The Great Grid Upgrade

Eastern Green Link 5 (EGL 5)

Preliminary Environmental Information Report

Volume 1
Part 3
Chapter 18 Intertidal and Subtidal Benthic Ecology

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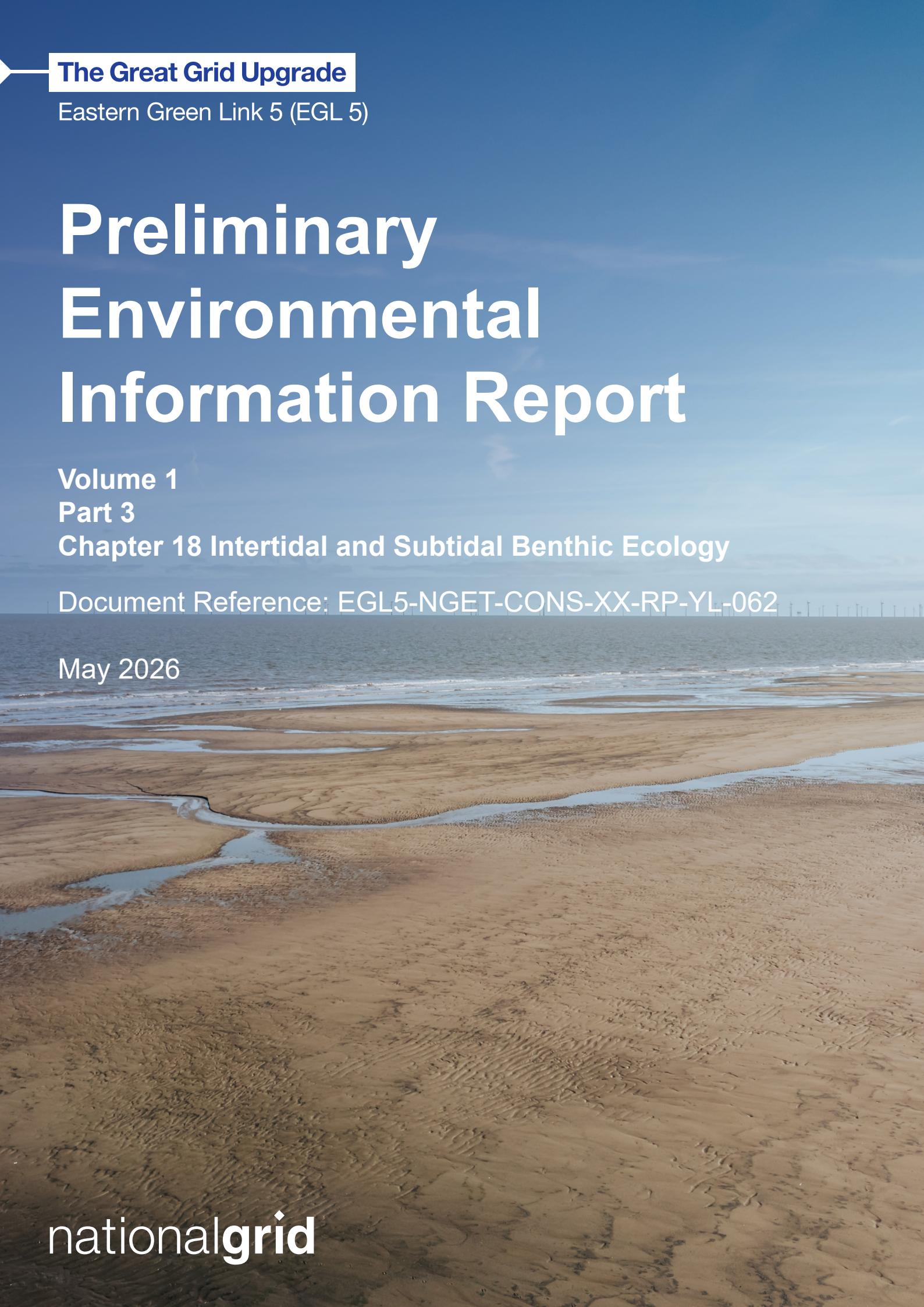

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Contents

18. Intertidal and Subtidal Benthic Ecology

18.1 Introduction

18.1.1 This chapter presents the preliminary findings of the Environmental Impact Assessment (EIA) undertaken to date for the Eastern Green Link 5 (EGL 5) English Offshore Scheme, with respect to the intertidal and subtidal benthic ecology. Benthic ecology receptors include organisms living in (infauna) or on (epifauna) the seabed, as well as their supporting habitats. The preliminary assessment is based on information obtained to date. It should be read in conjunction with the description of the Project provided in **Volume 1, Part 1, Chapter 4: Description of the Project**.

18.1.2 This chapter describes the methodology used, the datasets that have informed the preliminary assessment, baseline conditions, environmental measures, and the preliminary intertidal and subtidal benthic ecology effects that could result from the English Offshore Scheme during the construction, operation (and maintenance), and decommissioning phases. Specifically, it relates to the English Offshore elements of the Project (the English Offshore Scheme) seaward of Mean High Water Springs (MHWS) to the boundary with adjacent Scottish waters. Within this chapter, the Intertidal Zone is defined as the area between Mean Low Water Springs (MLWS) and MHWS; the subtidal area is the area seaward of MLWS.

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

- **Part 1, Chapter 2: Regulatory and Policy Overview;**
- **Part 1, Chapter 5: PEIR Approach and Methodology;**
- **Part 3, Chapter 17: Coastal and Marine Physical Processes**;
- **Part 3, Chapter 19: Fish and Shellfish**; and
- **Part 4, Chapter 27: Cumulative Effects.**

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

- **Part 2, Chapter 6: Biodiversity.**

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

- **Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area**; and
- **Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area.**

18.1.6 This chapter is supported by the following appendices in **Volume 2:**

- **Volume 2, Part 1, Appendix 2.A: Regulatory and Planning Context;**
- **Volume 2, Part 1, Appendix 2.B: Marine Plan Policy Assessment;**

- **Volume 2, Part 1, Appendix 2.C: Habitat Regulations Assessment (HRA) Stage 1 Screening Report;**
- **Volume 2, Part 1, Appendix 4.A: Electromagnetic Field (EMF) Study;**
- **Volume 2, Part 1, Appendix 4.B: EGL 5 Heat Calculations Technical Report;**
- **Volume 2, Part 1, Appendix 5.A: Outline Register of Design Measures;**
- **Volume 2, Part 1, Appendix 5.C: Outline Construction Environmental Management Plan;**
- **Volume 2, Part 3, Appendix 18.A: Intertidal Environmental Survey Report;**
- **Volume 2, Part 3, Appendix 18.B: Environmental Baseline Survey Report;**
- **Volume 2, Part 3, Appendix 18.C: Marine Conservation Zone (MCZ) Assessment Screening;**
- **Volume 2, Part 3, Appendix 18.D: Marine Conservation Zone Stage 1 Assessment**; and
- **Volume 2, Part 3, Appendix 18.E: In-Principal Benthic MEEB Strategy.**

18.1.7 **Volume 1, Part 1, Chapter 4: Description of the Project** establishes that the Applicant is applying to undertake Unexploded Ordnance (UXO) identification as part of the DML. UXO clearance would be the subject of a separate Marine Licence and EIA. A high-level preliminary assessment of the effects of UXO clearance and the potential environmental measures that would be considered as part of the separate Marine Licence application are provided in this chapter to provide a holistic overview of the effects of the English Offshore Scheme.

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

Limitations

18.1.9 The information provided in this Preliminary Environmental Information Report (PEIR) is preliminary; the final assessment of significant effects will be reported in the Environmental Statement (ES). The PEIR has been produced to fulfil National Grid Electricity Transmission plc (the 'Applicant') consultation duties in accordance with Section 42 of the Planning Act 2008 (PA 2008) and enable consultees to develop an informed view of the preliminary significant effects of the English Offshore Scheme.

18.1.10 This PEIR has been collated based on a range of publicly available data and information, as well as commissioned site-specific survey data. It is assumed that the publicly available data is accurate. The site-specific data is described further in Section 18.4.11.

18.1.11 The Anderby Creek intertidal survey for the English Offshore Scheme was undertaken in December 2025, outside of the optimal marine survey window (which is April –

October inclusive). The data gathered from the intertidal survey is still considered to provide robust characterisation of the baseline conditions at the Anderby Creek Landfall, when combined with the desk-based information provided in Section 18.5.

18.1.12 The EGL 5 environmental deoxyribonucleic acid (eDNA) data provided by the EGL 5 subtidal environmental baseline survey (EBS) may not be representative of all the macrofauna present within or migrating through the English Offshore Scheme. Certain taxa are poorly detected by eDNA analysis. Reasons for this include the marker needed to identify a species being too specific (i.e., if the target species' DNA is degraded or there are slight variations in target species' DNA sequence, the primers may be unable to amplify the target species' DNA giving a false negative result); an incomplete reference gene data bases; and low levels of DNA released into the environment by marine organisms. Taxa known to be poorly detected include Crustacea, Mollusca, Cnidaria, Bryozoa and Elasmobranchs. The eDNA dataset is just one tool in a wider toolkit to inform baseline conditions and provides useful context for the species it identifies.

18.1.13 Although the sampling design and collection process for the survey data analysed provided robust data on the benthic communities, interpreting these data by classifying and grading biotopes as three main limitations:

- It can be difficult to interpolate data collected from discrete sample locations to cover the whole study area (defined in Paragraph 18.4.2) and to define the precise extent of each biotope, even with site-specific geophysical data.
- Benthic communities generally show a transition from one biotope to another and, therefore, boundaries of where one biotope ends and the next begins cannot be defined with absolute precision.
- The classification of the community data into biotopes is not always straightforward, as some communities do not readily fit the available descriptions in the biotope classification system and the classification for subtidal benthic communities is generally regarded as incomplete.

18.1.14 In the absence of data, a precautionary approach has been taken and professional judgement, based on experience of similar linear projects, have been used where required to inform the scope of the assessment.

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

18.1.16 Despite these limitations, every effort has been made to obtain survey data and desk-based information concerning the existing environment and to accurately predict the likely environmental effects of the English Offshore Scheme. It is considered that the baseline information collected and used is representative of the study area.

Preliminary significance conclusions

18.1.17 The preliminary intertidal and subtidal benthic ecology environmental assessment presented in Section 18.10 to Section 18.17 has concluded that all potential significant effects assessed are either Negligible or Minor adverse effects and are Not Significant in EIA terms. These adverse effects can be adequately controlled by best practice and

legal controls, and opportunities to reduce their significance 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.

18.2 Relevant Technical Guidance

Technical guidance

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

18.2.2 A summary of the technical guidance used to inform this PEIR chapter is provided in **Table 18-1**.

Table 18-1 Technical guidance for intertidal and subtidal benthic ecology assessment

Technical guidance document	Context
Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland – Terrestrial, Freshwater, Coastal and Marine (Ref 18.1)	Sets out the industry standard approach to Ecological Impact Assessments (EcIA) for assessing the potential effects of a project on ecological receptors.
Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters (Ref 18.2)	Identifies the main pressures of subsea cables and sensitive habitats, as well as best practices for development in UK waters.
Natural England best practice guidance advice to facilitate sustainable development (Ref 18.3)	Uses high-quality data to provide guidance on assessing impacts on key ecological receptors, such as seabirds and marine mammals. Documents for all four phases of the "*Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards*" project provide advice for baseline surveys, pre-application engagement, data and evidence expectations at the application stage and post-consent monitoring plans.
Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Ref 18.4)	Provides guidance in the design, review and implementation of environmental data collection and analysis associated with all stages of offshore renewable energy development.

Technical guidance document	Context
Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (Ref 18.5)	Provides guidance on reporting benthic surveys to ensure consistency between consultants carrying out EIAs.
Environmental impact assessment for offshore renewable energy projects – Guide. PD 6900:2015 (Ref 18.6)	Provides guidance on writing EIAs for offshore wind projects, outlining all aspects of the EIA process. This Standard was withdrawn in 2023, but has not been officially superseded and still provides relevant advice.
The identification of the main characteristics of Annex I stony reef habitats under the Habitats Directive (Ref 18.7)	Outlines the key features of stony reefs to aid identification of Annex I stony reefs, as well as provides examples of stony reefs in UK waters.
Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Ref 18.8)	Provides a definition for Annex I Habitats, and a definition for habitats that are of 'low resemblance' to stony reefs and provides examples of areas with a 'low resemblance' to Annex I stony reefs in UK waters.
Defining and managing *Sabellaria spinulosa* reefs (Ref 18.9)	Provides a definition for *Sabellaria spinulosa* reefs.
Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Ref 18.10)	Provides advice on specific considerations for monitoring and sampling of seabed habitats and species. Advice for monitoring impacts on benthic habitats.
Marine Evidence-based Sensitivity Assessment (MarESA) (Ref 18.11)	Provides sensitivity reviews of species and habitats.
Natural England Conservation Advice for Marine Protected Areas	Provides advice on operations and advice on seasonality of designated features for marine protected areas.
Marine Pressures Activity Database (Ref 18.12)	Provides a UK-wide evidence base for linking human activities to their associated environmental pressures.

18.3 Consultation and Engagement

Overview

18.3.1 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 1, Chapter 5: PEIR Approach and Methodology**. Key consultees for this chapter include the Marine Management Organisation (MMO), Natural England and the Joint Nature Conservation Committee (JNCC).

18.3.2 An overview of the technical engagement undertaken or planned to inform the intertidal and subtidal benthic ecology assessment is provided in paragraph 18.3.5.

Scoping Opinion

18.3.3 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 13 October 2025. A summary of the relevant responses received in the Scoping Opinion in relation to the intertidal and subtidal benthic ecology, and confirmation of how these have been addressed within the assessment to date, is presented in **Table 18-2**.

18.3.4 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 18-2 Summary of EIA Scoping Opinion responses for the intertidal and subtidal benthic ecology assessment

Consultee	Category	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.2.1	Temporary habitat loss or seabed disturbance in the intertidal habitat during construction, operation and maintenance, and decommissioning.	The Scoping Report seeks to scope this matter out during construction on the basis that horizontal directional drill (HDD) would be used as the installation method in the intertidal area to avoid disturbance, and during operation as any new duct required to address cable failure would be the subject of a new marine licence. The Inspectorate agrees this matter can be scoped out for construction and operation based on the information presented. It should be clear within the DCO application that cable repair and HDD duct replacement during operation would require a new marine licence and not be authorised through the DML. However, if the HDD entry or exit pits are planned to be located in the Intertidal Zone, the ES should include an assessment of any associated likely significant effects or demonstrate the absence of likely significant effects with evidence of agreement from relevant consultation bodies. Regarding decommissioning, it is stated that the cable would likely be left in situ with no further impacts. In the absence of a definitive proposal for decommissioning, the Inspectorate cannot exclude the possibility of likely significant effects for example due to disturbance from activities associated with cable removal. This matter should be assessed for decommissioning, or the ES should demonstrate the absence of likely significant effects with evidence of agreement from relevant consultation bodies.	Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at the Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit below the 3 m Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to surface sediments and habitats. If a new cable duct is required due to a cable fault within the ducting a separate Marine Licence would be applied for. Cable repair and duct replacement work within the Intertidal Zone will not be authorised by the Development Consent Order (DCO) (including the DML). The approach to decommissioning for the cable ducting is described in **Volume 1, Part 1, Chapter 4: Project Description**. The impacts on the subtidal environment from decommissioning have been assessed in Section 18.10.

Consultee	Category	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.2.2	Temporary increase and deposition of suspended sediment in the intertidal habitat during construction, operation and maintenance, and decommissioning.	The Scoping Report seeks to scope this matter out during construction on the basis that HDD would be used as the installation method in the intertidal area to avoid disturbance, and during operation as any new duct required to address cable failure would be the subject of a new marine licence. Regarding potential frac-out of drilling fluid during construction, it states that bentonite poses little or no risk to the marine environment, limited smothering effect would occur as it would dilute within one or two tidal cycles and that measures to manage spills would be detailed in a marine pollution contingency plan. The Inspectorate agrees this matter can be scoped out for operation based on the information presented. It should be clear within the DCO application that cable repair and HDD duct replacement during operation require a new marine licence and would not be authorised through the DML. The Inspectorate is concerned about potential for subtidal construction activities to generate plumes that reach the intertidal area as noted by the MMO (Appendix 2 of this Opinion), and notes that the applicant acknowledges a risk of frac-out between the drilling bore and seabed / sediment surface. Notwithstanding the proposed commitments to frac-out management, the Inspectorate considers this impact pathway could result in significant effects during construction and advises that this should be assessed in the ES. The ES should clearly describe any measures relied upon to control and manage HDD drilling fluid frac-out, including proposals for monitoring, and explain how its delivery would be secured. The	If a new cable duct is required due to a cable fault within the ducting a separate Marine Licence would be applied for. Cable repair and duct replacement work within the Intertidal Zone will not be authorised by the DCO (including the DML). In addition, please see the response to ID 4.2.1. Measures to control and manage drilling fluid and frac-out will be provided as part of the Outline Cable Specification and Installation Plan (CSIP). The impact pathway on intertidal habitat during construction has been scoped in and a preliminary assessment is provided in Section 18.12.

Consultee	Category	Consideration	How addressed in this PEIR
		Inspectorate's comments at ID 4.2.1 of this Opinion also apply to this matter for the decommissioning phase of the proposed development.	
Planning Inspectorate ID 4.2.3	Temporary increase and deposition of suspended sediments due to sandwave clearance (pre-sweeping) in subtidal habitat during operation.	The Inspectorate agrees that where a cable requires repair because of third party damage, pre-sweeping is unlikely to be necessary as the cable would be on the seabed and, if pre-sweeping is necessary to repair faults where it was used during construction, this is unlikely to result in significant effects due to the limited spatial extent of the works. This matter can be scoped out of further assessment based on the information presented. The ES should confirm the expected frequency and nature of cable repairs in the subtidal habitat during operation.	Acknowledged. This impact pathway continues to remain scoped out as agreed – see Section 18.12. **Volume 1, Part 1, Chapter 4: Project Description** provides the expected frequency and nature of cable repairs in the subtidal habitat.
Planning Inspectorate ID 4.2.4	Underwater noise changes to subtidal species during construction, operation and maintenance, and decommissioning.	The Inspectorate does not agree that significant effects relating to underwater noise on subtidal species is unlikely. The Scoping Report does not provide information to demonstrate that noise would be localised or evidence of the level of background noise that is currently present. Furthermore, in the absence of confirmed construction details the Inspectorate considers that this matter should be scoped in for further assessment or the ES should demonstrate the absence of likely significant effects with evidence of agreement from relevant consultation bodies.	The potential for significant effects on subtidal species from underwater noise during all phases has been considered by the EIA and assessed in the Preliminary Assessment - see Section 18.14.

