark and reeds (McGrail, 1981, REF 26.73)

26.5.336 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.

26.5.337 Although there have been no recorded finds of prehistoric vessels within the study area, the nearby English 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 (Hull Musuems and Galleries, 2025, REF 26.74).

Roman (AD 43 to 410)

26.5.338 Extensive maritime activities 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.

26.5.339 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.

26.5.340 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 potsherd findspots south of Block B006 on the foreshore (HER refs: MLI41602 and MLI41607) and a cinerary urn burial in a field above MHWS in Block B003 (HER ref: MLI41495), this is not suggestive of a realistic potential for evidence of interaction with the offshore environment.

Early medieval and medieval (AD 410 to 1536)

26.5.341 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.

26.5.342 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.

26.5.343 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 (Hutchinson, 1997, REF 26.75) (Friel, 2003, REF 26.76). 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 (Müldner, 2016, REF 26.77).

26.5.344 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.

26.5.345 The trade links between English towns associated with Hanseatic towns in Northern Europe and development of activities associated with the offshore 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.

Post-medieval to modern (1536 to present)

26.5.346 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.

26.5.347 Interaction with the seascape during this period is evidenced by several heritage records, generally derived from late 19th and early 20th century Ordnance Survey maps. These include possible landing sites (TI_026, TI_029 and TI_055), possible oyster beds or fish farms (TI_024 and TI_031), clay pits (TI_027 and TI_028) and the site of a former coastguard station and rocket house (for signaling; TI_010) (see **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area** and **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**).

26.5.348 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 was one of the oldest and, by the end of the post-medieval period, was becoming 'a place of the first mercantile importance', rising to become the third port in the UK for foreign trade.

26.5.349 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 (Alvarez-Palau, 2019, REF 26.78). Coastal routes linking these, 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.

26.5.350 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 between 1652 and 1784, during which several naval engagements took place in the vicinity of the study area, including the Battle of Dogger Bank in 1781.

26.5.351 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 to 1714) is rare and discoveries of such sites are of potentially great significance.

26.5.352 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 and 19th centuries revolutionised shipbuilding, introducing the steam engine, iron hulls and the screw propeller and later 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.

26.5.353 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 (Firth, 2014, REF 26.79).

26.5.354 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.

26.5.355 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_009, TI_032-051 and TI_054) (see **Volume 3, Part 3, Figure 26-39: Intertidal and terrestrial heritage assets within the Study Area** and **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**).

26.5.356 During the modern period (1901 to 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.

26.5.357 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 also 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.

26.5.358 On the basis of 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

26.5.359 This sub-section examines the known wreck and documented loss records within the study area. Data derived from the UKHO, Canmore and CITiZAN databases and the NRHE has provided information for a minimum of 76 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.

26.5.360 The Lincolnshire HER did not hold any records for documented losses or wreck locations within the study area.

26.5.361 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.

26.5.362 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.

26.5.363 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.

26.5.364 The Projects-specific intertidal walkover survey (**See paragraph 26.4.14**) did not identify any archaeological remains.

26.5.365 The UKHO holds records for 71 wreck, possible wreck or documented loss locations (including one aircraft documented loss), 31 foul ground locations and five other or unknown locations. Five named vessels, however, are each attributed two UKHO records, where the available evidence is not able to 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 107 records):

- Sixty-six (66) wreck, possible wreck or documented loss locations (plus five duplicates);
- Thirty-one (31) foul ground locations; and
- Five (5) unknown or other locations (See **paragraph 26.5.11**).

26.5.366 The Canmore database holds records for 10 maritime losses within the study area, comprising:

- Six (6) records with corresponding 'live' UKHO records; and
- Four (4) documented losses, represented within the Canmore dataset only.

26.5.367 The NRHE holds 39 records within the study area, comprising:

- Ten (10) offshore wreck records (all correlating with UKHO records, though the UKHO record for one is situated 15 km west from the NRHE record (NRHE ID: 1456911; UKHO ID: 6687));
- Four (4) foul ground records (all correlating with UKHO records, though the UKHO record for one is situated beyond the study area (NRHE ID: 908476; UKHO ID: 6671));
- Thirteen (13) intertidal sites, monuments or findspots (including one (1) wreck, correlating with a CITiZAN record);
- Six (6) terrestrial sites, monuments or findspots (above MHWS);
- Four (4) documented loss records;
- One (1) offshore record relating to the recovery of two pieces of peat; and
- One (1) record relating to multi-period finds at Wold Farm (likely incorrect location data).