Consultee	Category	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.2.5 [paraphrased]	Electromagnetic changes or barrier to species movement to subtidal species from presence of cable during construction operation and decommissioning.	The Inspectorate agrees that there would be no impact pathway during construction and decommissioning as the cable would not be operational. This matter can be scoped out of further assessment for these phases of the proposed development. With respect to operation, in the absence of the proposed EMF study to validate that effects from EMF exposure would be negligible, the Inspectorate does not agree to scope this matter out at this stage. The ES should assess this matter or demonstrate an absence of likely significant effects, with evidence of agreement from relevant consultation bodies. The Inspectorate would also expect this matter to provide assessment and cross-referencing to the shellfish and fish aspect chapter, where this matter has been scoped in for further assessment.	A project-specific EMF study has been provided as **Volume 2, Part 1, Appendix 4.A: Electromagnetic Field (EMF) Study**. The potential for significant effects on benthic ecology has been considered by the EIA and assessed in the Preliminary Assessment - see Section 18.16.
Planning Inspectorate ID 4.2.5 [paraphrased]	Temperature increase to subtidal habitats and species from presence of cable during construction, operation, and decommissioning.	The Inspectorate agrees that there would be no impact pathway during construction and decommissioning as the cable would not be operational. This matter can be scoped out of further assessment for these phases of the proposed development. Regarding operation, in the absence of a Cable Burial Risk Assessment (CBRA) and confirmation of the cable burial depth that would be achieved, the Inspectorate does not have sufficient justification to exclude the possibility of significant effects. This matter should be scoped into the assessment or the ES should demonstrate, with evidence of	Impact pathway continues to remain scoped out as agreed for construction and decommissioning. This impact pathway is scoped in for assessment, presented in Section 18.17.

Consultee	Category	Consideration	How addressed in this PEIR
		agreement from relevant consultation bodies, an absence of likely significant effects.	
Planning Inspectorate ID 4.2.7	Accidental spills from presence of project vessels and equipment to intertidal and subtidal habitats during construction, operation and maintenance, and decommissioning.	The Inspectorate is content to scope this matter out noting the legal requirements upon vessels to manage any accidental spills, and that relevant measures to comply with legislation will be outlined in management plans to be submitted with the DCO application.	Acknowledged. Impact pathway continues to remain scoped out as agreed. Several management plans will be provided with the ES to support the DML. These will include an Outline Construction Environmental Management Plan (CEMP) and Outline Marine Pollution Contingency Plan (MPCP). These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme.
Planning Inspectorate ID 4.2.8	National sites designated with benthic features scoped into the assessment.	For the avoidance of doubt, the Inspectorate assumes that the reference to national sites would include international and European sites within the study area, including those listed at Table 19-8 of the Scoping Report.	The assessment of impacts on Marine Conservation Zones is presented in **Volume 2, Part 3, Appendix 18.C: Marine Conservation Zone (MCZ) Assessment Screening** and **Volume 2, Part 3, Appendix 18.D: Marine Conservation Zone Stage 1 Assessment**. The assessment of impacts on European Designated Sites (e.g., Special Areas of Conservation) is presented in **Volume 2, Part 1, Appendix 2.C: Habitat Regulations Assessment (HRA) Stage 1 Screening Report**. Designated sites considered within

Consultee	Category	Consideration	How addressed in this PEIR
			this chapter are nationally designated sites (e.g., Sites of Special Scientific Interest, National Nature Reserves).
Planning Inspectorate ID 4.2.9	Duration of impacts	Where the duration of impacts is being determined with reference to the time for recovery for various receptors, the ES should explain what evidence is being relied on to reach conclusions about the likely time for recovery from impacts.	The preliminary assessments provided in Section 18.10 to 18.17 reference evidence used to inform the significance assessments, including the sensitivity and magnitude assignments. For example, MarESA has been used to inform the sensitivities and recoverability of receptors.
Planning Inspectorate ID 4.2.10	Criteria for assessing impact magnitude	The Inspectorate advises that the proposed approach to defining impact magnitude should be clarified so that it is independent of receptor sensitivity and avoids any risk of double-counting. The applicant's attention is drawn to the MMO's comments (Appendix 2 of this Opinion) in this regard.	Magnitude is defined independently of receptor sensitivity within this assessment. The sensitivity and magnitude criteria used within this assessment is presented in Section 18.9.
JNCC	Baseline conditions	We note that the Study Area encompasses the English Offshore Scheme Scoping Boundary plus an additional 15 km buffer to either side, based on the tidal excursion. JNCC agrees that this is an appropriate approach for benthic subtidal ecology. We defer to Natural England for comments on the Study Area for the intertidal component.	Noted. Please refer to responses to Natural England Scoping comments.
JNCC	Data gathering methodology	JNCC advise that site-specific information is available for designated sites through our Site Information Centres which can be found here: https://jncc.gov.uk/our-work/offshore-mpas/ and	The resources noted have been used to inform this assessment. **Table 18-1** (the equivalent of Table 19-4 within this PEIR) has been updated to include the Pressures-Activity Database.

Consultee	Category	Consideration	How addressed in this PEIR
		these may be used as an evidence base layer over any broadscale distribution modelling. This information can also be viewed on the JNCC Marine Protected Area (MPA) Mapper available at: https://jncc.gov.uk/mpa-mapper/. We note that the Applicant has indicated that sensitivity information based upon the Marine Evidence-Based Sensitivity Assessment (MarESA) framework will be used to understand potential impacts on specific habitats and species (Table 19-4). We also note that the Marine Pressures-Activity Database (PAD) has been referenced in Section 24.6.5 and recommend that this be included in Table 19-4 for clarity.	
JNCC	Table 19-8 – Sites designated for benthic habitats and species within the study area.	JNCC note that North East of Farnes Deep MCZ has been listed in Table 19-8 however, North East of Farnes Deep Highly Protected Marine Area (HPMA) has not been included. Please note that the Conservation Objective for the North East of Farnes Deep HPMA which applies to the whole site is: *'To achieve full natural ecosystem recovery of the structure and functions, features, qualities and composition of characteristic biological communities present within HPMAs and prevent further degradation and damage to the marine ecosystem subject to natural change'*. JNCC therefore, recommend that the site be included in the list of relevant designated sites within the Study Area. We also note a slight discrepancy in the distance to the English Offshore Scheme Scoping Boundary (km) for the North East of Farnes Deep sites, compared with the distance presented in	The North East of Farnes Deep Highly Protected Marine Area (HPMA) and the North East of Farnes Deep MCZ has been included within the list of designated sites (**Table 18-7**). Distances to designated sites have been checked for consistency across sites. Potential impacts to the North East of Farnes Deep HPMA are considered within **Volume 2, Part 3, Appendix 18.C: Marine Conservation Zone (MCZ) Assessment Screening** and **Volume 2, Part 3, Appendix 18.D: Marine Conservation Zone Stage 1 Assessment**.

Consultee	Category	Consideration	How addressed in this PEIR
		Table 18-7. The distance presented in Table 18-7 is 12.29 km whereas, the distance presented in Table 19-8 is 12 km. We recommend the Applicant review these distances to ensure consistency across the application.	
JNCC	Design and Control Measures	Please see comments above regarding Design and Control measures within Chapter 18. *"JNCC agree with the approach to bury cables in the seabed, except in areas where trenching is not possible. Section 4.4.25 highlights that a preliminary Cable Burial Risk Assessment (CBRA) will be undertaken based on the results of the geophysical and geotechnical surveys to inform the PIER and ES. JNCC recommend that the potential for repeat passes of trenching and burying equipment be carefully reviewed as part of the DCO application process and suggests that if this is included as potential mitigation, it is clearly detailed how and where this may be possible using information from the surveys and CBRA. All rock placement will need to be clearly justified against the CBRA risks to the cable and predicted burial success. We have no further comments on the proposed design and control measures."*	Acknowledged. A CBRA will be used to inform the Maximum Design Scenarios. Relevant information from the CBRA, including justification for burial success, any requirement for repeat trenching passes, and the need for and extent of external cable protection will be presented within the Outline CSIP.
JNCC	Scope of Assessment	JNCC defer to our colleagues at Natural England for comments regarding impacts within territorial waters. We agree with the subtidal benthic ecology receptors that have been scoped into the assessment however, we note that UXO clearance has not been included within Table 19-9. We understand that this may be due to the Applicant's intention to apply for a separate licence for UXO	Noted. UXO clearance will not be authorised by the DML and would be the subject of a separate Marine Licence application to the MMO, informed by post-consent surveys.

Consultee	Category	Consideration	How addressed in this PEIR
		clearance should this be necessary. We would expect the Applicant to assess a worst-case scenario for benthic impacts from UXO clearance, based on data collected during site-specific geophysical surveys.	
Marine Management Organisation (MMO) ID 3.1.1	Scope of assessment	The MMO considers that the key pressures relevant to benthic ecology receptors have been scoped in. These include Temporary habitat loss / seabed disturbance; Permanent habitat loss from external cable protection; Temporary increase and deposition of suspended sediments; and Introduction / spread of Invasive Non-Native Species ("INNS"). The MMO agrees on the activities identified as sources of these pressures, the phases of the development during which they will occur, and the specific benthic ecology receptors that will potentially be affected. However, the MMO does query the scoping-out of one pressure-receptor combination (see point 3.1.2 below).	Noted. The MMO's agreement with the pressures, activities, phases and receptors scoped into the assessment is acknowledged. The pressure–receptor combination queried by the MMO is considered in detail below (Section 18.12 and 18.13) and the scope of assessment is clarified at Section 18.7.
MMO ID 3.1.2	Scope of assessment	The MMO notes that "*Temporary increase and deposition of suspended sediments*" for intertidal habitats has been screened out. While the MMO agrees this is reasonable for horizontal directional drilling ("HDD") duct installation (no open-cut works at the foreshore), it should be confirmed, with reference to plume modelling or analogous evidence, whether subtidal activities could generate plumes that reach intertidal habitats under certain tidal or wave conditions. If so, then this pressure–receptor combination should be scoped in for intertidal habitats as well as for the	**Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes** provides an assessment of the dispersal of sediment plumes. There is the potential for subtidal plumes to reach the intertidal environment and the impact pathway has been scoped in for assessment. More detail is provided in the assessment of impacts presented in Section 18.12 and 18.13. The Scope of assessment is outlined in Section 18.7.

Consultee	Category	Consideration	How addressed in this PEIR
		subtidal features that are being taken forward for assessment.	
MMO ID 3.1.3	Environmental Survey Work	The Scoping Report does not detail the sampling effort per habitat or the rationale for differences in the level of replication between stations; however, the stated subtidal sample numbers and spacing appear reasonable. Given that the surveys have already been conducted and the data are likely sufficient, the MMO considers that no action is required in relation to this point, however we raise it for awareness.	Noted. More detail of environmental survey work is provided in Section 18.4.6. Full details of the survey locations and methodology have been provided in **Volume 2, Part 3, Appendix 18.A: Intertidal Environmental Survey Report** and **Volume 2, Part 3, Appendix 18.B: Environmental Baseline Survey Report**.
MMO ID 3.1.4	Design and control measures	Several design and control measures relevant to benthic receptors are proposed (Section 19.5 in the Scoping Report), including HDD at the Anderby Creek Landfall, cable burial wherever feasible, the use of external cable protection only where necessary, and minimising seabed disturbance by anchors. These measures are appropriate.	Noted. Design and control measures are described in Section 18.6.
MMO ID 3.1.5	Consideration of Annex I Habitats	If sensitive Annex I habitats (e.g., biogenic or geogenic reef) are identified, the MMO notes that the Applicant will determine their extent and consider the need for additional surveys to further classify and avoid them (Section 19.7.10 of the Scoping Report). This approach is appropriate.	The EBS presents a full assessment of the presence of Annex I biogenic and geogenic reef, presented in full in **Volume 2, Part 3, Appendix 18.B: Environmental Baseline Survey Report**, and noted where appropriate within this chapter (i.e., Section 18.5.28).
MMO ID 3.1.6	Cumulative Pressures	The Scoping Report does not identify specific cumulative pressures for benthic receptors, which is reasonable at this stage. The MMO notes, however, that the two key pressures that it would	Noted. Cumulative Effects are discussed in Section 18.9.10. These two specific impact pathways will be considered as part of the Cumulative

Consultee	Category	Consideration	How addressed in this PEIR
		typically expect to require consideration within the Preliminary Environmental Information Report ("PEIR") and ES for a development of this type are: 1) 'Temporary increase and deposition of suspended sediments', where seabed-disturbing works from multiple projects overlap in time / space and 2) the 'Introduction / spread of INNS', where hard protection from multiple developments may together act as stepping stones that facilitate their spread. No changes are required in relation to the Scoping Report, but this should be noted for the ES.	Effects assessment presented for the ES.
MMO ID 3.1.7	Magnitude of impact criteria	The MMO notes that the definition of 'impact magnitude' is inconsistent between Chapter 5 (Table 5-3) and Chapter 19 (Table 19-11). Chapter 19 appropriately frames magnitude in terms of the pressure to which a receptor is exposed (e.g., spatial extent, duration, frequency), but both chapters also define it by referring to changes to baseline features in a way that appears to pertain to the response of the receptor itself (e.g., see section 5.5.5 of the Scoping Report). This risks double-counting and coming to invalid conclusions when determining effect significance based on a combination of impact magnitude and receptor sensitivity. The proposed approach to assessing impact magnitude should therefore be clarified and assurances made that it is defined consistently and independent of receptor sensitivity throughout the Scoping Report.	The sensitivity and magnitude criteria used within this assessment was shared and agreed with the MMO and is presented in Section 18.9.

Consultee	Category	Consideration	How addressed in this PEIR
Natural England	Designated Sites	Holderness Inshore MCZ has not been included in the Table 19.8 or Figure 19.2. It is assumed this site is outside the 15 km buffer area for the scoping red line boundary. It would be useful if the Holderness Inshore MCZ could be included in Figure 19.2, so it is transparent this site is outside the 15 km buffer for the scoping boundary.	The Holderness Inshore MCZ has been included in **Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area** (the equivalent of Figure 19-2 in the Scoping Report).
Natural England	Temporary increase and deposition of sediments – intertidal habitats	The potential impact for Temporary increase and deposition of sediments (Changes in suspended solids (water clarity) Smothering and siltation rate changes hydrocarbon and polycyclic aromatic hydrocarbons (PAH) contamination) has been screened out within the Intertidal Zone. While it is stated the proposed development will use a trenchless technique such as HDD at the Anderby Creek Landfall, as the Applicant states there remains for bentonite frac-out between the drilling bore and the seabed or sediment surface. Natural England therefore advises this impact pathway is scope in for construction and as outlined, measures to manage any such spills are included within a detailed frac-out management plan.	This impact pathway has been scoped in and is assessed in Section 18.12.
Natural England	Accidental spills	Accidental Spills impact pathway. At this stage Natural England is unable to take mitigation measures into account. Natural England advises Accidental Spill should be scoped in at this early stage.	The MMO and the Planning Inspectorate agreed in their Scoping responses that the impact of accidental pollution could be scoped out of the assessment. Justification is provided in **Table 18-11.**

Technical engagement

18.3.5 Technical engagement with consultees in relation to various disciplines within the wider PEIR is ongoing. No specific engagement with respect to intertidal and subtidal benthic ecology has occurred to date.

18.3.6 Monthly meetings are scheduled with the MMO, Natural England and JNCC between PEIR and ES. It is planned that a Technical Working Group will be established to address any comments following receipt of Section 42 Prescribed bodies comments on this PEIR. Should any further engagement with consultees specific to this discipline occur in the future, this will be made clear within the ES.

18.4 Data Gathering Methodology

18.4.1 This PEIR has been collated based on a range of site-specific survey data and publicly available data and information. It is assumed that the data collated is accurate. The data has been supplemented with additional information acquired as part of the stakeholder engagement process. The sources of data used are listed in **Table 18-3**.

Study Area

18.4.2 The study area for this receptor includes the English Offshore Scheme draft Order Limits plus an additional 19.8 km buffer to either side. This 19.8 km buffer is informed by the tidal excursion and acts a precautionary maximum zone of influence and incorporates the area within which there is the potential for direct impacts associated with the deposition of suspended sediments. It is consistent with **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**. The zone of influence will be influenced by the scale of effects predicted in **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**, which should be read in conjunction with this technical chapter.

18.4.3 The study area for the intertidal and subtidal benthic assessment and its relation to the English Offshore Scheme is presented in **Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area**.

Desk study

18.4.4 A summary of the organisations that have supplied data, together with the nature of that data is outlined in **Table 18-3**.

Table 18-3 Data sources used to inform the intertidal and subtidal benthic ecology assessment

Organisation	Data source	Data provided
Natural England	Designated Sites View (Ref 18.14)	Conservation Advice for Marine Protected Areas.
JNCC	Offshore Marine Protected Areas (Ref 18.15)	Conservation Advice for Marine Protected Areas.
JNCC	UK Sea Map (Ref 18.16)	Marine Habitats Data – UKSeaMap.

Organisation	Data source	Data provided
JNCC	Habitat suitability Model for *Sabellaria spinulosa* reefs in the UK: 2020 (Ref 18.17)	Habitat suitability model for *Sabellaria spinulosa* reefs in the UK for 2020.
National Biodiversity Network (NBN)	NBN Atlas (Ref 18.18)	Records for benthic species and habitats.
Marine Life Information Network	Marine evidence and sensitivity assessment (Ref 18.19)	Habitat and species sensitivity information.
EMODnet	EMODnet Seabed Habitats (Ref 18.20)	Broadscale predictive habitat map (EUSeaMap) based on EUNIS 2019 habitat types.
British Geological Survey (BGS)	BGS GeoIndex Offshore (Ref 18.21)	A range of marine geoscience data held within the National Geoscience Data Centre.
Marine Aggregate Levy and Sustainability Fund (MALSF)	The Humber Regional Environmental Characterisation (REC) Study (Ref 18.22)	A multidisciplinary study of the geology, biology, and archaeology of an 11,000 km² area off the east coast of England.
DEFRA	https://magic.defra.gov.uk/MagicMap.html Magic Map™ (Ref 18.23)	An interactive mapping system developed by Defra that holds spatially referenced data on the natural environment for England.
Cefas	Cefas OneBenthic Portal (Ref 18.24)	Marine Habitats data.
Various	Offshore Wind Farm (OWF) and Interconnector Environmental Statements	EIA documents for OWF developments. Ossian OWF (expected to be available for PEIR / ES) Outer Dowsing OWF Viking Link EGL 3 and EGL 4
DEFRA	Intertidal Substrate Foreshore: England and Scotland (Ref 18.25)	Intertidal substrate foreshore data.

Site Specific Surveys

18.4.5 An intertidal survey was completed for the English Offshore Scheme at Anderby Creek (Huttoft Beach) between 03 and 05 December 2025 over several tidal cycles. The intertidal survey extended between the estimated Mean Low Water Springs (MLWS) and Mean High Water Springs (MHWS) at the proposed Anderby Creek Landfall location.

18.4.6 Subtidal surveys were undertaken within a nominal 500 m wide corridor within the proposed cable corridor between 28 May and 25 June 2025.

18.4.7 The scope of the geophysical and geotechnical surveys is described in **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**. These surveys were used to focus the environmental survey strategy and subsequent data interpretation. The objective of the intertidal and subtidal environmental surveys was to:

- Characterise the benthic community and benthic habitats; and
- Determine the presence of any features that may have conservation significance.

18.4.8 To achieve these objectives, the subtidal surveys recorded seabed morphology and characterised habitats and macrofauna present through grab sample collection and analysis of drop-down video camera and transect data. Emphasis was placed on locating areas of potential conservation value (e.g., Annex I listed habitats). A sample plan to ensure sufficient data was acquired to inform the assessment of the impacts from pre-sweeping was developed in line with the principles followed for the EGL 3 and EGL 4 projects. The requirements stipulated in the sampling plan have been incorporated into the benthic sampling procedure.

18.4.9 Underwater imagery was captured at all subtidal sampling stations. EBS stations were sampled for macrofauna and physico-chemistry approximately every 4 km, potential herring (*Clupea harengus*) or sandeel (Ammodytes) spawning ground stations were sampled for particle size analysis (PSA) approximately every 2 km, and eDNA stations were sampled approximately every 10 km. Additional macrofaunal sampling was carried out at stations within the Holderness Offshore MCZ. Water eDNA samples included near-surface (TOP) and near-seabed (BOT) samples.

18.4.10 Table 18-4 summarises the number of sampling stations and camera transects acquired for the English Offshore Scheme. Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area illustrates the position of sampling stations within the draft Order Limits.

Table 18-4 Summary of environmental survey data collection

Survey technique	Data gathered
Intertidal core stations	9 stations (single physico-chemical and duplicate fauna). 3 stations (single sample).
Subtidal camera transects	260 transects.
Grab sample stations	104 macrofaunal stations (duplicate samples). 108 physico-chemical stations (duplicate samples). 101 PSD stations (single sample). 22 eDNA stations (single sample).
eDNA sample stations	23 stations (one sample near surface and one sample near seabed per station).

18.4.11 In several locations grab sampling failed due to coarse sediment or suspected hard underlying sediment. Re-attempts were made to acquire samples or stations were adjusted to avoid hard substrate. Imagery was captured from all 260 target stations.

18.4.12 It should be noted that draft survey reports were being received as the preliminary environmental assessment was being drafted. This chapter will be reviewed further once the final survey reports have been provided for the ES.

18.5 Overall Baseline

18.5.1 The following section presents the broad regional characterisation of the intertidal and subtidal benthic ecology study area and has been informed by data from EMODnet (Ref 18.20) and the EGL 5 EBS (**Volume 2, Part 3, Appendix 18.B: Environmental Baseline Survey Report**). This baseline section should be read in conjunction with **Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area**.

18.5.2 The purpose of this section is to provide a characterisation of the baseline environment to understand the diversity, abundance and function of organisms living in (infauna) or on (epifauna) the seabed up to MHWS. For the purposes of this PEIR, shellfish (with the exception of ocean quahog (*Arctica islandica*)) are covered in **Volume 1, Part 3, Chapter 19: Fish and Shellfish,** whilst habitats and species landward of MHWS have been considered in **Volume 1, Part 2, Chapter 6: Biodiversity**.

18.5.3 The baseline environment within the study area has been described in the following sub-sections using publicly available information and project-specific survey data. Habitats have been reported in accordance with the 2022 European Nature Information System (EUNIS) for classifying benthic habitats (Ref 18.26).

18.5.4 Kilometre points (KPs) have been used throughout the description to provide reference points along the English Offshore Scheme draft Order Limits. KP 0 is defined as the Anderby Creek Landfall, with KP 412 the border between English and Scottish adjacent waters – the northern most extent of the English Offshore Scheme.

Current baseline

Intertidal Zone

18.5.5 The definition of the Intertidal Zone is the area of the seashore that is exposed at low tide and inundated at high tide. The Landfall lies at Anderby Creek; foreshore sediments are largely composed of high energy infralittoral coarse sediment (MA32) (Ref 18.20).

18.5.6 The intertidal surveys conducted for the English Offshore Scheme identified that foreshore sediments consisted of coarse sediment in the upper shore (sand with variable amounts of pebbles) with occasional *Flustra flustra* bryozoan across the strand line (MA521). Farther down the shore, the substrate was finer sand (MA32). Due to the lack of suitable hard substrata for attachment, minimal epifauna and flora were observed across the survey area. Some bryozoans (*F. foliacea*), algae and sponges (Porifera) were observed along the MHWS. One live whelk (*Buccinum undatum*) was found in the mid shore area. Clusters of razor clam shells (*Ensis* sp.) were found between the mid water and MLWS, no live individuals were observed. There was generally minimal habitat variation across the Intertidal Zone.

Subtidal Zone

18.5.7 The definition of the subtidal zone is the area where the seabed is below the reach of the lowest spring tide. At the time the EBS was being undertaken, two route options were being considered; ENG Route A and ENG Route B, as shown in **Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area**. Following the mitigation hierarchy, the Applicant has since taken the decision to take forward ENG Route B as the shortest route through the Holderness Offshore MCZ to minimise the number of crossings and potential impacts to protected features.

Study Area

18.5.8 The nearshore section of the study area is dominated by MB32 Atlantic infralittoral coarse sediment with interspersed patches of MC42 Atlantic circalittoral mixed sediments. Further offshore, toward the northern region of the study area, the dominating habitat transitions to MD52 Deep circalittoral sand with interspersed patches of MD32 Deep circalittoral coarse sediment.

18.5.9 Other notable habitats within the study area, include MC221 Worm reefs in the Atlantic circalittoral zone, MC2211 *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment and MD22 Atlantic offshore circalittoral biogenic habitat. These habitats are all located in the nearshore part of the study area, within and to the south of the draft Order Limits.

18.5.10 All habitats present within the study area, as reported by EMODnet, are summarised in Table 18-5 and illustrated in Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area.

Table 18-5 Summary of subtidal broadscale habitats identified within the Study Area (EUNIS 2019 Habitats (Ref 18.20))

Habitat group	Biotope / Biotope Complex
Infralittoral sediments	MB32: Atlantic infralittoral coarse sediment
	MB42: Atlantic infralittoral mixed sediment
	MB52: Atlantic infralittoral sand
Circalittoral sediments	MC221: Worm reefs in the Atlantic circalittoral zone
	MC2211: *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment
	MC32: Atlantic circalittoral coarse sediment
	MC42: Atlantic circalittoral mixed sediment
	MC52: Atlantic circalittoral sand
	MC62: Atlantic circalittoral mud
	MD12: Atlantic offshore circalittoral rock

Habitat group	Biotope / Biotope Complex
Offshore circalittoral sediments	MD22: Atlantic offshore circalittoral biogenic habitat
	MD32: Atlantic offshore circalittoral coarse sediment
	MD42: Atlantic offshore circalittoral mixed sediment
	MD52: Atlantic offshore circalittoral sand
	MD62: Atlantic offshore circalittoral mud

18.5.11 A total of seven EUNIS Level 4 Biotope Complexes and four Level 5 Biotopes were identified within the draft Order Limits during the EBS (**Table 18-6**). It is not always possible to define Level 5 Biotopes due to the absence of certain characteristic species. In these instances, habitat classification stops at Level 4 (Biotope Complex). The nearshore sections of the draft Order Limits are dominated by MC32 Atlantic circalittoral coarse sediment with occasional areas of MC42 Atlantic circalittoral mixed sediment and MD42 Atlantic offshore circalittoral mixed sediment. From approximately KP 100, the habitat transitions to predominantly MD52 Atlantic offshore circalittoral sand. This is the predominant habitat for the remainder of the draft Order Limits until it meets Scottish waters. The findings of the EBS align closely with the EMODnet broadscale habitat information.

Table 18-6 Summary of subtidal broadscale habitats and biotope complexes identified along the draft Order Limits, along with top 10 characterising taxa

Level 2 (Biological Zone and Substrate)	Level 4 (Biotope Complex)	Level 5 (Biotope)
MB3 Infralittoral coarse sediment	MB323 Faunal communities in Atlantic infralittoral coarse sediment	-
MB5 Infralittoral Sand	MB523 Faunal communities in full salinity Atlantic infralittoral sand	-
MC2 Circalittoral biogenic habitat	MC221 Worm reefs in the Atlantic circalittoral zone	MC2211 *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment.
MC3 Circalittoral coarse sediment	MC321 Faunal communities of Atlantic circalittoral coarse sediment	-
MC4 Circalittoral mixed sediment	MC421 Faunal communities of Atlantic circalittoral mixed sediment	-
MC5 Circalittoral sand	MC521 Faunal communities in Atlantic circalittoral sand	-
		MC5212 *Abra prismatica*, *Bathyporeia elegans* and

Level 2 (Biological Zone and Substrate)	Level 4 (Biotope Complex)	Level 5 (Biotope)
		polychaetes in circalittoral fine sand.
		MC5214 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment.
MC6 Circalittoral mud	MC621 Faunal communities in Atlantic circalittoral mud	-
MD3 Offshore circalittoral coarse sediment	MD321 Faunal communities in Atlantic circalittoral coarse sediment	-
MD4 Offshore circalittoral mixed sediment	MD421 Faunal communities in Atlantic offshore circalittoral mixed sediment	-
MD5 Offshore circalittoral sand	MD521 Faunal communities in Atlantic offshore circalittoral sand	MD5212 *Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand.

18.5.12 Four main assemblages were identified through multivariate analysis of macrofaunal community data, and these were associated with sediment type (poorly sorted 'fine Sand' communities, poorly sorted 'Sand / gravel' communities, poorly sorted 'very coarse Sand' communities and very poorly sorted 'muddy sandy gravel' communities. Overall, the macrofaunal communities recorded in this study are indicative of habitats subject to a degree of surface sediment disturbance. The presence of coarse sediment, such as shell fragments and pebbles, increases habitat complexity and provides a suitable substrate for epifaunal attachment, thereby increasing biodiversity. This was reflected in the faunal diversity values, which ranged from 'poor' to 'high', with most samples having 'high' and 'good' diversity.

18.5.13 Echinodermata and Mollusca comprised most of the infaunal biomass, the former owing to the size of invertebrates, notably urchins, the latter owing to their numerical dominance and, to a lesser extent, the size of selected bivalves.

18.5.14 Habitats in the nearshore zone, generally circalittoral coarse sediment, were characterised by high abundances of the annelids *Polycirrus* sp., *Syllis garciai*, *Spio armata*, *Glycera lapidum*, *Notomastus* sp. and *Mediomastus fragilis*, as well as the arthropod *Balanus crenatus* and the mollusc *Timoclea ovata*.

18.5.15 Habitats in the offshore zone, generally offshore circalittoral sands, where characterised by high abundances of the molluscs *Abra alba*, *Nucula nucleus* and *Papillicardium minimum*, as well as a range of annelids including *Spirobranchus lamarcki*, *Lanice conchilega* and *Galathowenia oculata*.

18.5.16 More details of the habitats and biotopes recorded in the site-specific surveys in the study area can be found in **Volume 2, Part 3, Appendix 18.B: Environmental Baseline Survey Report**.

Designated Sites within the study area

18.5.17 There are several designated sites within the study area. A Habitat Regulations Assessment (HRA) Screening and MCZ Assessment Screening have been undertaken for the English Offshore Scheme and are provided in **Volume 2, Part 1, Appendix 2.C: Habitats Regulations Assessment (HRA) Stage 1 Screening Report**, **Volume 2, Part 3, Appendix 18.C: Marine Conservation Zone (MCZ) Assessment Screening** and **Volume 2, Part 3, Appendix 18.D: Marine Conservation Zone Stage 1 Assessment**. Screening identified the designated sites listed within **Table 18-7** as relevant for intertidal and subtidal benthic ecology. Whilst it is recognised that there are other designated sites within the study area with benthic features, these were outside of the relevant search areas of the screening assessments, and no source-receptor pathway has been identified between the English Offshore Scheme and the sites. The relevant designated sites are illustrated in **Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area**.

18.5.18 Three MCZs are present within the study area. The English Offshore Scheme avoids the Swallow Sand MCZ and North East of Farnes Deep MCZ and Highly Protected Marine Area (HPMA) but overlaps the Holderness Offshore MCZ for approximately 4.5 km (**Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area)**. The Holderness Offshore MCZ is designated for several protected features, including subtidal coarse, mixed and sand sediments, North Sea glacial tunnel valleys and ocean quahog. The English Offshore Scheme overlaps the North Sea glacial tunnel valley for approximately 3.5 km as shown in **Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area**. The conservation objectives of the Holderness Offshore MCZ are to recover the extent, structure, and supporting processes of sedimentary broadscale habitats and ocean quahog, and to maintain the extent, integrity, and functioning of the North Sea glacial tunnel valleys.

18.5.19 The Inner Dowsing, Race Bank and North Ridge Special Area of Conservation (SAC) (Ref 18.27) overlaps the study area at the southern end, but does not intersect the draft Order Limits. Designated features of this SAC are 1170 Reefs and 1110 Sandbanks which are slightly covered by sea water all the time. The conservation objectives for the site are to “ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- The structure and function (including typical species) of qualifying natural habitats;
- The structure and function of the habitats of the qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- The populations of each of the qualifying species; and
- The distribution of qualifying species within the site.”

Table 18-7 Sites designated for benthic habitats and species within the study area

Site name & code	Distance to the draft Order Limits (km)	Relevant designated features
Holderness Offshore MCZ UKMCZ0078 (Ref 18.28)	Overlaps with the English Offshore Scheme for 4.7	• Subtidal coarse sediment • Subtidal mixed sediments • Subtidal sand
		• North Sea glacial tunnel valleys (Silver Pit)
		• Ocean quahog (Arctica islandica)
Inner Dowsing, Race Bank and North Ridge SAC (UK0030370) (Ref 18.27)	6.7	• 1170 Reefs • 1110 Sandbanks which are slightly covered by sea water all the time
Swallow Sand MCZ UKMCZ0026 (Ref 18.29)	8.6	• Subtidal coarse sediment • Subtidal sand
		• North Sea glacial tunnel valleys (Swallow Hole)
North East of Farnes Deep MCZ UKMCZ0024 (Ref 18.30)	12.7	• Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediments • Subtidal mud
		• Ocean quahog (Arctica islandica)
North East of Farnes Deep HPMA	12.7	• All marine flora and fauna, all marine habitats and all geological or geomorphological interests, including all abiotic elements and all supporting ecosystem functions and processes, in or on the seabed, water column and the surface of the sea.
Humber Estuary Site of Special Scientific Interest (SSSI) 2000480 (Ref 18.31)	7.7	• Littoral Sediment • Wave exposed sandy shores (with burrowing crustaceans and polychaetes)
Saltfeetby-Theddlethorpe Dunes SSSI (S1002613) (Ref 18.32)	7.5	• Littoral sediment

Site name & code	Distance to the draft Order Limits (km)	Relevant designated features
Gibraltar Point SSSI (S1004400) and National Nature Reserve (NNR) (Ref 18.33)	14.6	• Littoral sediment

Protected Species and Priority Features within the study area

18.5.20 Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area illustrates the ecologically sensitive sites and features within the study area.

Sea pens and burrowing megafauna

18.5.21 Seapens and burrowing megafauna habitats occur in muddy areas at water depths from 15 m to over 200 m. It is characterised by mounds and burrows caused by the burrowing of animals, such as the Norway lobster *Nephrops norvegicus*, mud shrimps and Fries' goby *Lesueurigobius friesii.* The burrows offer shelter to smaller animals, and large invertebrates may be seen scavenging on the surface of the mud. The tall sea pen *Funiculina quadrangularis*, rare in UK waters, can occur within this habitat, as can the burrowing fireworks anemone *Pachycerianthus multiplicatus*, which is scarce in the UK and appears to be restricted to this habitat. The inclusion of this habitat in the Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) list of threatened and / or declining habitats and species is based on its ecological significance and its decline, the latter associated with habitat quality rather than extent (Ref 18.34).The habitat type is also a Habitat of Principal Importance and a UK Biodiversity Action Plan (BAP) habitat (Ref 18.35, 36)

18.5.22 Five stations (all located between KP 238 and KP 315) were assessed for the presence of this habitat type due to the identification of the seapen *Pennatula phosphorea* and burrows during video analysis. The abundance of faunal burrows created by megafaunal taxa of 3 cm to 15 cm in size, ranged between 'occasional' and 'frequent' at four of the five stations, the abundance of faunal burrows created by the Norway lobster ranged between 'occasional' and 'common' at three of the five stations and the abundance of sea pens ranged between 'rare' and 'frequent' and they were recorded at all five stations. Faunal mounds were recorded as 'rare' and 'occasional' at two of the five stations.

18.5.23 The habitat guidelines state that the seabed must be 'heavily bioturbated by burrowing megafauna with faunal burrows and mounds forming a prominent feature of the sediment surface' and that burrows should be at least 'frequent' on the SACFOR scale to be classified as a 'Sea pen and burrowing megafauna community' (Ref 18.37). Of all the transects assessed, only one station was assessed to have an abundance of faunal burrows as at least 'frequent'. At this station (ST231) the macrofaunal community at station ST231 was considered more representative of '*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand' (MD5212), despite particle size distribution (PSD) analysis reporting a mud fraction of 24.09 %.

Ocean quahog *Arctica islandica*

18.5.24 The ocean quahog is found inshore around all British and Irish coasts, as well as offshore. The growth rate of ocean quahog is rapid in juveniles but very slow and

indeterminate in adults. Individual growth rates vary widely across regions in the North Atlantic, within sites, between seasons and daily, depending on temperature, salinity, hydrography and food supply. They are the longest-lived unitary species with the oldest recorded specimen found being 507 years old (Ref 18.38).

18.5.25 The ocean quahog is a burrowing species which has been found in a range of sediments, from coarse clean sand to muddy sand, in water depths typically ranging from 4 m to 482 m deep. Ocean quahogs are thought to be highly sensitive to physical habitat loss. It is therefore important to conserve the extent and distribution of supporting habitats to provide the best chance of any potential settlement for new recruits and to retain existing individuals (Ref 18.39).

18.5.26 The ocean quahog is a protected feature of the following designated sites within the study area:

- Holderness Offshore MCZ; and
- North-East of Farnes Deep HPMA and MCZ.

18.5.27 Five ocean quahog adult individuals were recorded at five different grab sampling locations from KP 330 - 360 (ST257, ST261, ST279, ST281 ST287, ST291) and 38 juveniles were recorded at 19 grab sampling stations from KP 180 - 360 (ST185, ST187, ST189, ST193, ST197, ST211, ST213, ST215, ST217, ST219, ST225, ST233, ST239, ST259, ST261, ST267, ST271, ST275 and ST279). The eDNA analysis of water samples identified ocean quahog DNA at five additional stations (ST195, ST193, ST215, ST225 and ST265). None of these stations were within the Holderness Offshore MCZ and all are relatively clustered together in the northern part of the draft Order Limits.

Annex I Reefs

18.5.28 Annex I reef habitats are protected under the Habitats Regulations. The definition of an Annex I reef, based on the Interpretation Manual of European Union Habitats (Ref 18.40), is as follows:

> ‘Reefs can be either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions’.

18.5.29 Within UK waters, three types of Annex I reef have been identified: stony, bedrock and biogenic. The JNCC Annex I Reefs in UK waters dataset (Version 8.3, 2022) was used to identify Annex I reef habitat within the study area. This data is illustrated in **Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area**.

18.5.30 Review of publicly available habitat data suggests there is a small area of Annex I bedrock and / or stony reef in the south of the study area near KP 64, which does not overlap with the draft Order Limits. There are further areas of Annex I bedrock and / or stony reef further offshore between KP 141 and KP 170 and between KP 220 and KP 278. The majority of these areas are within the wider study area out with the draft Order Limits, with the exception of a small area near KP 160. These Annex I reef habitats are located outside an SAC.