26.5.368 The CITiZAN database records a single wreck location, within the intertidal zone close to the southern boundary within the study area (CITiZAN ID: 61510). The record states that the wreck is situated within a deepwater channel and may be the remains of a Norwegian fishing vessel. An accompanying photograph illustrates partial exposure of wooden elements of a vessel, including the port side rail, stempost (possibly with iron fitting) and the possible remainder of a mast (CITiZAN, 2025, REF 26.80). No further interpretation or reference is given, and it is possible that this may relate to UKHO record 8651, documented as the wreck of a stranded Norwegian fishing vessel, visible along its whole length at half tide and standing 8-10 feet above the surrounding sea. This record, however, is positioned by the UKHO *c.* 14.8 km to the northwest of the CITiZAN record, beyond the study area. An intertidal survey undertaken for the Projects examined the UKHO position at low tide and did not identify any such remains. The same survey did not extend to the CITiZAN record location; therefore, it is feasible that the two records relate to the remains at the location given by CITiZAN.

26.5.369 Two further CITiZAN records relate to postulated ship's timbers, joined by metal pins or wooden treenails, and illustrate a broad potential for miscellaneous wreckage within the study area.

26.5.370 **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records** presents the full gazetteer for the study area, correlating all UKHO, Canmore, CITiZAN and NRHE records for wrecks, possible wrecks, documented losses, foul ground positions and other records. **Table 26-20** 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 26-20 - Vessel Types Indicated by Documented Losses and Wrecks

Vessel type/rig	19th century	20th century	Unknown	Totals
Aircraft	0	1	0	1
Cargo vessel	2	0	0	2
Fishing vessel	0	2	0	2
Motor vessel	0	1	0	1
Sailing vessel	7	0	2	9
‘Small boat’	1	0	0	1
Steam ship	0	9	1	10
Steam trawler	0	3	0	3
Torpedo-boat destroyer	0	1	0	1
Trawler	2	13	2	17
Unknown	1	0	29	30
Totals	13	30	34	77

26.5.371 Examination of the documented losses can reveal broad patterns of maritime activity within the study area and surrounding seascape, with careful consideration of the nature of the evidence.

26.5.372 No records pre-date the 19th century and only 13 losses are recorded for that century. Many losses for this period and earlier were likely unrecorded, due to undeveloped local maritime administration and record keeping practices. The number of documented losses overall is rather low (9), perhaps reflecting limited record keeping or suggestive of other factors preventing the recording of historic losses.

26.5.373 Whilst associated information for documented losses can be used to infer activities and patterns in an offshore region, the limited dataset for documented losses within the Projects areas should be used with caution when drawing conclusions for the wider North Sea. The five records of lost trawlers reflect the 20th century fishing industry, an activity which the ‘small boat’ record may also relate to.

26.5.374 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 26-2: UKHO records (1 of 5);**
- **Volume 3, Part 3, Figure 26-3: UKHO records (2 of 5);**
- **Volume 3, Part 3, Figure 26-4: UKHO records (3 of 5);**
- **Volume 3, Part 3, Figure 26-5: UKHO records (4 of 5);** and
- **Volume 3, Part 3, Figure 26-6: UKHO records (5 of 5).**

26.5.375 With the exception of a single CITiZAN record, these are exclusively derived from the UKHO dataset, as Canmore and the NRHE 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.

26.5.376 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. As suggested by the nomenclature, “lifted” records relate to wreck or obstructions which have been recovered from the seabed.

26.5.377 “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.

26.5.378 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.

26.5.379 The UKHO dataset for the study area included 66 wreck records (plus five duplicate records for named wrecks – see **Section 26.5.365**). This comprised (excluding duplicates):

- Forty-five (45) “live” records; and
- Twenty-one (21) “dead” records.

26.5.380 Four (4) UKHO records within the study area were correlated with geophysical anomalies during the archaeological review of site-specific survey data and are described below. The remaining UKHO records and their descriptions are included in **Volume 2, Part 3, Appendix 3.26.B: Gazetteer of UKHO and Heritage Records**.

W_001

26.5.381 W_001 (UKHO ID: 103434) represents a dangerous, unknown wreck, first recorded on 19 February 2024 in general water depth of 19 m. The sonar dimensions are given as 8.58 m (L) by 3.03 m (W) by 0.6 m (H). W_001 directly corresponds with the medium potential geophysical anomaly EGL4_885.