18.5.31 Aggregations of cobbles at 38 stations were assessed for the potential to constitute Annex I stony reef following Irving (Ref 18.7) and Golding *et al.* (Ref 18.8). ‘Medium reef’ was assessed along the entirety of the photographic data acquired at stations ST013

and ST021a (KP 26 and KP 42 respectively). At stations ST022a (KP 44), ST072 (KP 25) and ST102 (KP 68), alternating 'Medium reef' and 'Low reef' were identified. At station ST074 and along sections of stations ST044, ST094, ST103 and ST105, due to a more established emerging epifaunal community observed, the assessment was 'Possible reef with veneer'. At the remaining stations investigated the assessment was 'Low reef' (14 stations) or 'Not a reef' (15 stations). Transects along the section of the draft Order Limits that passes through the Holderness Offshore MCZ had twenty-nine patches assessed as 'Low Reef' with one small area (two patches) of 'Medium reef'.

18.5.32 The EBS did not note the presence of any 'rocky reef'; the only geogenic reef present within the study area is 'stony reef'.

18.5.33 Annex I *S. spinulosa* reef is present at the southern end of the study area, with the closest reef situated 4 km from the English Offshore Scheme. This reef is 12 km long and the largest reef within the study area and is a designated feature of the Inner Dowsing, Race Bank and North Ridge SAC. Smaller patches of Annex I *S. spinulosa* reefs are also present to the east of the aforementioned reef along the edge of the study area.

18.5.34 *S. spinulosa* was observed at stations ST008 (KP 17) and ST011 (KP 9), both near the southern part of the draft Order Limits. Approximately 80% of the transect at ST011 was medium reef, with 10% 'low reef' and 10% not a reef. ST008 was assessed to be 'Not a Reef' as the aggregations represented a crust with minimal fresh tube growth observed.

Subtidal sands and gravels

18.5.35 Subtidal sands and gravels are a broad habitat type listed as a Habitat of Principal Importance under Section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act as well as a UK Biodiversity Framework habitat. They are a designated feature of the Holderness Offshore MCZ, Swallow Sand MCZ and the North East of Farnes Deep MCZ and HPMA.

18.5.36 Habitats associated with subtidal sands and gravels, such as MC32 Atlantic circalittoral coarse sediment, and MC52 circalittoral sand, dominate the study area. This suggests the presence of subtidal sands and gravels throughout large proportions of the study area.

Future baseline

18.5.37 This section will set out how the current baseline is predicted to change naturally in the absence of the English Offshore Scheme.

18.5.38 The existing habitats within the English Offshore Scheme are dominated by sand, with mixed and coarse sediment habitats interspersed along the draft Order Limits. The existing macrofauna is dominated by polychaetes, with occasional presence of *S. spinulosa* and ocean quahog. Generally, the existing baseline conditions for intertidal and subtidal benthic ecology is stable. However, it is influenced by a combination of physical processes that occur within the North Sea, anthropogenic activities, such as fishing, in particular beam trawling and the development of man-made structures within the North Sea and so is subject to a degree of natural change.

18.5.39 Rising sea temperatures, as a result of anthropogenically induced climate change, can cause northerly migration of benthic species. At a large scale, this can alter the abundance and biodiversity within a given area, consequently changing habitat composition. This was supported by the findings of Hiddink *et al.* (Ref 18.41), who evaluated changes in the distribution of 65 common benthic invertebrate species between 1986 and 2000. These species demonstrated a northwesterly migration toward deeper, cooler waters, which positively correlated with increases in seabed temperatures. Thus, as sea temperatures continue to rise, changes in the habitats and biodiversity of benthic communities within the study area could occur in the absence of the English Offshore Scheme. These changes could subsequently alter rates and timings of ecosystem processes such as nutrient recycling, larval supply and organic waste assimilation. There could also be indirect effects to benthic ecology due to changes in hydrodynamic conditions brought about due to climate change.

18.6 Environmental Measures

18.6.1 As set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, the environmental measures are characterised as design measures or control and management measures. A range of environmental measures would be implemented as part of the English Offshore Scheme and will be secured though the DML and in the DCO as relevant. **Table 18-8** outlines the design and control measures proposed to reduce the potential for impacts on intertidal and subtidal benthic ecology.

18.6.2 Design measures that are relevant to the intertidal and subtidal benthic ecology assessment are denoted by a (D) in the ID reference column in **Table 18-8**. These are also included in **Volume 2, Part 1, Appendix 5.A: Outline Register of Design Measures**.

18.6.3 Several Outline Management Plans will be provided with the DCO application to support the DML. These include an Outline CEMP and an Outline MPCP. These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) across all phases of the English Offshore Scheme. Final management plans will be developed post-consent in accordance with the outline plans and in consultation with the licensing authority and relevant stakeholders. Control and management measures that are relevant to the intertidal and subtidal benthic ecology assessment are denoted by a (C) in the ID reference column in **Table 18-8**. These control and management measures are also included within the Outline CEMP that can be found in **Volume 2, Part 1, Appendix 5.D: Outline Construction Environmental Management Plan (CEMP)**.

Table 18-8 Summary of environmental measures

Receptor	Potential changes and effects	Environmental measures	ID reference
Intertidal habitats and species	Temporary habitat loss / seabed disturbance	The Intertidal Zone would be crossed by a trenchless technique to avoid disturbance to intertidal sediments and habitats.	OMT01 (D)
Intertidal habitats and species	Temporary habitat loss / seabed disturbance	The trenchless construction technique exit will be below the 3 m Lowest Astronomical Tide (LAT) depth contour.	OMT02 (D)
Subtidal habitats and species	Temporary habitat loss / seabed disturbance	The cables shall be buried in the seabed, except in areas where burial is not possible e.g., where ground conditions do not allow or at infrastructure crossings.	OMT03 (D)
Subtidal habitats and species	Permanent habitat loss due to the deposit of external cable protection	External cable protection features would only be installed where considered necessary for the safe operation of the English Offshore Scheme. This includes the repair of cables due to accidental damage, where target burial depth is not achieved and at infrastructure crossings.	OMT04 (D)
Subtidal habitats and species	Permanent habitat loss due to the deposit of external cable protection	In sites designated for benthic features, external cable protection materials will be selected to match the environment (e.g., when cables are installed in areas of cobbles or other natural rock features, rock of similar diameter as the receiving environment should be used as an alternative to the current normal approach of using terrestrially sourced granite, where feasible).	OMT05 (D)
Subtidal species (including ocean quahog)	Electromagnetic changes	High Voltage Direct Current (HVDC) poles would be bundled to minimise the effects of electromagnetic fields (EMFs).	OMT06 (D)
Subtidal habitats and species	Temporary habitat loss / seabed disturbance	Designated (and as minimal as possible) anchoring areas and protocols shall be employed during marine operations to minimise physical disturbance of the seabed.	OMT07 (D)
Subtidal habitats and species	Temporary habitat loss / seabed disturbance	No cable burial trial trenching will be undertaken within the Holderness Offshore Marine Conservation Zone, unless otherwise agreed in writing by the MMO.	OMT08 (D)

Receptor	Potential changes and effects	Environmental measures	ID reference
Subtidal habitats and species	Introduction or spread of marine invasive non-native species (MINNS)	Any material introduced into the marine environment, such as rock protection material, will be from a suitable source or cleaned to ensure no MINNS can be introduced.	BE01 (D)
Intertidal habitats and species	Temporary habitat loss / seabed disturbance	Drilling fluids required for trenchless operations would be carefully managed to minimise the risk of breakouts into the marine environment. This would include the use of biodegradable drilling fluids (pose little or no risk (PLONOR) substances) where practicable.	OMT01 (C)
Intertidal and subtidal habitats and species	Accidental spills	All oil, fuel and chemical spills would be reported to the Marine Management Organisation (MMO) Marine Pollution response team in accordance with the MPCP.	OMT03 (C)
Intertidal and subtidal habitats and species	Accidental spills	Chemicals will be chosen from the list of chemicals approved under the Offshore Chemical Notification Scheme (OCNS).	OMT04 (C)
Subtidal species	Underwater noise changes	In accordance with the UK Government (2025) guidance "*Supporting minimising environmental impacts from unexploded ordnance clearance*" the UXO mitigation hierarchy would be followed for any targets identified during the UXO survey and confirmed as UXO.	OMT06 (C)
Subtidal species	Underwater noise changes	The Applicant would apply for a separate Marine Licence and European Protected Species Licence for UXO clearance.	OMT07 (C)
Subtidal habitats and species	Temporary habitat loss / seabed disturbance	Micro-routeing within the English Offshore Scheme draft Order Limits shall be undertaken to avoid environmental and sensitive seabed features where possible.	OMT13 (C)

18.7 Scope of the Assessment

Spatial scope and study area

18.7.1 The spatial scope of the assessment of intertidal and subtidal benthic ecology covers the area of the English Offshore Scheme contained within the draft Order Limits, together with the study area for intertidal and subtidal benthic ecology described in Section 18.4 and illustrated in **Volume 3, Part 3, Figure 18-1: Subtidal Seabed Sampling Stations, Seawater Sampling Stations and Broadscale Habitats within the Study Area**.

Temporal scope

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

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

Identification of receptors

18.7.4 **Table 18-9** summarises the principal intertidal and subtidal benthic ecology receptors that have been identified as being potentially impacted by the English Offshore Scheme. It should be noted that certain receptors included as a potential receptor for consideration by the EIA in the Scoping Report were found not to be present within the draft Order Limits following the EBS. Receptors that have been scoped out of the assessment are identified in **Table 18-11**.

18.7.5 The Scoping Report identified a potential receptor as ‘broadscale subtidal habitats’. Following the marine characterisation surveys, greater clarity has now been provided, and **Table 18-9** includes receptors present within the English Offshore Scheme. For example, ‘Subtidal Sands and Gravels’ was identified throughout most of the English Offshore Scheme and is a ‘Habitat of Principal Importance’ under Section 41 of the 2006 NERC Act. Therefore, ‘Subtidal Sands and Gravels’ has been identified as its own receptor.

Table 18-9 Intertidal and subtidal benthic ecology receptors subject to potential effects

Receptor	Reason for consideration
National sites designated with benthic features including the Holderness Offshore MCZ, Swallow Sand MCZ, North East of Farnes Deep HPMA and North East of Farnes Deep MCZ	These sites are considered relevant by the MCZ Assessment **Volume 2, Part 3, Appendix 18.C: Marine Conservation Zone (MCZ) Assessment Screening** and **Volume 2, Part 3, Appendix 18.D: Marine Conservation Zone Stage 1 Assessment**.
European sites designated with benthic features including the Inner Dowsing, Race Bank and North Ridge SAC	These sites are considered relevant by the HRA Assessment (**Volume 2, Part 1, Appendix 2.C: Habitat Regulations Assessment (HRA) Stage 1 Screening Report)**.
National sites designated with benthic features including Gibraltar Point SSSI, Humber Estuary SSSI and Saltfleetby – Theddlethorpe Dunes SSSI	Designated features of these sites include littoral sediments. Whilst the proposed Anderby Creek Landfall location is not within the sites' boundaries, there is the potential for impacts associated with works to the Intertidal Zone.
Intertidal habitats	Whilst the majority of the direct impacts would be avoided due to the commitment to use trenchless techniques at the Anderby Creek Landfall, consideration has been given to potential impacts to intertidal habitats from drilling fluid breakout.
Subtidal broadscale habitats	The draft Order Limits and wider study area contain commonly occurring infralittoral and circalittoral habitats that are widely distributed within the North Sea region. The construction, operation and maintenance and decommissioning phases of the English Offshore Scheme could cause abrasion of the seabed surface, penetration of the substrate below the surface and change the type of benthic habitat present. Additionally, pre-sweeping could cause a temporary increase and deposition of suspended sediments, which in turn can cause smothering of habitats. MarLIN sensitivity assessments suggest the habitats present within the English Offshore Scheme have varying levels of sensitivity (low to high) to the potential impacts stated. Localised heating of sediments during the operation of the HVDC cables could cause localised avoidance by benthic species. This could lead to a lack of bioengineering benthic species within the area and can cause a shift in the habitats present. This is common in cable bundles buried less than 0.75 m.
Subtidal sands and gravels	This broad habitat type is listed as a 'Habitat of Principal Importance' under Section 41 of the 2006 NERC Act and a FoCI for several MCZs within the study area.
Subtidal Annex I geogenic reefs (stony and rocky reefs)	The study area contains Annex I geogenic reef habitats located outside of SACs. Annex I reef habitats are protected under the

Receptor	Reason for consideration
	Habitats Regulations. The construction, operation and maintenance and decommissioning phases of the English Offshore Scheme could cause abrasion of the seabed surface, penetration of the substrate below the surface and change the type of benthic habitat present. As outlined by MarLIN sensitivity assessments, Annex I habitats are highly sensitive to the listed impacts.
Annex I *Sabellaria spinulosa* reefs	The study area contains Annex I *S. spinulosa* reef habitat located within and outside of SACs. Annex I *S. spinulosa* reefs are protected under the Habitats Regulations and the 2006 NERC Act, designated as a UK BAP habitat and FoCI, as well as being listed as a threatened and / or declining habitat by OSPAR. they are present within the draft Order Limits and wider study area and therefore there is the potential for temporary and permanent habitat disturbance to these habitats. Temporary and permanent habitat disturbance could cause loss of these habitats. Increased suspended sediment could cause smothering of these habitats and mobilise contaminants within the marine environment, interfering with the natural biological processes of *S. spinulosa.*
Sea-pen and burrowing megafauna communities	Feature of conservation importance and potentially present within the draft Order Limits.
Subtidal species	Subtidal benthic species such as crustaceans and molluscs live within and on the sediment of marine habitats and are subject to disturbance during marine cable construction, operation and maintenance and decommissioning, particularly due to habitat disturbance and disruption due to EMF and heat changes.
Ocean quahog (*A. islandica*)	Ocean quahog are thought to have a high sensitivity to physical loss of habitat and are a protected feature of the Holderness Offshore MCZ, North East of Farnes Deep MCZ and HPMA. It is also included in the OSPAR list of threatened or declining species (Ref 18.42), with seabed disturbance from anthropogenic activities being a main threat to this species (Ref 18.43).

Potential effects considered within this assessment

18.7.6 The effects on intertidal and subtidal ecology receptors which have the potential to be significant and have been taken forward for further assessment are summarised in **Table 18-10**.

Table 18-10 Intertidal and subtidal benthic ecology receptors scoped in for further assessment

Receptor	Likely significant effects
• Subtidal broadscale habitats and species • Subtidal sands and gravels • Subtidal Annex I geogenic reefs • Annex I *S. spinulosa* reefs • Seapens and burrowing megafauna • Ocean quahog	**Temporary habitat loss / seabed disturbance** from seabed preparation, cable burial, and cable de-burial.
• Subtidal broadscale habitats and species • Subtidal sands and gravels • Subtidal Annex I geogenic reefs • Annex I *S. spinulosa* reefs • Seapens and burrowing megafauna • Ocean quahog	**Permanent habitat loss** from external cable protection.
• Intertidal habitats • Designated sites with intertidal features • Subtidal broadscale habitats and species • Subtidal sands and gravels • Subtidal Annex I geogenic reefs • Annex I *S. spinulosa* reefs • Ocean quahog	**Temporary increase and deposition of suspended sediments, including disturbance mobilisation of sediment bound contaminants** from seabed preparation, cable burial, the trenchless technique and cable de-burial.
• Subtidal species (including Ocean quahog)	**Underwater noise changes** from project vessels and equipment and UXO clearance.
• Subtidal broadscale habitats • Subtidal sands and gravels • Subtidal Annex I geogenic reefs • Subtidal Annex I *S. spinulosa* reefs • Ocean quahog	**Introduction of marine invasive non-native species** from project vessels and equipment and external cable protection.

Receptor	Likely significant effects
• Subtidal species (including Ocean quahog)	**Electromagnetic changes and barrier to species movement** from the presence of operational marine cables.
• Subtidal species (including Ocean quahog)	**Temperature increase** from the presence of operational marine cables.

18.7.7 On the basis of the baseline environment and the description of the English Offshore Scheme provided in **Volume 1, Part 1, Chapter 4: Description of the Project**, the receptors / impacts detailed in **Table 18-11** have been scoped out for further assessment because the potential effects are not considered likely to be significant.

Table 18-11 Summary of effects scoped out of the intertidal and subtidal benthic ecology assessment

Receptors / potential impact	Justification
Annex I *Modiolus modiolus* and *Mytilus edulis* beds – all impacts	The baseline characterisation has confirmed that these Annex I habitats are not present within the study area.
Intertidal habitats - Temporary habitat loss / seabed disturbance (Abrasion / disturbance of the substrate on the surface of the seabed. Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion) (Construction, Operation and Maintenance)	The Intertidal Zone at the Anderby Creek Landfall would be crossed using trenchless techniques (e.g., HDD) to avoid disturbing surface sediments and habitats. There is therefore no impact pathway, and it is scoped out of the assessment. During operation and maintenance, the likelihood that the English Offshore Scheme requires maintenance and repair is low. If the cables were to fail within the cable duct, there is no means of repairing them, and a new duct would need to be drilled. This would be the subject of a separate Marine Licence. Therefore, impacts during operation and maintenance have been scoped out for the intertidal area.
National sites designated with intertidal features including Humber SSSI, Saltfleetby-Theddlethorpe Dunes SSSI and Gibraltar Point SSSI – temporary habitat disturbance and permanent habitat loss	The Intertidal Zone at the Anderby Creek Landfall would be crossed using trenchless techniques (e.g., HDD) to avoid disturbing surface sediments and habitats. There is therefore no impact pathway for temporary or permanent habitat loss and disturbance during construction, and it is scoped out of the assessment. During operation and maintenance, the likelihood that the English Offshore Scheme requires maintenance and repair is low. If the cables were to fail within the cable duct, there is no means of repairing them, and a new duct would need to be drilled. This would be the subject of a separate Marine Licence. Therefore, impacts during operation and

Receptors / potential impact	Justification
	maintenance have been scoped out for the intertidal area.
Intertidal and subtidal habitats and species – Accidental spills (Hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination) due to presence of project vessels and equipment (Construction, Operation and Maintenance)	There is a risk of pollution being accidentally released during the construction, operation and maintenance and decommissioning phases from sources including vessels / vehicles and equipment / machinery. However, the risk of such events is managed by the implementation of measures set out in standard post-consent plans (e.g., Environmental Management Plan, including MPCP). Project vessels and contractors will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 which relates to pollution from oil from equipment, fuel tanks, and other ship-based sources, and release of sewage (black and grey water). It is a legal requirement that all vessels have a Shipboard Oil Pollution Emergency Plan (SOPEP). Compliance with Regulations together with the implementation of secured management plans, is expected to reduce the likelihood and consequences of accidental spills and will be sufficient to minimise environmental risks. As such, this impact was scoped out of further consideration within the PEIR. The MMO and the Planning Inspectorate agreed in their Scoping responses that the impact of accidental pollution could be scoped out of the assessment.
Subtidal habitats - Temporary increase and deposition of suspended sediments, (Changes in suspended solids (water clarity), Smothering and siltation rate changes, Hydrocarbon and PAH contamination. (Operation and Maintenance)	Generally, during operation and maintenance, remedial works are focused on protecting sections of cable that have become exposed due to sediment mobility or to repair cables that have been damaged by a third party (e.g., fishing damage). Pre-sweeping would not be required during a cable repair for third-party damage, as the cable would already be exposed on the seabed.
Seapens and burrowing megafauna - Temporary increase and deposition of suspended sediments, (Changes in suspended solids (water clarity), Smothering and siltation rate changes) (all phases)	One station was identified to potentially contain this habitat type. MarESA concludes that this habitat type is not sensitive to this impact pathway (Ref 18.44) as it is associated with mud-dominated habitats subject to a natural degree of siltation and accretion. Given the very limited presence of the habitat type across the English Offshore Scheme and the lack of sensitivity, the impact pathway is scoped out of further assessment.