W_042

26.5.382 W_042 (UKHO ID: 6666) represents a non-dangerous wreck first identified in 1986 and last in 1997, in waters 58 m deep. It is recorded as intact, probably lying on its side, with sonar measurements of 30 m (L) by 12 m (W) by 4.7 m (H). W_042 directly corresponds with high potential geophysical anomaly EGL3_240.

W_071

26.5.383 W_071 (UKHO ID: 8903) possibly represents the dangerous wreck of the *Larchwood*, a British-flagged steam ship built in 1924 and lost on 26 January 1932. The wreck is described as intact, measuring on sonar 45 m (L) by 5 m (H) (no width measurement is given), in waters 25 m deep. W_106 directly corresponds with medium potential geophysical anomaly EGL3_1551.

W_106

26.5.384 W_106 (UKHO ID: 94757) represents a dangerous wreck, detected in waters 5 m deep in September 2020 (*c*. 400 m below MLWS). Sonar measurements of 26 m (L) by 15 m (W) by 0.5 m (H) are given. W_106 directly corresponds with high potential geophysical anomaly EGL3_506.

Coastal and maritime archaeological remains and potential

26.5.385 UKHO and heritage records present a broad view of historic use of the draft Order Limits and, more widely, the North Sea. The types of vessel represented by the loss records indicate activities such as fishing, transportation and defence were undertaken, principally during the 20th century (see **Table 26-20**). Evidence of these activities may be present within the draft Order Limits, as exemplified by the four UKHO records correlated with geophysical anomalies (see **Section 26.5.381 to 26.5.384**). Remains relating to historic maritime activity may also be encountered within the intertidal zone, as exemplified by the CITiZAN records within the study area (**See paragraphs 26.5.368 and 26.5.369**).

26.5.386 Identified remains likely represent only a small percentage of the wider coastal and maritime archaeological resource within the draft Order Limits 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 (21 within the study area – see **Sections 26.5.377 to 26.5.379**) suggest that active reworking of seabed sediments may be affecting the visibility and identification of potential archaeological remains.

Aviation Archaeology

26.5.387 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

26.5.388 There are no known aviation remains within the study area. A single documented loss record relates to an F15 fighter jet ditched over the North Sea (W_084). This location is not known to correlate with physical remains.

Summary

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

Assessment of Significance

26.5.390 This Section summarises the identified archaeological potential within the study area and examines the likely significance of any remains.

Submerged prehistory

26.5.391 No *in situ* findspots or sites relating to prehistoric hominin activity have been identified within the study area. While a series of Quaternary formations have been identified, these deposits generally indicate a succession of glacigenic, glaciomarine and marine environments, unsuitable for hominin occupation. Where an identified unit has a broader archaeological potential, this has often been reduced by one or a combination of other factors, including RSL indicating a marine environment or a wider absence of hominin evidence in the regional or national record.

26.5.392 A combination of factors suggests that elements of Unit 2C may have lacustrine 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 defined within this Unit. *In situ* remains therein may be considered of regional or local significance, for their potential to inform understanding of the submerged Mesolithic and Neolithic landscapes of the North Sea and human interaction with them.

26.5.393 A small number of artefact findspots, recorded by the NRHE, 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.

26.5.394 Deriving from glacigenic, glaciomarine or marine depositional environments, many of the Units are likely to have limited potential for palaeoenvironmental remains of archaeological interest. Units 1, 2C, 2D and 3, however, have demonstrated a low or moderate potential for palaeoenvironmental remains. Such remains may be of moderate significance, for their potential to inform understanding of pre-inundation palaeolandscapes.

26.5.395 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 (Research Frameworks Network, 2025, REF 26.81);
- The National Mesolithic Research and Conservation Strategy for England (Research Frameworks Network, 2025, REF 26.82); and
- The East Midlands Historic Environment Research Framework (Research Frameworks Network, 2025, REF 26.83); especially the Palaeolithic, Mesolithic and Neolithic and Early to Middle Bronze Age Strategic Objectives.

Coastal and maritime archaeology

26.5.396 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.

26.5.397 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.

26.5.398 A total of 8,135 magnetic anomalies of between 5.0 nT and 2,028.5 nT, and 0.1 kg and 39,220 kg, with no definitive correlation with archaeological anomalies, seabed features, or infrastructure, have been identified within the data extents. Magnetic anomalies are ferrous and thus generally anthropogenic in origin, anthropogenic material has the potential to be of archaeological significance. Therefore, there is broad potential to identify additional material of potential archaeological interest within the extents of the geophysical survey data following the collection of high resolution (tighter line spacing) data prior to construction. The size of some of the anomalies (>100 nT or >1,000 kg) may indicate potential to be of archaeological interest, however the line spacing is not sufficient to determine the position.

26.5.399 Isolated findspots may be encountered for remains dating from the Mesolithic 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

26.5.400 The single documented loss record for an aircraft within the study area is not known to relate to physical remains and refers to a broad area rather than a precise location. Therefore, the overall potential for aircraft material to be present within the study area is very low.

26.5.401 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

26.5.402 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 would continue to affect the burial and preservation of remains.

26.5.403 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 would 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.

26.5.404 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 would 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 offshore environment.

26.5.405 Further offshore infrastructure projects within the region would 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.

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

26.6 Environmental measures

26.6.1 As set out in **Volume 1, Part 3, Chapter 5: PEIR 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 DCO as relevant. **Table 26-21** outlines how these design and control measures would influence the Marine Archaeology assessment.

26.6.2 All environmental measures are described in further detail within **Volume 2, Part 3, Appendix 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries.** The purpose of the WSI is to set out the environmental measures and further work of the Projects in relation to Marine Archaeology. The PAD sets out the procedure for reporting discoveries of potential archaeological interest during the Projects lifetimes. An Outline CEMP can be found in **Volume 2, Part 1,**

Appendix 1.5.C: Outline Construction Environmental Management Plan. In addition, design measures identified through the EIA process have been applied to avoid or reduce potential significant effects. Design measures included that are relevant to Marine Archaeology receptors are included in **Table 26-21** below and are also included in **Volume 2, Part 1, Appendix 1.5.A; Outline Register of Design Measures**.

26.6.3 The Outline WSI and PAD would be submitted as part of the DCO application.

Table 26-21 - Summary of the Environmental Measures

Receptor	Potential changes and effects	Embedded measures
All receptors	Direct and/or indirect impacts resulting in damage to/loss of historic material/remains	Written Scheme of Investigation: implementation of a protocol for avoiding, mitigating and managing finds of archaeological interest, following the guidance for the Protocol for Archaeological Discoveries.
		Archaeological input into specifications for and archaeological analysis of any further pre-construction surveys, including (but not limited to) UXO, Remotely Operated Vehicle (ROV), diver, geophysical and geotechnical surveys.
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.
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.
Geophysical anomalies of low archaeological potential		
Magnetic anomalies		
Unknown archaeological sites and remains		

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	Implementation of Archaeological Exclusion Zones (AEZs) or Temporary Archaeological Exclusion Zones (TAEZs) around identified known or potential Marine Archaeology receptors.
Unknown archaeological sites and remains		
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 Protocol for Archaeological Discoveries.
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.
Magnetic anomalies	Direct and/or indirect impacts resulting in damage to/loss of historic material/remains	Operational awareness of the location of geophysical/magnetic anomalies identified as having a low archaeological potential. Reporting through the PAD would be undertaken should material of potential archaeological interest be encountered.
Geophysical anomalies of low archaeological potential		

26.7 Scope of the assessment

26.7.1 This Section presents information relating to the current scope of the assessment rather than the scope as set out in the Scoping Report, accounting for comments received in the Scoping Opinion and ongoing stakeholder engagement.

Spatial Scope and Study Area

26.7.2 The spatial scope of the impact assessment for Marine Archaeology covers the area of the English Offshore Scheme contained within the draft Order Limits, together with the study area, described as follows. The study area for Marine Archaeology is shown by **Volume 3, Part 3, Figure 26-1: Marine Archaeology Study Area**.

26.7.3 The study area comprises the draft Order Limits and a 2 km buffer measured from its boundaries, within the offshore 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 draft Order Limits and indirect impacts are, at this stage, considered unlikely to result in significant effects to offshore heritage assets beyond 2 km from the causal activity.

26.7.4 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 would be informed by the results and amended, if necessary.

Tidal River Works

26.7.5 In addition to the works proposed offshore, works are proposed within a tidal river. The works consist of the following:

- Tidal river crossing of the River Nene and the River Welland by Horizontal Directional Drilling (HDD) or trenchless solution beneath the bed of the Rivers; and
- Option for the construction of a Temporary Quay on the River Nene.