18.8 Key Parameters for Assessment

Realistic worst-case design scenario

18.8.1 The assessment has followed the Rochdale Envelope approach as outlined in **Volume 1, Part 1, Chapter 4: Description of the Project** and **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**. The assessment of effects has been based on the description of the Project and parameters outlined in **Volume 1, Part 1, Chapter 4: Description of the Project**. However, where there is uncertainty regarding a particular design parameter, the realistic worst-case design parameters are provided below with regards to intertidal and subtidal benthic ecology along with the reasons why these parameters are considered worst-case. The preliminary assessment for 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.

18.8.2 In relation to intertidal and subtidal benthic ecology **Table 18-12** summarises the assumptions made regarding the English Offshore Scheme design parameters in order to ensure a realistic worst-case assessment has been undertaken.

Table 18-12 Key parameters for the intertidal and subtidal benthic ecology assessment

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
Temporary Habitat Loss / Seabed Disturbance	✓	✓	✓	**Construction** **Total subtidal temporary habitat disturbance = 13.91 km²** **Seabed Preparation** **Trenchless technique exit pits** – 2 x 750 m² **Boulder clearance** – 8.46 km², pre-lay plough with swathe of 20 m assumed across approximately 423 km of the English Offshore Scheme (20 m x 423 km of route) (assumed to be within footprint of pre-lay grapnel run (PLGR)). **Sand wave clearance** – 1.2 km² precautionary footprint for use of trailing suction hopper dredger and / or controlled flow excavation (CFE). Precautionary estimate assuming clearance along 60 m width x 20.04 km). **Pre-Lay Grapnel –** 12.9 km² footprint with swathe of 30 m x 423 km route length. **Cable burial trial trenching** –125,000 m² footprint of trial trenching (25 m x 5,000 m length). **Cable Installation** Impact will occur fully within combined footprint from seabed preparation activities.	The MDS for temporary habitat loss / seabed disturbance relates activities associated with seabed preparation and cable lay and burial. It should be noted that boulder clearance overlaps with the PLGR footprint and this is reflected in the total area of subtidal temporary habitat disturbance. The subtidal habitat disturbance MDS includes other de-minimis footprints such as from the jack-up barge, anchors and temporary deposits.
				Operation and Maintenance **Total subtidal temporary habitat disturbance = 0.315 km²** De-burial and re-burial of cable failure points across 13 km of bundled cables (25 m cable plough footprint x 13,000 m length).	Assumes an indicative 13 cable repairs and eight cable remediations over project lifetime.

Impact		Phase C	Phase O	Phase D	Maximum Design Scenario (MDS)	Justification
					Decommissioning Refer to the construction phase MDS.	MDS is similar (or less) to that of the construction phase.
Permanent Loss	Habitat	✓	✓	✓	**Construction** **Total permanent habitat loss = 1.94 km²** **Cable Crossings –** 464,000 m² assuming rock berm 16 m width and 29,000 m in total length (58 crossings). **External Cable Protection –** 1,472,000 m² to reach target burial depth assuming rock berm (16 m width x 92 km remedial external cable protection length).	Maximum effect of permanent habitat loss will occur because of the maximum area of seabed covered by external cable protection and cable crossings protection (i.e., rock berms).
					Operation and Maintenance **Total permanent habitat loss = 0.336 km²** **External cable protection remediation –** 128,000 m² total length of remediation 8,000 m x 16 m width. **Cable repairs –** 208,000 m² total length of external cable protection for cable repairs (13,000 m x 16 m width).	MDS for operation and maintenance is external cable protection.
					Decommissioning No additional external cable protection will be placed during decommissioning.	
Temporary increase in suspended sediments and sediment deposition		✓	✓	✓	**Construction** **Total sediment volume = 736,199 m³** **Seabed Preparation** • Pre-sweeping [TSHD] – Suspension of 33,715 m³ during placement and 26,972 m³ during dredging. **Cable Installation**	For seabed preparation the MDS results from placement of dredged sediment from a TSHD. While the overall volume of sediment suspended is less than that disturbed by CFE, the rate of release and height of release are such that clearance by TSHD is the MDS. While all dredged

Impact	Phase C O D	Maximum Design Scenario (MDS)	Justification
		• Cable Trenching [jet trencher or CFE] – Suspension of 666,225 m³ (30% of CSA x route length). **Trenchless technique Operations** • Exit Pit Excavation – Suspension of 1,687.5 m³ (30% of volume for three exit pits). • Trenchless Technique Drilling Fluid Release – Maximum volume and mass of drilling fluid released per trenchless technique – 7,600 m³ (304 m³ of bentonite) over 12 hours with estimated release rate of 19.7 kg/s.	sediment is released in suspension, only 10% will form a passive plume (with the other 90% descending rapidly to the bed as a dynamic plume). Only a small proportion of this sediment will disperse more than 100 m from the placement site (the fine sediment fractions). The quoted volumes include a 20% contingency. For cable installation, the MDS results from cable trenching with a jet trencher or CFE with 30% of sediment expected to be suspended. Only a small proportion of this sediment will disperse more than 100 m from the placement site (the fine sediment fractions). Length of 423 km x 1.5 m wide x 3.5 m deep rectangular trench. For trenchless technique operations, the MDS results from using a CFE for exit pit excavation with 30% of sediment expected to be suspended. Maximum release: 7,600 m^3 of drilling fluid at punch-out. Drilling fluid 4% bentonite, 96% water. Density of bentonite 2,800 kg/m^3.

Impact		Phase C	Phase O	Phase D	Maximum Design Scenario (MDS)	Justification
					Operation and Maintenance De-burial and re-burial of cable failure points across 13 km of bundled cables (15 m cable plough footprint x 13,000 m length).	Impacts during operation and maintenance will be less than those during construction.
					Decommissioning Refer to the construction phase MDS.	If the English Offshore Scheme is removed, temporary increase in suspended sediment concentrations and subsequent deposition will be the same as during construction.
Underwater changes	noise	✓	✓	✓	**Construction** Maximum of 17 vessels on each of nearshore and offshore campaigns at any one time. Maximum of nine vessels involved in trenchless technique enabling and cable pull in in nearshore. Geophysical survey – Sub-bottom profiler. UXO clearance – high order detonation (maximum charge 697 kg). UXO clearance – low order detonation (maximum charge 0.5 kg).	Maximum noise is from high order detonation for UXO clearance. A detailed UXO survey will be completed prior to construction. The type, size and number of possible detonations and duration of UXO clearance operations is not known at this stage. The Applicant is not seeking to licence UXO activities in the DCO Application, but a high-level consideration has been provided and the values reported should be considered indicative estimates. Pre-construction works are predicted to generate underwater noise.
					Operation and Maintenance Maximum of five vessels per cable repair operation.	Maximum number of vessels required for simultaneous cable repair in several locations.
					Decommissioning Refer to the construction phase MDS.	MDS is similar (or less) to that of the construction phase.

Impact	Phase			Maximum Design Scenario (MDS)	Justification
	C	O	D		
Marine Invasive Non-Native Species (MINNS)	✓	✓	✓	**Construction** Where equipment or structures are introduced to the water column there is risk of introduction and spread of MINNS. Includes MDS associated with cable installation and vessels outlined above for underwater noise.	Most likely pathway for MINNS is via vessel movements, therefore maximum number of vessels will represent the maximum risk of introduction of MINNS. MDS also includes all external cable protection that leads to permanent habitat loss.
				Operation and Maintenance Maximum of five vessels per cable repair operation.	
				Decommissioning Refer to the construction phase MDS.	MDS is similar (or less) to that of the construction phase.
Electromagnetic changes / barrier to species movement		✓		**Operation and Maintenance** Two cables (bundled) up to 423 km operating up to 525 kV. Target burial depth of 1.5 m (minimum 0 m but covered by external cable protection).	Maximum scenario for EMF is defined by the maximum length of cables installed with further refinement through the CBRA. The operation of the cable could result in the generation of EMFs which could affect benthic invertebrates. Maximum EMF values emitted from cable and extent of the EMFs will vary in relation to a number of aspects including the maximum cable voltage, burial depth, distance from the seabed and length of the cable.
Temperature increase		✓		**Operation and Maintenance** Two cables (bundled) up to 423 km operating up to 525 kV. Target burial depth of 1.5 m (minimum 0 m but covered by cable protection).	The maximum heat change will result from the maximum cable voltage. Maximum extent of heat change will result from the maximum length of cable bundles.

18.9 Assessment Methodology

Overview

18.9.1 The intertidal and subtidal benthic ecology assessment generally follows the assessment approach framework as set out in **Part 1, Chapter 5: PEIR Approach and Methodology**. However, while this has informed the approach, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of the intertidal and subtidal benthic ecology assessment.

18.9.2 In line with the industry standard approach across offshore EIAs, a four category sensitivity and magnitude scale, from "Negligible" to "High" has been used. While **Part 1, Chapter 5: PEIR Approach and Methodology** provides for a "Very High" category, this is based on onshore specific guidance, rather than being applicable to offshore receptors.

18.9.3 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. The criteria applied to determine the value, sensitivity and magnitude for intertidal and subtidal benthic ecology receptors are outlined in **Table 18-13** and **Table 18-14,** respectively. The criteria are based on a combination of professional judgement and CIEEM guidance (Ref 18.1).

18.9.4 The assessment of sensitivity will be made with consideration of the vulnerability of the receptor to an impact (the susceptibility of a species / habitat to disturbance, damage or death, from a specific external factor) and its recoverability (the ability of the same species / habitat to return to a state close to that which existed before the activity or event which caused change). Vulnerability can differ between different groups and species of benthic invertebrates and also vary depending on the impact pathway. For example, sessile species are more sensitive to smothering than mobile species. Reference will be made to the MarESA published by MarLIN to aid in the categorisation of sensitivity.

18.9.5 The assessment of sensitivity also includes consideration of the value of the receptor as presented in **Table 18-13**. A species may be of international importance (e.g., a designated feature of an SAC) and initially categorised as 'highly' sensitive according to **Table 18-13**. However, if baseline studies and species characteristics indicate that the species is only rarely or occasionally present, or if it is not sensitive to the impact pathway, professional judgment may justify lowering its sensitivity category. Where such assessments are made, justification would be provided.

18.9.6 Where a species or habitat is a designated feature of a designated site these features will also be considered as part of the MCZ assessment and HRA process.

18.9.7 The assessment of magnitude will be made with consideration of the extent of the area impacted, the duration and frequency of the impact and the scale of the change (i.e., whether it has an effect at an individual or population level). When determining the magnitude of impacts, the life history and ecology of the receptors are important. Factors such as seasonal presence patterns or whether specific areas are required for a certain life stage, which the species may be unwilling or unable to avoid, are considered.

18.9.8 The EcIA will use available evidence, professional judgement and knowledge of benthic ecology and behaviour to determine the level of impact.

18.9.9 The significance of an effect, either adverse or beneficial, will be determined using a combination of the magnitude of the impact and the sensitivity of the receptor. A matrix approach is used throughout all topic areas to ensure a consistent approach within the assessment, as shown in **Table 18-15**.

Table 18-13 Criteria for characterising the sensitivity of receptors

Sensitivity	Description of criteria
High	Equivalent to MarLIN MarESA sensitivity category High. Receptor has high vulnerability and low recoverability to change (i.e., recovery will take longer than 10 years following the cessation of activity or will not occur).
Medium	Equivalent to MarLIN MarESA sensitivity category Medium. Receptor has intermediate vulnerability and / or recoverability to change i.e., recovery to pre-impact conditions is possible between five and ten years.
Low	Equivalent to MarLIN MarESA sensitivity category Low. Receptor has high recoverability, with recovery to pre-impact conditions between one and five years.
Negligible	Equivalent to MarLIN MarESA sensitivity category Not Sensitive. The receptor has low vulnerability to change without detriment to its character. Recovery expected to be relatively rapid (i.e., less than approximately six months following cessation of activity).

Table 18-14 Criteria for characterising the magnitude of an impact

Magnitude	Description of criteria
High	Loss of resource and / or quality and integrity of resource; severe damage to key characteristics, features or elements.
Medium	Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements.
Low	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one or more key characteristics, features or elements.
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements.

Table 18-15 Significance matrix

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

Sensitivity or value	Magnitude of change			
	High	Medium	Low	Negligible
Low	Moderate (potentially significant)	Minor (not significant)	Minor (not significant)	Negligible (not significant)
Negligible	Minor (not significant)	Minor (not significant)	Negligible (not significant)	Negligible (not significant)

Preliminary assessment of cumulative effects

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

18.10 Preliminary assessment of temporary habitat loss and seabed disturbance – All phases

18.10.1 Temporary habitat loss and seabed disturbance may result from activities that physically disturb the seabed, including seabed preparation (e.g., UXO) identification and pre-sweeping of sandwaves), construction of exit pits associated with trenchless techniques at the Anderby Creek Landfall, use of jack-up vessels, vessel anchoring, cable burial, cable repair, and eventual cable removal.

18.10.2 Two pressures established by the Marine Pressures-Activities Database v1.5 (Ref 18.12) that are relevant to this impact pathway include:

- abrasion / penetration of the substrate on the surface of the seabed; and
- penetration and / or disturbance of the substratum below the surface of the seabed including abrasion.

18.10.3 Typically, the extent of this disturbance will be a maximum of 30 m wide along the entire English Offshore Scheme; although noting that for the most part, not all of this area will be disturbed. Beyond this footprint, low intensity physical disturbance may also occur from vessel anchoring, UXO identification, or removal of substratum associated with pre-sweeping. The worst-case installation footprint for temporary habitat loss is presented in **Table 18-12**. The footprint for impacts during operation and maintenance will be less than those during construction, and so no additional assessment is presented.

18.10.4 Most activities that will penetrate the seabed will present a temporary impact i.e., will only be undertaken once and the seabed will be able to recover after the activity. Some activities will occur in the same footprint and will be separated by several months e.g., seabed clearance followed by trenching. Abrasion and penetration of the substrate could

result in the localised loss of sediment but will not directly remove habitats. However, a change in habitat, even temporarily, could affect species biodiversity and abundance in the area of impact.

18.10.5 Sensitivity to the impact of seabed disturbance and temporary habitat loss varies between habitats and species, depending on the stability of the habitat and its resilience to disturbance and the vulnerability of an individual species to mechanical disturbance. For example, mobile species such as crabs are able to avoid construction activities, whereas less mobile benthic species such as bivalves and echinoderms can be subject to injury.

18.10.6 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor sensitivities and the magnitude of impact. A summary of the preliminary assessment conclusions during construction is provided in **Table 18-16** for ease of reference. Where receptors share a common sensitivity, magnitude and significance of effect they have been grouped together. Effects arising during operation and maintenance and decommissioning are predicted to be less than construction.

Table 18-16 Summary of preliminary assessment conclusions for temporary habitat loss and disturbance

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Atlantic circalittoral coarse sediment Atlantic circalittoral sand	Low	Negligible	Negligible (N/S)
Subtidal sands and gravels Annex I stony reef	Low	Low	Minor (N/S)
Atlantic circalittoral mud	Medium	Negligible	Minor (N/S)
Atlantic circalittoral mixed sediment Annex I *S. spinulosa* reef Seapens and burrowing megafauna	Medium	Low	Minor (N/S)
Ocean quahog	High	Low	Moderate (N/S)

N/S: Not Significant

Subtidal Broadscale Habitats and Species

18.10.7 There are 10 Level 4 Biotope Complexes within the English Offshore Scheme, with four Level 5 Biotopes, based on the EBS and EMODnet Broadscale Habitat information.

18.10.8 **Atlantic circalittoral coarse sediment** and **Atlantic circalittoral sand** are the most prevalent habitats within the English Offshore Scheme, occurring in multiple long stretches within the draft Order Limits (e.g., MD52 Atlantic offshore circalittoral sand is present from KP106 – 151 and again from KP 160 - 412).

18.10.9 These two habitats consist of a range of Level 5 biotopes, with most classified as habitats of principal importance and habitats of conservation interest, and one also classed as a UKBAP habitat. Mobile sands or habitats in shallow water, such as those present within nearshore sites along the English Offshore Scheme, are exposed to a natural level of physical disturbance from high wave energy. These habitats are likely to be dominated by mobile infauna, such as crustacea, that can tolerate physical disturbance and, as sediments are displaced, temporarily relocate but return once cable construction and decommissioning is completed within the area.

18.10.10 Therefore, the sensitivity of Atlantic circalittoral coarse sediment and Atlantic circalittoral sand to seabed disturbance and temporary habitat loss from abrasion and penetration is considered to be low, as supported by MarESA (Ref 18.11).

18.10.11 Species within these habitats demonstrate rapid recruitment and recolonisation following seabed disturbance. This, coupled with the dynamic nature of the habitat, suggests there would be very little change from baseline conditions during cable construction, operation and maintenance and decommissioning, or recovery from any change would occur from a few months to 1 - 2 years (Ref 18.45). These habitats are common throughout the North Sea and are therefore considered to be of low importance with temporary habitat loss having little effect on the wider distribution of these habitats. Thus, the magnitude of abrasion and penetration of the seabed is negligible.

18.10.12 The significance of this effect to Atlantic circalittoral coarse sediment and Atlantic circalittoral sand is **negligible** and **not significant** during construction, operation and maintenance and decommissioning

18.10.13 Atlantic Circalittoral Mixed Sediment is present between KP 56 - KP 63, and in small, interspersed patches from KP 6 to KP 34. The characterising species of this habitat are mainly sessile with no protection from abrasion. During boulder clearance, boulders and rocks can be rotated, causing the smothering and crushing of sessile organisms. Additionally, species such as hydroids have demonstrated damage through entanglement as a result of abrasion. Thus, the sensitivity of Atlantic circalittoral mixed sediment to abrasion and penetration has been assessed as medium.

18.10.14 Mixed sediment habitats have a high sand content. As discussed above, sand habitats are exposed to a natural level of physical disturbance similar to that caused by abrasion and penetration. Additionally, this habitat extends for approximately 6 km along the route of the English Offshore Scheme; therefore, any seabed disturbance within this habitat is confined to a small area. The impact would be short term, intermittent and reversible. The magnitude of this impact on mixed sediment habitats is low.

18.10.15 Therefore, the significance of the effect on mixed sediment habitats has been assessed as **minor** and **not significant** during construction, operation and maintenance and decommissioning.

18.10.16 Atlantic circalittoral mud was found along a small area of the cable route at KP 5 and at select patches within the study area (but not within the draft Order Limits). The characterising species of mud habitats, such as bivalves and brittlestars, are infaunal which provides them protection from seabed disturbance. However, most infaunal organisms need access to the water column for respiration and feeding, where they can become vulnerable to the activities associated with the construction, operation and maintenance, and decommissioning of marine cables.