26.7.6 In respect to the Tidal River Crossings and in accordance with Article 35 of the 2011 Exempted Activities Order, these activities are considered a ‘bored tunnel’ and exempt from needing a Marine Licence. Associated works would be carried wholly under the seabed, with no interaction and no potential for significant adverse effects on the offshore environment. Therefore, these works would not be included in the DMLs. Impacts relating to the HDD entry and exit above MHWS are assessed in relevant chapters of the English Onshore Scheme in **Volume 1, Part 2, Chapter 7: Cultural Heritage**.

26.7.7 The River Nene Temporary Quay is an option being explored within the Projects designs, for delivery of components for the English Onshore Scheme. At this stage, feasibility of the temporary quay is still being explored and insufficient information is available to complete a preliminary assessment. If taken forward, the ES will include a full assessment of effects of the temporary quay. **Section 26.20** outlines the further work that would be undertaken to inform the assessment.

Temporal Scope

26.7.8 The temporal scope has been informed by **Volume 1, Part 1, Chapter 4: Description of the Projects**. 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 covers the period from award of consent to the anticipated end of the Projects lifespans.

26.7.9 It assumes construction of the English Offshore Scheme would commence at the earliest 2028 and cover a period of 6 years of total construction time. Operation would commence in 2033 with periodical maintenance required during the operational 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.

26.7.10 It is during the construction phase of the English Offshore Scheme that direct impacts to Marine Archaeology receptors are most likely to occur. Indirect impacts may also occur during construction-related activities.

26.7.11 The English Offshore Scheme is expected to have a life span of more than 40 years. As described in **Section 26.1.3 and 26.1.4** it is considered that the significance of effects from decommissioning would be no greater than those during the construction phase and decommissioning effects are not discussed in detail in this chapter.

Identification of Receptors

26.7.12 **Table 26-22** summarises the principal marine archaeology receptors that have been identified as being potentially impacted by the English Offshore Scheme.

Table 26-22 - 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.
Magnetic anomalies	Baseline has identified numerous magnetic anomalies of 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 Order Limits and study area, which may experience direct/indirect impacts.
Sub-seabed deposits of palaeoenvironmental potential	Baseline has identified geological units within the Order Limits 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

26.7.13 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 26-23.**

Table 26-23 - 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
Magnetic anomalies	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

26.7.14 There are no effects that are to be scoped out of the assessment at this stage.

Key Parameters for Assessment

Realistic worst-case design scenario

26.7.15 The assessment has followed the Rochdale Envelope approach as outlined in **Volume 1, Part 1, Chapter 4: Description of the Projects** and **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology of the PEIR**. The assessment of effects has been based on the description of the Projects and parameters outlined in **Volume 1, Part 1, Chapter 4: Description of the Projects**. However, 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. 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 draft Order Limits), to that assessed here be taken forward in the final design plan.

26.7.16 In relation to Marine Archaeology, the following assumptions are made regarding the Projects design parameters in order 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.

26.7.17 The worst-case scenario may result in the maximum effect to any Marine Archaeology receptor, i.e. the total loss of all heritage value inherent to the affected receptor. The worst-case scenario is presented by **Table 26-24**.

Table 26-24 - Worst-case Scenario for Marine Archaeology Receptors

Project phase	Activity	EGL 3	EGL 4	Maximum effect
Construction	Boulder clearance	3.48 km^2	1.875 km^2	Damage to or loss of archaeological material resulting in loss of all inherent heritage value
		<2 m deep	<2 m deep	
	Pre-Lay Grapnel Run	13.20 km^2	12.75 km^2	
	Trial trenching	0.075 km^2	0.075 km^2	
	Sandwave clearance	0.23 km^2	0.17 km^2	
		138,830.02 m^3	108,280.24 m^3	
	Removal of out of service (OOS) cables	<200 m long section of OOS cable to be removed per cable		
		<2 m deep penetration of de-trenching grapnel		
	Cable laying	8.72 km^2	8.5 km^2	
		<6 m deep	<6 m deep	
	Installation of cable protection	0.915 km^2	1.135 km^2	
	Landfall (HDD pits)	4,500 m^2	4,500 m^2	
	Landfall Inspection surveys	<25 m pit depth	<25 m pit depth	
Operation	Cable repair	TBC	TBC	Damage to or loss of archaeological material resulting in loss of all inherent heritage value
	Replacement/ maintenance of cable protection			

26.7.18 Additional impacts may be experienced from vessel anchoring and jack-up activities. Such activities would adhere to the environmental measures (**Table 26-21**) and any anchoring plans would be subjected to archaeological review before the activity commences.

Assessment Methodology

Overview

26.7.19 The generic, project-wide approach to the assessment methodology is set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, and 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

26.7.20 The UK Marine Policy Statement (HM Government, 2011, REF 26.84) 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.

26.7.21 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.

26.7.22 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.

26.7.23 To define the sensitivity of a receptor, the guidelines presented in **Table 26-25** have been adopted in this Marine Archaeology assessment.

Table 26-25 - 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 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

26.7.24 The UK Marine Policy Statement (HM Government, 2011, REF 26.84) 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 significance of effect.

26.7.25 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 (English Heritage, 2008, REF 26.85):

- 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.

26.7.26 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 26-26** provides definitions for the value afforded to a receptor based on importance regarding legislation and guidance.

Table 26-26 - 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 (HM Government, 2011, REF 26.84), 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.

Value	Definition
	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

26.7.27 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.

26.7.28 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.

26.7.29 Methods set out in **Table 26-27** - 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 (HM Government, 2011, REF 26.84).

Table 26-27 - 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	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

Magnitude criteria	Beneficial effect	Adverse effect
	(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.	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 improvement to attribute quality (beneficial).	Minor loss of, or small alterations to, one or a small number of characteristics, features or elements; noticeable change in 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

26.7.30 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 26-28**. The effects are assessed as negligible, minor, moderate or major significance and can be either beneficial (positive) or adverse (negative). **Table 26-29** presents the definitions of each possible resultant significance of effect.

26.7.31 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 26-28 - Significance of Effect Matrix

		Magnitude of change			
		High	**Medium**	**Low**	**Negligible**
Sensitivity of receptor	**High**	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible

Table 26-29 - Significance of Effect Definitions

Significance of effect	Definition	
	Beneficial	**Adverse**
Major	Development would 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 would 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. Harm to a non-designated heritage asset of a greater degree than that perceived as minor adverse, which should be considered in determining an application.
Minor	Development would 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. Harm to a non-designated heritage asset that can be adequately compensated through the implementation of a programme of industry-standard mitigation measures.
Negligible	No discernible change to the receptor and its significance.	

26.8 Preliminary assessment of cumulative effects

26.8.1 At the current stage of the Projects (PEIR stage), design information for the Projects is insufficient to allow for a robust cumulative assessment to be undertaken. Furthermore, given the current position in relation to baseline data collection, with much of the environmental surveys still to be undertaken during 2025, the baseline identified at this PEIR stage cannot be taken as a complete picture of the potential presence and significance of sensitive receptors.

26.8.2 Therefore, a cumulative assessment has not been undertaken at this stage; however, **Volume 1, Part 4, Chapter 28: Cumulative Effects**, presents the long and short lists of 'other developments' which will be considered at the ES stage, 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 Projects design further evolves and in response to any comments raised at statutory consultation.

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

26.9.1 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;
- HDD; and
- Vessel anchoring/jack-up.

26.9.2 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 Landfall, along with vessel anchoring/jack-up. 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.

26.9.3 The potential for impacts to Marine Archaeology receptors within the intertidal zone would be limited as the HDD 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.

26.9.4 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.

26.9.5 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.

26.9.6 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 (English Heritage, 2008, REF 26.85). 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.

26.9.7 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.

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

26.9.9 The magnitude of impact would be reduced by environmental measures. The establishment and adherence to 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 would be implemented for each known asset, within which no construction activities would 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.

26.9.10 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.

26.9.11 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 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

26.9.12 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.

26.9.13 After application of the environmental measures, correlation of **high sensitivity** and **negligible magnitude** of impact would result in a **negligible significance of effect (no change).** 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.

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

26.10.1 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 26.9.1 to 26.9.5**).

26.10.2 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.

26.10.3 As smaller entities with lesser weight than, for example, whole wrecks, archaeological material represented by this receptor would likely be more mobile, compact and robust, having withstood or accommodated background impacts since deposition. As such, they may have the ability to accommodate, in part, impacts arising from the proposed construction activities, such as translocation through PLGR or boulder clearance.

26.10.4 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.

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

26.10.6 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.

26.10.7 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 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

26.10.8 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.

26.10.9 After application of the environmental measures, correlation of **medium sensitivity** and **low magnitude** would result in a **minor significance of effect.** 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 significant effect.

26.10.10 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.