18.10.17 The brittlestar *Amphiura filiformis* extend their arms into the water column for feeding. Bergman and Hup (Ref 18.46) demonstrated that beam trawling had no significant effect on brittlestar abundance; this can be attributed to their regenerative capabilities,

whereby brittlestars can withstand damage to their arms and disks without experiencing mortality. Bivalves extend their siphons into the water column for feeding and respiration. To avoid injury, bivalves may retract their siphons in response to seabed disturbance, which can reduce feeding opportunities and consequently reduce growth rates. For example, *Abra alba*, *Abra prismatica, Kurtiella bidentata* and *Thyasira flexuosa* are bivalves found in mud habitats along the English Offshore Scheme. These bivalves have fragile shells and have previously demonstrated vulnerability to injury and population decline in areas of seabed abrasion and penetration.

18.10.18 Based on the evaluation of the species present, the sensitivity of mud habitats within the English Offshore Scheme to seabed disturbance and temporary habitat loss has been assessed as medium.

18.10.19 Mud habitats are common throughout the North Sea and were only found in a very small proportion of the habitats along the English Offshore Scheme. Any injury or mortality that may occur as a result of seabed abrasion and penetration within this habitat will be localised, short term and intermittent within the English Offshore Scheme. Therefore, the magnitude of this effect to mud habitats has been assessed as negligible.

18.10.20 The significance of the effect on mud habitats has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Subtidal Sands and Gravels

18.10.21 Subtidal sands and gravels, which are commonly found in the North Sea and present within the English Offshore Scheme, are highly mobile (Ref 18.7). For example, the subtidal sands and gravels habitats present within the nearshore sections off the English Offshore Scheme are subject to natural physical disturbance from high energy wave action, a similar level to that expected to be caused by cable construction, operation and maintenance, and decommissioning. Thus, subtidal sands and gravels habitats have a low sensitivity to seabed disturbance.

18.10.22 Due to their dynamic nature, it would be expected that these habitats would return to baseline conditions within <12 months of abrasion and penetration (Ref 18.47) Additionally, temporary habitat loss to subtidal sands and gravels would have little effect on their wider distribution in the North Sea. The magnitude of seabed disturbance to this benthic habitat is low.

18.10.23 The significance of the effect on subtidal sands and gravels has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I Stony Reef

18.10.24 Broadscale habitat data from JNCC indicates that there are examples of Annex I Bedrock and / or Stony Reef between KP 141 and KP 170 (**Volume 3, Part 3, Figure 18-2: Designated Sites with Benthic Features, Protected Species and Priority Features within the Benthic Study Area)**. Small areas are located within the draft Order Limits (near KP 160), but the majority are within the wider study area. Camera transect data from the EBS indicated that 'Medium stony reef' was present along the entirety of the photographic data acquired at stations ST013 and ST021a. At stations ST022a, ST072 and ST102 the assessment was an alternating 'Medium reef' and 'Low reef'. The section of the EBS study area that passes through the Holderness Offshore MCZ was assessed 'Low Reef' with one small area of 'Medium reef'.

18.10.25 No Annex I rocky reef was identified during the EBS.

18.10.26 Annex I reefs are associated with sessile assemblages that are unable to relocate to avoid the effects of construction, operation and maintenance, and decommissioning of marine cables, and may experience smothering and mortality if boulders and rocks are rotated during boulder clearance. For example, the coral *Alcyonium digitatum* is a characterising sessile species of Annex I stony reef and is present within the English Offshore Scheme. This species can be subject to mechanical interference, crushing, physical blows or erosion of its surface as a result of abrasion and seabed disturbance. Despite this, *A. digitatum* demonstrates low sensitivity to seabed disturbance (Ref 18.48). The Annex I stony reef identified within the English Offshore Scheme are considered to have low and medium resemblance to stony reef due to having lower biodiversity and abundance compared to those with high resemblance (Ref 18.8). Therefore, the sensitivity of Annex I stony reef to seabed disturbance and habitat loss is low.

18.10.27 Boulder clearance through ploughing within the draft Order Limits has a narrow footprint of 30 m at each clearance site and, where possible, smaller rocks and boulders will be relocated using grabs, reducing the risk of injury to epifauna. Additionally, the presence of Annex I stony reef across the English Offshore Scheme is limited. Micro-routeing to avoid sensitive habitats will be undertaken where possible within the English Offshore Scheme. Thus, the magnitude of this effect on Annex I habitats is low.

18.10.28 Therefore, the significance of the effect on Annex I stony reef has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I *Sabellaria spinulosa* reef

18.10.29 Examples of Annex I *S. spinulosa* reef is present at the southern end of the study area, with the closest reef situated 4 km from the English Offshore Scheme. This reef is 12 km in length and is the largest reef within the study area. Smaller patches of Annex I S. spinulosa reefs are present to the east of the forementioned reef and are situated along the edge of the 15 km study area. *S. spinulosa* was observed at stations ST008 and ST011 (near the southern part of the cable route). Medium reef formed 80% of the transect at ST011, with 10% 'low reef' and 10% not a reef. No reef was observed at ST008. None of the Annex I reef that is a designated feature of the Inner Dowsing, Race Bank and North Ridge SAC is within the English Offshore Scheme draft Order Limits.

18.10.30 The epifauna of this habitat type includes a variety of bryozoans including *Flustra foliacea*, *Alcyonidium diaphanum* and *Cellepora pumicosa*, in addition to calcareous tubeworms, pycnogonids, hermit crabs and amphipods. The reefs formed by *S. spinulosa* consolidate the sediment and allow the settlement of other species not found in adjacent habitats, leading to a diverse community of epifaunal and infaunal species (Ref 18.49).

18.10.31 *S. spinulosa* reef biotopes are directly exposed to physical damage that affects the surface. Abrasion at the surface is likely to damage the worm tubes and cause sub-lethal and lethal damage to the worms (Ref 18.50), as well as potential mortality to associated faunal assemblages. The MarESA for this habitat type does suggest that recovery of the habitat can occur within two years, and the overall sensitivity of the habitat type is medium.

18.10.32 Boulder clearance through ploughing within the draft Order Limits has a narrow footprint of 30 m at each clearance site and, where possible, smaller rocks and boulders will be

relocated using grabs, reducing the risk of injury to epifauna. Additionally, the presence of Annex I *S. spinulosa* reefs across the English Offshore Scheme is limited and the impact is short-term and temporary. Micro-routeing to avoid sensitive habitats will be undertaken where possible within the English Offshore Scheme. Thus, the magnitude of this effect on Annex I habitats is low.

18.10.33 Given the medium sensitivity of this receptor and low magnitude of impact, the overall significance of effect is **minor** and therefore **not significant** during construction, operation and maintenance, and decommissioning.

Seapens and burrowing megafauna

18.10.34 The EBS indicated that the potential presence of this habitat type at one station due to the presence of *P. phosphorea* as 'frequent', *Nephrops norvegicus* burrows as 'common' and faunal burrows as 'frequent'. The presence of this habitat type cannot be confirmed however as the macrofaunal community was more associated with '*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand' (MD5212) rather than the seapens biotope MC6216. On a precautionary basis an impact assessment is presented.

18.10.35 This habitat type is associated with a rich infauna of polychaetes, bivalves, burrowing sea urchins, brittlestars, and sea cucumbers, and a mobile epifauna of crabs and starfish. While the infaunal species composition varies between the biotopes, the infaunal and mobile epifaunal community is probably found across a range of circalittoral mud and deep mud habitats (Ref 18.44). The seapen *Pennatula phosphorea* (a characterising species of the seapen community identified at this site) is able to avoid abrasion by withdrawing into the sediment. MarESA notes that the sensitivity of this habitat type to penetration or disturbance of the substratum is high, based on the impact of penetrative fishing gear. However, as the causes of this impact pathway are primarily associated with abrasion of the seabed surface rather than penetration, and the sensitivity to abrasion is medium (Ref 18.44), the overall sensitivity is considered to be medium.

18.10.36 This habitat type is relatively common in the deep offshore waters of the North Sea (Ref 18.44), and only possibly present at one location along the English Offshore Scheme. Boulder clearance through ploughing within the draft Order Limits has a narrow footprint of 30 m at each clearance site, and where possible, smaller rocks and boulders will be relocated using grabs, reducing the risk of injury to epifauna. Given the short term and temporary nature of the impact, the extremely limited presence of this habitat across the English Offshore Scheme, particularly considering its distribution within the wider North Sea, the overall magnitude of impact is low.

18.10.37 Given the medium sensitivity of this receptor and low magnitude of impact, the overall significance of effect is **minor** and therefore **not significant** during construction, operation and maintenance, and decommissioning.

Ocean quahog

18.10.38 Five ocean quahog adult individuals were recorded at five different grab sampling locations (between KP 330 – 360) and 38 juveniles were recorded at 19 grab sampling stations (between KP 180 – 360). None of these stations were within the Holderness Offshore MCZ and all are relatively clustered together in the northern part of the study area.

18.10.39 The growth rate of ocean quahog is rapid in juveniles, reaching maximum growth rates between three and seven years, and slows down in adults after 15 to 20 years. Ocean quahog is an infaunal species with limited mobility, splitting its time between the seabed surface and burying itself vertically within the top few centimetres of the seabed with its siphon at the surface for respiration. Taylor (Ref 18.51) reported that ocean quahog can remain buried for one to seven days. Like other marine bivalves, the ocean quahog is at risk of injury and mortality from shell damage through seabed penetration and the siphon of ocean quahog is at risk of physical damage from abrasion. The sensitivity of ocean quahog to seabed disturbance and temporary habitat loss is high.

18.10.40 Abundance of ocean quahog varies between location within the North Sea. For example, there are 28,600 individuals per 100 m² within the Northern North Sea (juvenile dominance), 7 adults (>10 mm in length) per 100 m² in Southern North Sea and 21 adults (>10 mm in length) per 100 m² in Central North Sea (Ref 18.38). 43 ocean quahog (adults and juveniles) were found within the draft Order Limits, however it is recognised that the limited numbers do not mean and absence in other parts of the draft Order Limits. The English Offshore Scheme will have a highly localised impact on the seabed and will not affect the ecological function of the species within the North Sea. Therefore, the magnitude of this impact is low.

18.10.41 The significance of effect has been assessed as **moderate** during construction, operation and maintenance, and decommissioning, but given the highly localised nature of the impact it is assessed as **not significant** in EIA terms.

18.11 Preliminary assessment of permanent habitat loss – All phases

18.11.1 Permanent habitat loss arises from the permanent change of one marine habitat type to another marine habitat type through the change in substratum including to artificial material (e.g., concrete). Associated project activities include the installation of cables within the seabed (and eventual decommissioning if they remain in-situ) and the deposition of external cable protection. External cable protection would be used in the construction of infrastructure crossings and for burial remediation where full cable burial into sediment has not been achieved. Whilst most external cable protection would be installed during construction, additional external cable protection may also be required during the operation and maintenance phase, either for the maintenance of infrastructure crossings or for remedial burial e.g., associated with a cable repair, or if the cables become exposed. No additional external cable protection is expected during decommissioning.

18.11.2 The maximum footprint of permanent habitat loss will occur because of the maximum area of seabed covered by external cable protection and cable crossings protection during construction and operation and maintenance as detailed in **Table 18-12**.

18.11.3 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor sensitivities and the magnitude of impact. A summary of the preliminary assessment conclusions is provided in **Table 18-17** for ease of reference. Where receptors share a common sensitivity, magnitude and significance of effect they have been grouped together.

Table 18-17 Summary of preliminary assessment conclusions for permanent habitat loss and disturbance.

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Atlantic circalittoral coarse sediment	High	Negligible	Minor (N/S)
Atlantic circalittoral sand			
Atlantic circalittoral mixed sediment			
Atlantic circalittoral mud			
Annex I stony reef			
Seapens and burrowing megafauna			
Ocean quahog			
Annex I *S. spinulosa* reef			

Subtidal Broadscale Habitats and Species, and Subtidal Sands and Gravels.

18.11.4 External cable protection in subtidal sands and gravels and subtidal broadscale habitats will result in the irreversible replacement of muds, sands and gravels with hard substrate, permanently altering the ecological composition and function of the affected area. Such changes can lead to shifts in benthic community structures, favouring sessile species adapted to hard substrates while displacing infaunal organisms, such as bivalves and polychaetes, that live in softer sediments. The vulnerability of this habitat type is therefore high and the recoverability low. The sensitivity of subtidal broadscale habitats to permanent habitat loss through rock protection is high.

18.11.5 External cable protection will be a long-term (>40 year) addition to these habitats and it is assumed that it will not be removed following decommissioning. External cable protection would be installed only where considered necessary for the safe operation of the English Offshore Scheme and, in benthic designated sites, external cable protection materials would be selected to match the environment (e.g., when cables are installed in areas of cobbles or other natural rock features, rock of similar diameter as the receiving environment will be used as an alternative to terrestrially sourced granite, where feasible) (see Section 18.6). Additionally, these habitats are common throughout the North Sea. The permanent loss of small sections of these habitats would have little effect on their wider distribution or functioning. Therefore, the magnitude of permanent habitat loss on subtidal sands and gravels and broadscale habitats present throughout the English Offshore Scheme has been assessed as negligible.

18.11.6 The significance of this effect has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I Stony Reef

18.11.7 Annex I stony reef host a highly diverse stable community of sessile benthic macrofauna that live on pebbles, rocks, cobbles and boulders and are highly sensitive to habitat loss as a result of change in seabed composition. The addition of external cable protection

to these habitats within the English Offshore Scheme could increase the abundance of hard substrate available for sessile organisms to colonise. However, as it would still constitute a change to the local environment the sensitivity has been assessed as high.

18.11.8 In sites designated for benthic features, external cable protection materials will be selected to match the environment (e.g., when cables are installed in areas of cobbles or other natural rock features, rock of similar grade as the receiving environment will be used as an alternative to the current normal approach of using terrestrially sourced granite) where feasible. The extent of external cable protection required is small in the context of the presence of this habitat across the study area and wider North Sea, and micro-routeing to avoid sensitive habitats will be undertaken where possible within the English Offshore Scheme. The magnitude of the impact has been assessed as negligible.

18.11.9 The significance of the effect on this receptor has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I *S. spinulosa* reef

18.11.10 Examples of Annex I *S. spinulosa* reef is present at the southern end of the study area, with the closest reef situated 4 km from the English Offshore Scheme. This reef is 12 km in length and is the largest reef within the study area. Smaller patches of Annex I S. spinulosa reefs are present to the east of the forementioned reef and are situated along the edge of the 15 km study area. *S. spinulosa* was observed at stations ST008 and ST011 (near the southern part of the cable route). Medium reef formed 80% of the transect at ST011, with 10% 'low reef' and 10% not a reef. No reef was observed at ST008. None of the Annex I reef that is a designated feature of the Inner Dowsing, Race Bank and North Ridge SAC is within the English Offshore Scheme draft Order Limits.

18.11.11 *S. spinulosa* and other associated epifauna can colonise hard structures (including artificial hard structures) (Ref 18.52), meaning that the habitat resulting from the installation of external cable protection would be suitable for reef re-development. However, the introduction of external cable protection would constitute a change in the overall biotope from a sedimentary habitat to a rock reef habitat, and the biotope is an Annex I habitat. The sensitivity of the habitat is therefore high.

18.11.12 There are no areas of 'high' Annex I *S. spinulosa* reef within the English Offshore Scheme, only 200 m of 'medium' reef and 25 m of 'low' reef were found. Direct impacts to the Annex I habitat would be extremely limited and would not affect the functioning of *S. spinulosa* reef to the south and east, including those parts of the Inner Dowsing, Race Bank and North Ridge SAC. In sites designated for benthic features, external cable protection materials will be selected to match the environment (e.g., when cables are installed in areas of cobbles or other natural rock features, rock of similar grade as the receiving environment will be used as an alternative to the current normal approach of using terrestrially sourced granite) where feasible. The extent of external cable protection required is small in the context of the presence of this habitat across the study area and wider North Sea, and micro-routeing to avoid sensitive habitats will be undertaken where possible within the English Offshore Scheme. Thus, the magnitude of this effect on Annex I habitats is negligible**.**

18.11.13 The significance of effect on this receptor has therefore been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Seapens and burrowing megafauna

18.11.14 The EBS indicated that the potential presence of this habitat type at one station due to the presence of *P. phosphorea* as 'frequent', *Nephrops norvegicus* burrows as 'common' and faunal burrows as 'frequent'. The presence of this habitat type cannot be confirmed however as the macrofaunal community was more associated with '*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand' (MD5212) rather than the seapens biotope MC6216. On a precautionary basis an impact assessment is presented.

18.11.15 This Priority Marine Feature (PMF) supports a rich infauna of polychaetes, bivalves, burrowing sea urchins, brittlestars, and sea cucumbers, and a mobile epifauna of crabs and starfish. While the infaunal species composition varies between the biotopes, the infaunal and mobile epifaunal community is probably found across a range of circalittoral mud and deep mud habitats (Ref 18.44). A change from mud-dominated sediment to a natural or artificial hard substrate through installation of external cable protection would remove the sedimentary habitat required by the characterising species of this biotope. Therefore, the sensitivity of seapens and burrowing megafauna to permanent habitat loss is high.

18.11.16 This habitat type is relatively common in the deep offshore waters of the North Sea (Ref 18.44), and is only potentially present at one location along the English Offshore Scheme. External cable protection would only be installed across a limited area (as outlined in **Table 18-13** and is unlikely to be required in areas where seapens were identified. Indicative design information suggests that burial in sediment would be successful and external cable protection would not be required in the area where this habitat was found. Micro-routeing to avoid sensitive habitats will be undertaken where possible within the English Offshore Scheme. The overall magnitude of impact is therefore considered to be negligible.

18.11.17 The significance of effect on this receptor has therefore been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

Ocean quahog

18.11.18 Five ocean quahog adult individuals were recorded at five different grab sampling locations, and 38 juveniles were recorded at 19 grab sampling stations. None of these stations were within the Holderness Offshore MCZ and all are relatively clustered together in the northern part of the draft Order Limits.

18.11.19 Ocean quahog are an infaunal species, commonly occurring in mud and sand habitats. A change to natural or artificial hard substratum through external cable protection would remove the sedimentary habitat required by the species, causing individual mortality and population decline. Therefore, the sensitivity of ocean quahog to permanent habitat loss is high.

18.11.20 Ocean quahog are a protected feature of the Holderness Offshore MCZ. However, none of the locations where Ocean quahog were recorded during the EBS were within the Holderness Offshore MCZ. Therefore, the addition of external cable protection in the Holderness Offshore MCZ would not affect their distribution or abundance. Abundance of ocean quahog varies between location within the North Sea. For example, there are 28,600 individuals per 100 m^2 within the Northern North Sea (juvenile dominance), 7 adults (>10 mm in length) per 100 m^2 in Southern North Sea and 21 adults (>10 mm in length) per 100 m^2 in Central North Sea (Ref 18.38). Any mortality that occurs as a result

of the English Offshore Scheme would have little effect to the wider population and abundance within the North Sea. Thus, the magnitude of this effect is negligible.

18.11.21 The significance of effect has been assessed as **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

18.12 Preliminary assessment of temporary increase and deposition of suspended sediments – All phases

18.12.1 The construction, operation and maintenance, and decommissioning of the English Offshore Scheme has the potential to temporarily increase suspended sediments arising from activities that disturb the seabed such as seabed preparation, cable burial and cable de-burial. This can create sediment plumes within the water column that can travel away from the English Offshore Scheme before the sediment is deposited on the seabed. Additionally, once deposited, this sediment can cause smothering of habitats and features.

18.12.2 **Sensitivity** to the impact of temporary increase and deposition of suspended sediments varies between habitats and species, depending upon the sediment composition of the habitat and the vulnerability of an individual species to turbidity and smothering. For example, fine particulate sediments such as silt and clay remain suspended in the water column longer than heavier sediments such as sand and gravel. These fine sediments can in turn travel further distances away from the English Offshore Scheme.

18.12.3 MarESA considers several separate impact pathways associated with the mobilisation of suspended sediments; changes in suspended solids (water clarity), smothering and siltation rate changes (both heavy (≥30 cm) and light (<5 cm) smothering) and contamination by various chemicals (heavy metals, hydrocarbons and PAHs). Gooding *et al.* (Ref 18.53) reported that fine sediment plumes created by ploughing rapidly dilute and disperse within the water column, settling in 1 mm thick layers once deposited on the seabed. Increased sediment suspension and smothering by sediment plumes can affect the biological processes of marine organisms. This includes:

- Reduced photosynthesis due to increased turbidity, resulting in reduced primary production in algae;
- Smothering of invertebrate species and clogging of respiratory and feeding apparatus; and
- Indirect effects of the release of contaminants, such as heavy metals and hydrocarbons, during sediment mobilisation, on benthic species.

18.12.4 Epifauna, less mobile organisms and suspension / filter feeders are the most vulnerable organisms to temporary increase and deposition of suspended sediments.

18.12.5 Project specific data, presented in **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes** suggests coarse sediment plumes, created from seabed preparation (pre-sweeping and trenching) and cable trenching activities, will settle from the water column within the draft Order Limits. This will cause light smothering of <5 cm, and fine sediment will cause lighter smothering of <2 mm up to 13.6 km from the draft Order Limits arising from pre-lay and cable trenching activities. For trailer suction hopper dredger (TSHD) activities, coarse sediment will settle within the draft Order Limits and cause light smothering of <5 cm (from one pass of the TSHD), and fine sediment will cause lighter smothering of <2 mm out to a maximum distance of 10.4 km, dependent

upon peak flow speed. There will be no heavy smothering as a result of the English Offshore Scheme and heavy smothering will not be considered in this assessment.

18.12.6 The maximum distance from trenching activities where suspended sediment concentrations (SSC) exceed 10 mg/l is 8.8 km at KP 10 and is <4 km beyond KP 46. SSCs exceed 10 mg/l for a maximum distance of 2.8 km from TSHD activities.

18.12.7 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor sensitivities and the magnitude of impact. A summary of the preliminary assessment conclusions is provided in **Table 18-18** for ease of reference. Where receptors share a common sensitivity, magnitude and significance of effect they have been grouped together.

Table 18-18 Summary of preliminary assessment conclusions for temporary increase and deposition of suspended sediments.

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Intertidal habitats			
Designated sites with intertidal features	Negligible	Negligible	Negligible (N/S)
Ocean quahog			
Atlantic circalittoral coarse sediment			
Atlantic circalittoral sand			
Atlantic circalittoral mixed sediment			
Atlantic circalittoral mud	Low	Negligible	Negligible (N/S)
Subtidal sands and gravels			
Annex I stony reef			
Annex I *S. spinulosa* reef			

Intertidal Habitats

Intertidal works

18.12.8 The English Offshore Scheme installation will use a trenchless technique, avoiding intrusive works in the intertidal area. The exit point for the cable ducts, would be entirely in the subtidal environment. There would be no direct impacts to intertidal benthic ecology receptors, except in the event of drilling fluid breakout (frac-out), where clean-up activities may be required. A frac-out can occur if drilling occurs within unconsolidated sediment. In this situation a pathway can form between the drilling bore and the surface (e.g., the ground or seabed). The bentonite used within the bore can travel through this pathway to the surface, causing a temporary increase of suspended sediment.

18.12.9 Bentonite is an inert, clay-like lubricant listed on the Cefas list of notified chemicals and has been proven to have no long-lasting effects on the marine environment. Due to its clay-like nature, bentonite consists of very fine particulates that will remain within the water column. The intertidal habitats recorded within the draft Order Limits were

generally devoid of flora and fauna, and are characterised by high turbidity and regular sediment re-mobilisation and deposition The sensitivity of the habitats present within the Intertidal Zone to increased suspended sediment from a bentonite plume is negligible.

18.12.10 If a frac-out occurs, a bentonite plume will be visible within the marine environment for the length of the tidal cycle over which the release occurred and will be completely diluted in seawater after two tidal cycles. Should a frac-out occur during low tide, there will be a temporary period where bentonite arisings remain on the intertidal which could result in smothering. Despite this, bentonite arisings would be washed away and diluted at the next high tide. The CEMP for the English Offshore Scheme will include mitigation plans to ensure frac-outs are managed appropriately should an event occur; this could involve the use of an absorbent matting to remove the bentonite during low tide if considered appropriate. The magnitude of increased suspended sediments on intertidal habitats is therefore negligible.

18.12.11 The significance of the effect is **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Subtidal works

18.12.12 The maximum SSC increases, as defined in **Table 18-12**, from works in the English Offshore Scheme have the potential to impact the intertidal environment.

18.12.13 The EBS notes that the Intertidal Zone at the Anderby Creek Landfall is predominantly sandy, with coarse sediment (MA521) in the upper shore and finer sand (MA32) in the lower shore. The faunal assemblage was impoverished due to a lack of hard substrata for attachment, with only occasional bryozoan, sponge and algal coverage.

18.12.14 Sandy shores occur in areas of wave scour and will be highly turbid during periods of tidal inundation. MarESA considered that this habitat type is not sensitive to changes in suspended solids, light or heavy smothering (Ref 18.54), as the habitat is naturally exposed to large fluctuations in suspended solids and sediment transport. The sensitivity of this habitat to this impact is therefore negligible.

18.12.15 The Environment Agency undertakes annual beach nourishment along the sandy beaches within the study area (Ref 18.55). The additional sediment loading caused by construction activities will be short term and temporary, and within the natural variability in the system. The magnitude of impact is therefore considered to be negligible.

18.12.16 The significance of the effect is therefore **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Designated Sites with Intertidal Features

18.12.17 The study area intersects with the following Designated Sites within intertidal features: Humber Estuary SSSI, Saltfleetby-Theddlethorpe Dunes SSSI, Gibraltar Point SSSI and NNR. All these sites are designated for the presence of littoral sediment within them. The units within the study area are characterised by similar intertidal habitats to those found within the English Offshore Scheme i.e., a mosaic of littoral sand and coarse sediment with relatively sparse fauna (MD32 and MD52). The habitats therefore have the same sensitivities to the intertidal and subtidal construction activities as is described above. The sensitivity of the relevant intertidal features of the various designated sites is therefore negligible.

18.12.18 As discussed above, the area is naturally subject to high turbidity and fluctuations in suspended solids and sediment transport. The magnitude of the impact is therefore negligible.

18.12.19 The significance of the effect is therefore **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Subtidal Broadscale Habitats and Species

18.12.20 Coarse sediment and sand habitats are the most prevalent habitats within the English Offshore Scheme, occurring in multiple long stretches within the draft Order Limits (e.g., MD52 Atlantic offshore circalittoral sand is present from KP106 – 151 and again from KP 160 - 412).

18.12.21 These two habitats consist of a range of Level 5 biotopes, with most classified as habitats of principal importance and habitats of conservation interest, and one also classed as a UKBAP habitat. All three Level 5 biotopes have an identical sensitivity to this impact pathway (with similar justification). The Level 5 biotopes present are characterised by burrowing species or bivalve, which are likely to be able withstand light smothering events and to move through at least 5 cm of deposited sediment. The sensitivity of this habitat is therefore considered to be low.

18.12.22 Based on the extent of mobilisation and deposition of sediments described in Section 18.12.5, the magnitude of this effect is negligible.

18.12.23 Therefore, the significance of the effect has been assessed as **negligible** and **not significant** during construction, operation and maintenance, and decommissioning**.**

18.12.24 Atlantic Circalittoral Mixed Sediment is present between KP 56 - KP 63, and in small, interspersed patches from KP 6 - KP 34. These habitats comprise mobile and sessile fauna. Whilst mobile fauna can temporarily relocate to avoid temporary increases and deposition of suspended sediments, the epifauna associated with this habitat are likely to be vulnerable to effects. Hydroids are suspension feeders, thus increased turbidity can reduce feeding efficiency and ability, reducing growth rates and overall biomass of hydroids. The same is true for bryozoa present within this habitat. However, *Flustra foliacea* is tolerant of higher concentrations of suspended sediment because it occurs in turbid, fast-flowing environments. Atlantic circalittoral mixed sediment habitats occur in areas of moderate water flow and are, therefore, exposed to natural increases in turbidity. Additionally, this moderate water flow is likely to remove any light smothering from sediment deposition and some heavy smothering. Mixed sediment habitats are considered to have negligible sensitivity to increased suspended sediment and light smothering.

18.12.25 Based on the extent of mobilisation and deposition of sediments described in Section 18.12.5, the magnitude of this effect is negligible.

18.12.26 Therefore, the significance of the effect has been assessed as **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

18.12.27 Atlantic circalittoral mud was found along a small area of the cable route at KP 5 and at select patches within the study area (but not within the draft Order Limits). Characterising species of mud habitats that are also present with the draft Order Limits include *A. filiformis, K. bidentata, A. alba, A. prismatica, T. flexuosa and Thyasira biplicate*. These species can switch from suspension feeding to deposit feeding during periods of increased turbidity. Temporary increase and deposition of suspended sediment increase the availability of organic matter, which can be incorporated into the seabed through

bioturbation, enhancing food supply for deposit feeders. Sudden light smothering would temporarily stop feeding and respiration, compromising growth and reproduction rates. Macrofauna whose only method of feeding is either filter or suspension feeding are at risk of physical damage and clogging of gills or filters, thus reducing feeding and impaired respiration. The characterising polychaetes of mud habitats are either predators or deposit feeders and are unaffected by increased suspended sediment in the water column.

18.12.28 *Kurtiella bidentata, Abra spp. and Thyasira spp.* can migrate through up to 20 cm of sediment deposition to reach the seabed surface. Other characterising species present within the draft Order Limits include the brittlestar *Ophiura ophiura,* which can survive up to 32 days buried in up to 7 cm of coarse and fine sediment (Ref 18.56) and the polychaetes *Nephtys* spp. and *Nereis* spp., which can migrate through up to 50 cm of deposited mud and 80 cm of deposited sand. The sensitivity of mud habitats to increased suspended sediment and light smothering is therefore negligible

18.12.29 Based on the extent of mobilisation and deposition of sediments described in paragraph 18.12.5, the magnitude of this effect is negligible.

18.12.30 Therefore, the significance of the effect has been assessed as **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Subtidal Sands and Gravels

18.12.31 Subtidal sands and gravels, which are commonly found in the North Sea and present within the English Offshore Scheme, are highly mobile (Ref 18.7). The subtidal sands and gravel habitats present within the nearshore sections of the draft Order Limits are subject to natural increased turbidity from high energy wave action, a similar level to that expected to be caused by cable construction, operation and maintenance, and decommissioning. Additionally, this moderate high tidal energy is likely to remove all light smothering (<5 cm) from sediment deposition.

18.12.32 Thus, subtidal sands and gravels habitats have a low sensitivity to temporary increase and deposition of suspended sediment. The magnitude of this effect is considered to be negligible, therefore the significance of this effect has been assessed as **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I Stony Reef

18.12.33 Annex I stony reef is associated with sessile assemblages, which are unable to relocate to avoid smothering or increased suspended sediments. Despite this, the height of characterising fauna results in a reduced sensitivity to increased sediment suspension and smothering. For example, the coral *A. digitatum*, a characterising species of Annex I stony reef that is present along the English Offshore Scheme, can grow up to 20 cm in height and can extend its tentacles to greater heights for feeding (Ref 18.48). Adult *A. digitatum* can also dislodge settled particles with large amounts of mucous, demonstrating a high tolerance to increased suspended sediment (Ref 18.57). Juvenile colonies, however, that initially form crusts of 5 – 10 mm, can experience decreased respiration ability in periods of increased turbidity or smothering.

18.12.34 The Annex I reefs identified along the English Offshore Scheme are considered to have low and medium resemblance to stony reef, and, as such, are usually associated with lower biodiversity and abundance compared to those with high resemblance. This,

coupled with the fact that characteristic species can withstand a certain degree of smothering, the sensitivity of Annex I stony reef to this impact pathway is low.

18.12.35 Project specific data (as per **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**) suggests coarse sediment will settle directly back into the trench and therefore light smothering in this habitat is unlikely due to the limited presence of fine sands and silts. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l in areas surrounding Annex I stony reef will be ~3 km. However, suspended sediment concentrations have been shown to fall to ambient levels within 66 m of trenching activity in hard ground areas (Ref 18.53). Due to the presence of boulders of varying heights within this habitat, sediment will demonstrate dispersed deposition. Therefore, the magnitude of this impact pathway on Annex I stony reef is considered to be negligible.

18.12.36 Given the low sensitivity of this receptor and the negligible magnitude of impact, the overall significance effect is **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Annex I *S. spinulosa* Reefs

18.12.37 *S. spinulosa* reefs are found in the nearshore region of the study area, approximately 4 km from the Anderby Creek Landfall. The reef forming species is often found in higher energy environments with a degree of natural sediment transport. Last *et al*. (Ref 18.56) found that *S. spinulosa* can survive burial in up to 7 cm of sediment for 32 days. The sensitivity of this receptor is therefore considered to be low.

18.12.38 Project specific data (as per **Volume 1, Part 3, Chapter 17: Coastal and Marine Physical Processes**) indicates that smothering of fine sediments in high energy environments found in the nearshore region is <1 mm, but could occur up to 13.6 km from the draft Order Limits. This sedimentation will be similar to smothering conditions typically experienced during storm events. Furthermore, given the distance between the trenching activities and the significant areas of Annex I *S. spinulosa* reef within the study area, the magnitude of this effect is therefore considered to be negligible.

18.12.39 Thus, the significance of the effect has been assessed as n**egligible** and **not significant** during construction, operation and maintenance, and decommissioning.

Ocean Quahog

18.12.40 The sensitivity of ocean quahog to temporary increase and deposition of suspended sediment is negligible (Ref 18.38). The ocean quahog is a deposit feeder with a large intestinal tract and palps. This species of bivalve lives beneath the sediment surface and extends its siphon to feed on the organic material deposited at the seabed surface and therefore is not adversely affected by increased turbidity. Powilleit *et al.* (Ref 18.58) recorded no significant change to population or growth rates of ocean quahog when buried 1.5 m deep in sediment. Additionally, Powilliet *et al.* (Ref 18.59) demonstrated Ocean quahog are able to burrow between 32 - 41 cm of smothering by fine and coarse sediment at a rate of 0.37 - 3.89 cm/day to regain contact with the sediment surface.

18.12.41 Ocean quahog is present within mud and sand habitats within the study area. Fine sediments plumes created by seabed preparation, cable burial and cable removal works cause light smothering of <2 mm of the seabed. Any smothering caused as a result of temporary increase and deposition of suspended sediments will be insufficient to cause

adverse effects on ocean quahog. Therefore, the magnitude of this effect on ocean quahog is negligible.

18.12.42 The significance of effect has been assessed as **negligible** and **not significant** during construction, operation and maintenance, and decommissioning.

18.13 Preliminary assessment of mobilisation and deposition of sediment-bound contaminants

18.13.1 Construction activities that disturb the seabed such as seabed preparation, cable burial and cable de-burial (and similar activities during operation and maintenance, and decommissioning) have the potential to mobilise sediment-bound contamination which may then settle out on intertidal and subtidal habitats. MarESA considers two separate impact pathways under this general category:

- Transition elements and organo-metal contamination; and
- Hydrocarbon and PAH contamination.

18.13.2 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor sensitivities, magnitude of impact and finally an assessment of significance. A summary of the preliminary assessment conclusions is provided in **Table 18-19** for ease of reference.

Table 18-19 Summary of preliminary assessment conclusions for mobilisation and deposition of sediment bound contaminants

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Subtidal coarse and mixed sediment habitats Subtidal sands and gravels Ocean quahog	Medium	Negligible	Minor (N/S)
Annex I stony reef Subtidal mud and sand habitats Annex I *S. spinulosa* reef	Low	Negligible	Negligible (N/S)
Intertidal habitats Designated sites with intertidal features	Negligible	Negligible	Negligible (N/S)

Sensitivity - Intertidal, designated sites with intertidal features

18.13.3 The intertidal habitats within the study area, and intertidal features of designated sites are characterised by sandy and coarse sediments with relatively sparse flora and fauna. Adverse impacts of the mobilisation and subsequent deposition of sediment bound contaminants on habitats are related to the impacts on the infaunal and epifaunal community. Therefore, the **sensitivity** of these receptors is **negligible**.

Sensitivity - Subtidal broadscale habitats, subtidal sands and gravels, Ocean quahog

18.13.4 The MarESA assessment of this impact pathway is based on uncontrolled releases or incidental spills, rather than mobilisation and deposition of sediment bound contaminants.

18.13.5 The coarse and mixed sediment habitats present within the English Offshore Scheme are characterised by a range of epifauna and infauna, including molluscs, echinoderms and crustaceans. Mollusc reactions to sub-lethal levels of heavy metal stressors include siphon retraction, valve closure, inhibition of byssal thread production, disruption of burrowing behaviour, inhibition of respiration, inhibition of filtration rate, inhibition of protein synthesis and suppressed growth (Ref 18.60). Reactions to hydrocarbon exposure also include reduced byssal thread production (thus weakening attachment) and infaunal burrowing rates. MarESA does not provide a sensitivity assessment for this specific impact pathway, although taking a precautionary approach, a sensitivity of medium has been applied to this assessment for point-source contamination events. This sensitivity categorisation also applies to Ocean quahog as there is no specific evidence on the response of this species to chemical contamination, but responses are likely similar to that of other molluscs.

18.13.6 Communities associated with more mud-dominated habitats such as brittlestars and polychaete worms. These faunal groups have been shown to be tolerant of depositions of heavy metal and hydrocarbon contamination (Ref 18.61) and so a sensitivity of low is applied.

Sensitivity - Annex I Stony reef

18.13.7 Annex I stony reef are associated with sessile assemblages, which are unable to relocate to avoid smothering or increased suspended sediments. Despite this, the height of characterising fauna results in a reduced sensitivity to increased sediment suspension and smothering. For example, the coral *A. digitatum*, a characterising species of Annex I stony reef that is present along the English Offshore Scheme, is thought to be tolerant to heavy metal and hydrocarbon contamination (Ref 18.48).