26.11 Preliminary assessment of magnetic anomalies – construction phase

26.11.1 Construction activities also have the potential to impact magnetic anomalies. 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 **Sections 26.9.1 to 26.9.5**).

26.11.2 Magnetic anomalies are likely anthropogenic in origin but may alternatively be geological. These typically represent discarded marine/fishing equipment, however, they may represent wreck, wreck material or other entities of archaeological significance. The criteria and process for determining the archaeological potential of this receptor are detailed within **Section 26.4**. Although the review of geophysical data identified several magnetic anomalies of some archaeological potential, these could not be characterised further or positioned with confidence. No magnetic anomalies were identified which, with the current data, have been deemed likely to represent wrecks associated with other supporting evidence.

26.11.3 Wrecks may be considered of the highest value, with the potential to possess a combination of evidential, historical, aesthetic and communal values. Non-wreck related magnetic anomalies may hold moderate to negligible value, however, this cannot be refined further whilst uncertainty regarding their character and origin remains.

26.11.4 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 intrinsic, contextual or associative held (equivalent to a maximum high magnitude of impact). Indirect impacts may cause similar damage/loss, resulting in similar change to any value held by the receptor.

26.11.5 The uncertainty of the nature and value of the receptor presents difficulty in determining its capacity to accommodate impacts and therefore its sensitivity. In consideration of the low likelihood of high value remains, the likely moderate to negligible value of this receptor and the worst-case scenario, a maximum of medium sensitivity is considered.

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

26.11.7 Mitigation of impacts to this receptor would not necessarily require the establishment of AEZs, however, the magnitude of effect 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 magnetic anomalies and archaeological review of the survey results may enable other embedded mitigation to be implemented to reduce impacts to identified archaeological remains, such as the establishment of new AEZs or TAEZs.

26.11.8 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 magnetic anomalies. All embedded mitigation and methods for implementation and adherence are laid out in **Volume 2, Part 3, Appendix 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

26.11.9 In consideration of the embedded mitigation, direct impacts to magnetic anomalies 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.

26.11.10 After application of the environmental measures, correlation of **medium sensitivity** and **low magnitude** would result in a **minor significance of effect.** 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 significant effect.

26.11.11 Should further investigations or surveys provide additional data relating to one or more identified magnetic anomalies, this may result in reclassification, for example, if a magnetic 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.

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

26.12.1 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 26.9.1 to 26.9.5**).

26.12.2 The potential for hitherto unidentified wrecks and archaeological remains has been established by the current baseline, presented within **Section 26.5**. 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.

26.12.3 *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.

26.12.4 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.

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

26.12.6 Embedded mitigation has been integrated into the Projects to minimise the 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.

26.12.7 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 3.26.A: Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**.

26.12.8 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.

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

26.12.10 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

Projects. 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. Discovery therefore can be considered to have a maximum high beneficial magnitude of effect (i.e. in the instance of a discovery of the highest value).

26.12.11 Where instances of positive and negative change must be compared, industry guidance defers to professional judgement, informed by experience and expertise (English Heritage, 2008, REF 26.85). Unknown archaeological remains cannot meaningfully contribute to understanding or appreciation of the historic environment and may thus be construed as having no value, 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 offshore environment including seabed development, fishing and recreation.

26.12.12 Unmitigated impacts to unknown remains may result in total loss. Although discovery of new archaeological remains within the English Offshore Scheme may in itself result in impacts, any subsequent potential impacts would be mitigated. Appropriate preservation and the potential for new discoveries to contribute to research frameworks and objectives would result in a beneficial (positive) outcome. It is therefore considered that the maximum high negative magnitude of effect on discovery would be balanced by a maximum high positive magnitude, thereafter, resulting in an overall negligible magnitude.

26.12.13 After application of the environmental measures, correlation of **high sensitivity** and **negligible magnitude** would result in a **minor significance of effect.** The value of this receptor would be preserved as far as reasonably possible by implementation of embedded mitigation, potentially resulting in a positive magnitude of effect. Further direct/indirect impacts would be managed through the embedded mitigation, as appropriate.

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

26.13 Preliminary Assessment Sub-Seabed Deposits of Palaeoenvironmental Potential – Construction Phase

26.13.1 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 26.9.1 to 26.9.5**).

26.13.2 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 Projects' 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).

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

26.13.4 Archaeological involvement in the planning of future surveys and archaeological review of acquired data are included as embedded mitigation of the Projects, as laid out in **Volume 2, Part 3, Appendix 3.26.A: Offshore 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.