18.13.8 The Annex I reefs identified along the English Offshore Scheme are considered to have low and medium resemblance to stony reef, and, as such, are usually associated with lower biodiversity and abundance compared to those with high resemblance. Therefore, the sensitivity of Annex I stony reef to this impact pathway is low.

Sensitivity - Annex I *S. spinulosa* reefs

18.13.9 There is no specific assessment for the impacts of sediment bound chemical contamination on *S. spinulosa* reefs. However, as the characteristic species of this biotope is a reef-forming polychaete worm, it is assumed that sensitivity will be in line with other polychaete dominated biotopes, and a sensitivity of low is applied.

Magnitude of Impact and Significance

18.13.10 The EBS indicates that sediment Total Hydrocarbon (THC) concentrations were typical of background marine sediments. PAH levels (normalised to 2.5% Total Organic Carbon) were slightly elevated at all stations, with pyrolytic and petrogenic origins suspected throughout. Metals listed on the OSPAR Coordinated Environmental

Monitoring Programme concentrations were below Cefas AL1 and all metals were below AL2. Generally, sediment-bound contamination is within expected levels with no adverse impacts on the macrofaunal community identified. **Volume 1, Part 3, Chapter 17: Marine and Coastal Physical Processes** indicates that sediments will settle out within the near vicinity of the mobilisation location, and therefore additional contamination would not be transported large distances. The magnitude of impact for all receptors is therefore considered to be negligible.

18.13.11 The significance of effect of the mobilisation and deposition of sediment bound contaminants on Annex I stony reef, Annex I *S. spinulosa* reef, subtidal mud and sand habitats, intertidal habitats and designated sites with intertidal features would be **negligible** and **not significant** during construction, operation and maintenance, and decommissioning. The significance of effect of the mobilisation and deposition of sediment bound contaminants no subtidal coarse and mixed sediment habitats, subtidal sands and gravels, and ocean quahog would be **minor** and **not significant** during construction, operation and maintenance, and decommissioning.

18.14 Preliminary assessment of underwater noise changes – All phases

18.14.1 All works undertaken during the construction, operation and maintenance, and decommissioning of the English Offshore Scheme will generate underwater sound. Sound is readily transmitted in the underwater environment and can be categorised as either impulsive or continuous. Impulsive sources are typically transient, brief (less than one second), broadband, and consist of high peak sound pressure with a rapid rise time and decay (Ref 18.62, 63). This category includes sound sources such as seismic surveys and underwater explosions. Continuous (non-impulsive) noises can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with a rapid rise / decay time that impulsive noises do. This category includes sound sources such as continuous running machinery, sonar, and vessels.

18.14.2 Primary sources of underwater associated with the English Offshore Scheme include vessel movements, geophysical sonar-like surveys, the use of equipment on the seabed (e.g., boulder grabs, pre-sweeping, trenching equipment) and UXO clearance (noting that UXO clearance will not be authorised through the DML). Most sources generate continuous (non-impulsive) sound, with the exception of UXO clearance.

18.14.3 At present, there are no published sensitivity thresholds for benthic species. MarESA classify ocean quahog sensitivity to underwater noise changes as ‘not relevant’, citing evidence by Morton (Ref 18.64). Although sensitive to vibration, no evidence has been found to suggest that underwater noise and sound from passing vessels or construction have an effect on this species (Ref 18.38). A further review of MarESA sensitivity assessments for habitats and marine invertebrates identified within the English Offshore Scheme identified that bivalves and polychaetes are likely to detect vibrations and probably withdraw their siphons and palps as a predator avoidance mechanism. However, for most species, they are not expected to be sensitive or are considered tolerant at the benchmark level, which MarESA defines as the regular passage of a 30 m trawler at 100 m or a working cutter-suction transfer dredge at 100 m for one month during important feeding or breeding periods. As the benchmark is analogous to the activities that would take place during construction, maintenance and decommissioning i.e., vessel movements, seabed disturbance, the sensitivity of marine invertebrates to underwater noise has been assessed as negligible.

18.14.4 Given the temporary, intermittent and reversible nature of the noise-generating activities, the magnitude of the impact has been assessed as negligible.

18.14.5 Although there is currently very limited evidence on the effects of underwater sound on marine invertebrates, the current data suggest that the effect of the type and duration of underwater sound generated by the activities will be negligible. The significance of the effect has been assessed as **negligible** and **not significant**.

18.15 Preliminary assessment of the introduction or spread of marine invasive non-native species – All phases

18.15.1 The presence of project vessels, equipment and external cable protection has the potential to introduce and encourage the spread of MINNS through the attachment of adult individuals or eggs to their surface and the subsequent release into the marine environment (Ref 18.11).

18.15.2 The American slipper limpet *Crepidula fornicata* is an invasive mollusc that is prevalent throughout the North Sea and was introduced to the UK and Europe in the 1870s from the Atlantic coasts of North America. This species typically resides in shallow, sheltered marine environments and thrives in areas of muddy gravel, where it settles on the shells of fellow adults, forming characteristic 'stacks' (Ref 18.65). At high densities, the species physically smothers the sediment surface, and the resulting build-up of silt and faeces is deposited on the seabed. Once deposited, an anoxic mud layer is formed, making the environment unsuitable for the characterising species of that habitat. Subsequently, biodiversity is reduced, and the habitat is at risk of permanent conversion to another habitat type.

18.15.3 The carpet sea squirt *Didendum vexillum* is native to Japan but present in UK waters (Ref 18.66). This species has the potential to colonise and smother offshore gravel habitats within the North Sea, as evidenced by previous colonisation of gravel habitats in Georges Banks along the United States (US) / Canada border (Ref 18.67).

18.15.4 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor sensitivities. Due to the vessel regulations and mitigation plans (see Section 18.6) that will be followed during construction, operation and maintenance, and decommissioning of the English Offshore Scheme, the magnitude of effect on each receptor is the same. To avoid repetition, the magnitude and significance of the effect on each receptor are reported in a separate subheading after the description of receptor sensitivities. A summary of the preliminary assessment conclusions is provided in **Table 18-20** for ease of reference.

Table 18-20 Summary of preliminary assessment conclusions for MINNS

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Atlantic circalittoral coarse sediment Subtidal sands and gravels	High	Negligible	Minor (N/S)
Atlantic circalittoral sand Atlantic circalittoral mixed sediment	Medium	Negligible	Minor (N/S)

Receptor	Receptor sensitivity	Magnitude	Significance of effect
Annex I *S. spinulosa* reef	Low	Negligible	Negligible (N/S)
Annex I stony and rocky reef	Negligible	Negligible	Negligible
Ocean quahog			

Sensitivity - Subtidal broadscale habitats and Subtidal sands and gravels

18.15.5 Coarse sediment habitats and Subtidal sands and gravels demonstrate a high sensitivity to MINNS. Mixed sediment habitats and sand habitats demonstrate a medium sensitivity to MINNS. The American slipper limpet thrives in areas of high gravel content and has the potential to colonise the coarse sediment within subtidal sands and gravels, modifying community structure and sediment composition. Across the English Offshore Scheme, sand is the most dominant sediment type present, even within coarse sediment habitats. Within sand habitats, or habitats with a high sand content, macrofaunal communities undergo a shift toward sessile suspension feeders in the presence of the American slipper limpet, due to the increased availability of hard substrata (i.e., *C. fornicata* shells). Blanchard (Ref 18.68) suggested that this transition becomes irreversible at 50% *C. fornicata* cover and De Montaudouin *et al.* (Ref 18.69) suggested that this shift occurred above a threshold of 20 - 50 Crepidula/m^2. Additionally, *Didemnum vexillum* has the potential to colonise the gravel present within subtidal sands and gravels habitats, forming dense matts and smothering the seabed surface.

18.15.6 The American slipper limpet is detrimental to a habitat when its presence has the potential to change the structure of the habitat it is within. The biodeposition from *C. fornicata* communities form layers of mud within the habitat they reside; when added to mud habitats, this does not change the sediment composition and habitats shifts do not occur. Therefore, sensitivity value of negligible has been assigned to this receptor.

Sensitivity - Annex I Stony reef

18.15.7 The boulders, rocks and gravel present within Annex I stony reef provide ample hard substrate for the American slipper limpet to attach to. However, these habitats are dominated by sessile macrofauna, thus the presence of the American slipper limpet in these habitats will not change biodiversity and macrofaunal communities within these habitats. Therefore, the sensitivity of Annex I stony reef to MINNS is negligible.

Sensitivity - Annex I S. spinulosa reef

18.15.8 Annex I *S. spinulosa* reef is found in the nearshore section of the study area. This habitat is often found in high energy environments exposed to storm and wave action, which may prevent colonisation by *Crepidula* at high densities (Ref 18.49). The presence of mixed substrata, including pebble and cobble in some examples of the biotope, could provide suitable hard substrata for the colonization by *Crepidula*, but there is no evidence to suggest *Crepidula* would establish. The MarESA for this habitat notes that there is insufficient evidence to give an estimate of the overall sensitivity (Ref 18.49). For *Didemmum vexillum*, there is no evidence that the species actively colonises *S. spinulosa* reefs, although it is known to colonise the substrates and wave / climate

conditions within which the habitat is found. For the purposes of this assessment the sensitivity of this habitat is taken to be low.

Sensitivity - Ocean quahog

18.15.9 Ocean quahog lives within habitats of high mud content. The American slipper limpet is only detrimental to a habitat and its species when the presence of the slipper limpet has the potential to change the structure of the habitat it is within. The biodeposition from *C. fornicata* communities form layers of mud within the habitat of which they reside; when added to mud habitats this change in sediment composition and habitat shift does not occur. Additionally, ocean quahog is a burrowing bivalve, only using the sediment surface for suspension feeding and respiration. The American slipper limpet lives on the surface of hard substrate at the surface of the seabed; the availability of hard substrata within mud habitats is minimal. According to the MarESA for this species (Ref 18.38), there is no evidence of adverse effects by MINNS toward ocean quahog populations. The sensitivity of ocean quahog to MINNS is considered to be negligible.

Magnitude and Significance of MINNS on the described receptors

18.15.10 During construction, operation and maintenance and decommissioning of the English Offshore Scheme, various project vessels will be present throughout the draft Order Limits (as outlined in **Table 18-12**). Project vessels will follow all relevant guidelines (Ref 18.70). This includes vessel cleaning facilities and the use of anti-fouling paint. Project vessels and contractors will comply with the International Convention for the Control and Management of Ships' Ballast water and sediments, and all seabed deposits will be inert with no biologically active material. Project vessels will complete a biosecurity risk assessment prior to arriving on site which will include factors such as origins of the vessels and ensuring that relevant equipment is cleaned before deployment (see Section 18.6). Compliance with Regulations should be sufficient to minimise the risk to the environment, however, there is still the potential for external cable protection to provide hard substrates that could act as 'stepping stones' to facilitate the spread of MINNS in the region.

18.15.11 The American slipper limpet is prevalent throughout the North Sea and has been present within UK waters since 1870. The presence of this species in the North Sea has not already negatively impacted the distribution of the described broadscale habitats and other receptors within the study area. Additionally, Didemnidae (the family name of the carpet sea squirt) has been recorded as already present within the English Offshore Scheme. The magnitude of MINNS on all five described broadscale habitats is considered to be negligible.

18.15.12 The preliminary assessment concluded that the significance of the effect of MINNS during construction, operation and maintenance, and decommissioning on each described receptor is as follows:

- Atlantic circalittoral coarse sediment habitats and Subtidal sands and gravels: **minor** and **not significant.**
- Mixed sediment habitats and sand habitats, Annex I stony reef, Annex I *S. spinulosa reef*, ocean quahog: **negligible** and **not significant.**

18.16 Preliminary assessment of electromagnetic changes – Operation and Maintenance

Subtidal species

18.16.1 During the operation of an HVDC cable localised electromagnetic fields are generated that may affect benthic ecology receptors. To inform the assessment, a number of scenarios were modelled to calculate the EMF emissions. The calculations are presented in **Volume 2, Part 1, Appendix 4.A: EGL 5 Electromagnetic Field (EMF) Study**. They show that for bundled HVDC poles buried 1 m below the seabed the magnetic field dissipates to below background geomagnetic levels within 20 m. The magnetic field directly above the cables at the seabed is 124.3 μT (or 74.7 μT without the earth's magnetic field).

18.16.2 There is very little information about the sensitivity of benthic species to EMF. It is known that magnetic sensitivity occurs in species that undergo large scale migrations or movements. With respect to subtidal benthic species this includes decapod crustaceans (crabs, lobster, shrimp, prawns), and isopods and amphipod crustaceans. Marine invertebrate species (molluscs, polychaetes, crustaceans and echinoderms) have been poorly studied. A review of available literature by Albert *et al.* (Ref 18.71) reported that that 50% of papers provided support for an attraction towards magnetic fields in three crustacean species; 30% of papers found no effects of magnetic field while studying more taxonomic groups (crustaceans, echinoderms, molluscs and polychaetes); one paper found repulsive behaviour in spiny lobster; and another reported orientation disruption is sand hoppers (amphipods). However, it was noted that 75% of the papers reviewed related to controlled experiments made on individuals, and effects at a population or community level could not necessarily be inferred from the results. Ocean quahog are not known to exhibit sensitivity to EMF, and given its lack of magneto-receptive capabilities, any potential effects from EMF exposure are considered negligible. The sensitivity of subtidal species to electromagnetic changes is low.

18.16.3 Where possible, the marine cables used within the English Offshore Scheme will be buried at an average depth of 1.5 m across the cable length. The background magnetic field of 49.6 μT induces an electric field that could range between 5.0 and 65.0 μV/m in tidal velocities ranging between 0.1 m/s and 1.35 m/s. Although effects from electromagnetic changes would be long-term and occurring continuously for the operational lifetime of the English Offshore Scheme, the highest intensity emission strength for the English Offshore Scheme is significantly lower than that used in the laboratory experiments reviewed by Albert *et al*. (Ref 18.71). Thus, the magnitude of the effect is negligible.

18.16.4 The significance of the effect has been assessed as **negligible** and **not significant** during operation and maintenance.

18.17 Preliminary assessment of temperature increase – Operation and Maintenance

Subtidal species

18.17.1 During the operation of an HVDC cable, heat losses occur because of the resistance in the cable / conductor. This can cause localised heating of the surrounding environment (i.e., sediment for buried cables, or water in the interstitial spaces of external cable

protection). There are no specific regulatory limits applied to temperature changes in the seabed, although a two-degree Celcius change between seabed surface and 0.2 m depth is used as a guideline in Germany (Ref 18.72). The benchmark for sensitivity used by MarESA is a five-degree Celcius increase in temperature for one month, or two-degree Celcius for one year.

18.17.2 A change in sediment temperature has the potential to cause sediment dwelling and demersal mobile organisms to move away from the affected area. Increased heat may also alter physio-chemical conditions for epifaunal species and bacterial activity (with shifts in bacterial community composition and changes in nitrogen cycling) in surrounding sediments, contributing to altered faunal composition and localised ecological shifts.

18.17.3 An increase in temperature may affect spawning and recruitment levels in ocean quahog. Distribution of this species appears to be restricted by water temperature, with 16 Celcius being the upper threshold, with larvae tending to grow optimally between 13 Celcius and 15 Celcius. MarESA suggests a sensitivity of medium to temperature increases for this species (Ref 18.38). A review of the sensitivity of other infaunal species identified within the draft Order Limits (e.g., *A. alba*, *A. prismatica, K. bidentata, P. jeffreysii, Thyasira spp., A. filiformis, H. filiformis)* concluded that their resistance and resilience to temperature increases lead to an overall low or no sensitivity categorisation by MarESA. Therefore, the sensitivity of the ocean quahog has been used on a precautionary basis.

18.17.4 The heat loss from the cable is related to the physical and thermal properties of the cables. To inform the assessment, a number of scenarios were modelled to evaluate the thermal performance of the cables, including cables buried in a bundle to varying depths and contained within a duct at the Anderby Creek Landfall. The calculations are presented in **Volume 2, Part 1, Appendix 4.B: EGL 5 Heat Calculations Technical Report**. They show that for cables operating at full power, the temperature rises in the immediate vicinity of the cable but reduces with distance. Assuming an ambient seabed temperature of 12 Celcius, seabed temperatures at 0.2 m immediately above the cables are estimated to be 13 - 14 Celcius, with the cables operating at their maximum temperature. The actual system is unlikely to reach these temperatures; it would have to operate at full load continuously for an extended period of time (months / years) to meet these temperatures. In reality, the system will not be at full load for this long and therefore the temperature will fluctuate and it would be unlikely reach these maximums. Although thermal effects would be long-term and occurring continuously for the operational lifetime of the English Offshore Scheme, the temperature increase is low-level and likely to be only a few degrees higher than ambient at the shallow sediment depths (<20 cm) at which infaunal species are typically found. Where the cables are buried at a shallower depth, or where they are surface-laid with external cable protection, there is potential for fauna to be exposed to higher temperature gradients. However, there is negligible capacity to warm the overlying water, so there will be no effect on epibenthic communities.

18.17.5 Due to natural seasonal changes in water temperature, a sediment temperature change of a few degrees higher than ambient is regarded as an insignificant temperature increase. Given that temperature changes will be limited to immediately above the cables, the magnitude of the impact on subtidal species has been assessed as low.

18.17.6 The significance of the effect on subtidal habitats, species and ocean quahog has been assessed as **minor** and **not significant** during operation and maintenance.

18.18 Transboundary Effects

18.18.1 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. Similarly, the English Offshore Scheme lies wholly in UK waters. Separate applications will be submitted to the relevant Statutory Authority for the Scottish Schemes. Where the English and Scottish Schemes meet, collaborative environmental assessments will ensure impacts are fully assessed.

18.18.2 Given the distance to the UK Exclusive Economic Zone boundary (as outlined in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**), no potential transboundary impacts have been identified for intertidal and subtidal benthic ecology. This is in line with the preliminary transboundary screening carried out by the Planning Inspectorate (dated 06 November 2025).

18.19 Further Work to be Undertaken

18.19.1 The information provided in this PEIR is preliminary; the final assessment of significant effects will be reported in the ES. This section describes the further work to be undertaken to support the intertidal and subtidal benthic ecology assessment presented in the ES.

Baseline

18.19.2 An extensive programme of marine characterisation surveys has been undertaken for the English Offshore Scheme as outlined in Section 18.4.5 to Section 18.4.12. Draft survey reports were issued by the survey contractor to inform the Preliminary Environmental Assessment. Further work will be undertaken for the ES to ensure all survey results and analyses are incorporated and cross referenced.

18.19.3 Data ‘walk throughs’ with technical stakeholders will be proposed to enable statutory consultees the opportunity to gain a detailed understanding of the data sets used to inform the EIA prior to ES submission.

Assessment

18.19.4 The assessments undertaken for the PEIR will be reviewed following stakeholder consultation feedback, further design refinement and review of final marine characterisation survey results. However, a worst-case scenario has been adopted for PEIR and preliminary environmental survey results have informed the assessments presented. There is a good understanding of the nature of the seabed habitats present in the study area and the presence / absence of protected features. The preliminary assessment has not identified any potential significant effects.

18.19.5 Further assessment of the requirements for external cable protection across the English Offshore Scheme, and the requirement for micro-routeing around sensitive benthic habitats, will be undertaken and the results presented in the ES.

Further environmental measures

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

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