26.13.5 After application of the environmental measures, correlation of **medium sensitivity** and **negligible magnitude** would result in a **negligible significance of effect.** The value of this receptor would be preserved by implementation of embedded mitigation, offsetting the negative magnitude of effect experienced during geotechnical investigations by providing the benefit of greater understanding of the receptor.

26.14 Preliminary Assessment of Known Archaeological Sites and Geophysical Anomalies of High or Medium Archaeological Potential – Operation Phase

26.14.1 Activities during the operation phases of the Projects 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.

26.14.2 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.

26.14.3 The extent of any direct impacts during operation 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 would be experienced than has previously occurred. Direct impacts arising from operation activities therefore concern where these activities interact with areas of the seabed not previously impacted during the Projects.

26.14.4 Indirect impacts arising from operational 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.

26.14.5 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.

26.14.6 The impact assessment for known archaeological sites and geophysical anomalies of high and medium archaeological potential is the same for operational 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 significance of effect.

26.14.7 Following the application of environmental measures, **a high sensitivity** combined with **negligible magnitude** of impact would conclude a **negligible (no change) significance of effect** (**See Section 26.9** for details).

26.15 Preliminary Assessment of Geophysical Anomalies of Low Archaeological Potential – Operation Phase

26.15.1 Operational 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 26.14.1 to 26.14.5**).

26.15.2 The impact assessment for geophysical anomalies of low archaeological potential is the same for operational 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 significance of effect.

26.15.3 Following the application of environmental measures, a **medium sensitivity** combined with a **low magnitude** of impact would conclude a **minor significance of effect** (**See Section 26.10** for details).

26.16 Preliminary Assessment of Magnetic Anomalies – Operation Phase

26.16.1 Operational activities also have the potential to impact magnetic anomalies. 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 26.14.1 to 26.14.5**).

26.16.2 The impact assessment for magnetic anomalies is the same for operational 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 significance of effect.

26.16.3 Following the application of environmental measures, a **medium sensitivity** combined with a **low magnitude** of impact would conclude a **minor significance of effect** (**See Section 26.11** for details).

26.17 Preliminary Assessment of Unknown Archaeological Sites and Remains – Operation Phase

26.17.1 Operational 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 26.14.1 to 26.14.5**).

26.17.2 The impact assessment for unknown archaeological sites and remains is the same for operational 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 significance of effect.

26.17.3 Following the application of environmental measures, a **high sensitivity** combined with a **negligible magnitude** of impact would conclude a **minor significance of effect** (**See Section 26.12** for details).

26.18 Preliminary Assessment of Sub-Seabed Deposits of Palaeoenvironmental Potential – Operation Phase

26.18.1 Operational 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 26.14.1 to 26.14.5**).

26.18.2 The impact assessment for sub-seabed deposits of palaeoenvironmental potential is the same for operational 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 significance of effect.

26.18.3 Following the application of environmental measures, a medium sensitivity combined with a low magnitude of impact would conclude a minor significance of effect (See **Section 26.13** for details).

26.19 Transboundary Effects

26.19.1 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.

26.19.2 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 would be carried out by the Planning Inspectorate. Information to inform this screening assessment would be provided as part of the application for the DCO.

26.20 Further Work to be Undertaken

26.20.1 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

26.20.2 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.

26.20.3 Furthermore, the staged process for geoarchaeological review of soil samples acquired during the preliminary geotechnical investigation may have advanced to allow further discussion regarding the palaeoenvironmental and/or geoarchaeological interest within the English Offshore Scheme.

26.20.4 The current baseline would further be enhanced through the review of additional geophysical and hydrographic data that may be collected to support alterations to route alignment, and in support of the identification of pUXO.

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

26.20.6 Route development remains dynamic at the time of writing. Any micro-routeing would 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.

26.20.7 Realisation of the River Nene Temporary Quay option may also require further baseline assessment, appropriate to the scope and nature of the associated works.

Assessment

26.20.8 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 and impacts;

- A review of the significance of effect on sub-seabed deposits of palaeoenvironmental interest in consideration of the enhanced baseline regarding this receptor; and
- Review of additional data acquired for the baseline in response to any final route elements outside of the draft Order Limits and/or River Nene Temporary Quay option.

Further Environmental Measures

26.20.9 No environmental measures in addition to those outlined in **Section 26.6** and **Table 26-21** are anticipated. Further refinement of existing environmental measures should be undertaken following stakeholder engagement and/or review of additional data, as necessary.

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