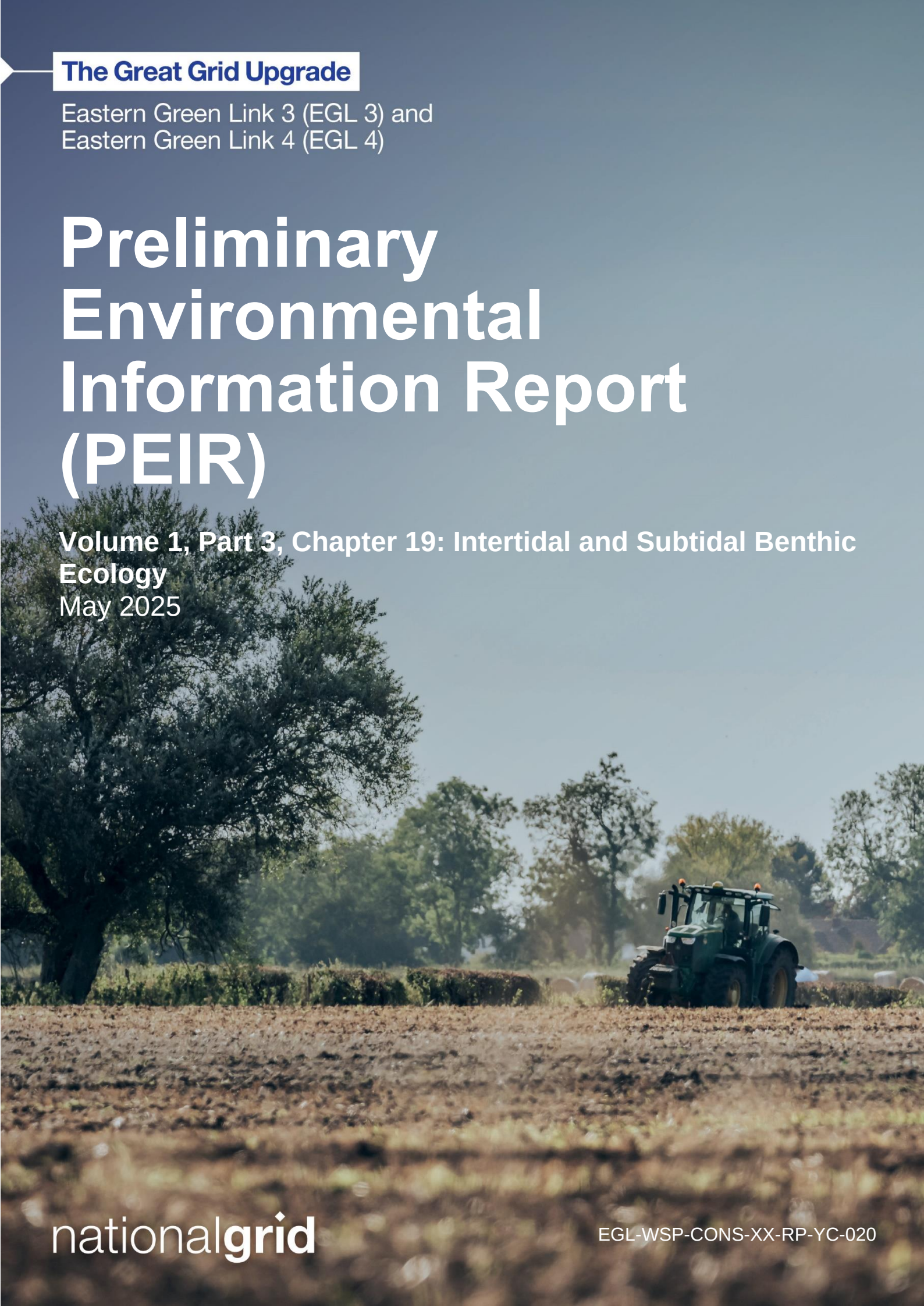
The Great Grid Upgrade

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

Preliminary Environmental Information Report (PEIR)

Volume 1, Part 3, Chapter 19: Intertidal and Subtidal Benthic Ecology

May 2025



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EGL-WSP-CONS-XX-RP-YC-020

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19. Intertidal and Subtidal Benthic Ecology

19.1 Introduction

19.1.1 This chapter presents the preliminary findings of the Environmental Impact Assessment (EIA) undertaken to date for the English Offshore Scheme, with respect to intertidal and subtidal benthic ecology including organisms living in (infauna) or on (epifauna) the seabed, as well as their supporting habitats. The chapter excludes shellfish which are covered in **Volume 1, Part 1, Chapter 20: Fish and Shellfish**. The preliminary assessment is based on information obtained to date. It should be read in conjunction with the description of the English Offshore Scheme provided in **Volume 1, Part 1, Chapter 4: Description of the Projects**.

19.1.2 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 and operation (and maintenance) phases. Specifically, it relates to the English offshore elements of Eastern Green Link 3 (EGL 3) Project and Eastern Green Link 4 (EGL 4) Project seaward of Mean High Water Springs (MHWS) up to 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.

19.1.3 This chapter should be read in conjunction with:

- **Volume 1, Part 1, Chapter 4: Description of the Projects**
- **Volume 1, Part 2, Chapter 6: Biodiversity** which identifies the potential impacts on onshore ecology and receptors which might be using the intertidal area;
- **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes** which identifies the spatial extent of potential impacts from temporary sediment suspension and subsequent redeposition;
- **Volume 1, Part 3, Chapter 20: Fish and Shellfish** which identifies the potential impacts on fish and shellfish species many of which rely on specific benthic ecological habitats for prey or breeding habitat;
- **Volume 1, Part 3, Chapter 21: Intertidal and Offshore Ornithology** (due to the close association between fish and shellfish receptors as prey species for marine birds);
- **Volume 1, Part 3, Chapter 22: Marine Mammals and Marine Reptiles** (due to the close association between fish and shellfish receptors as prey species for marine mammals); and
- **Volume 1, Part 3, Chapter 23: Shipping and Navigation** due to the close association with vessel traffic within the English Offshore Scheme.

19.1.4 This chapter is supported by the following figures:

- **Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area;**

- **Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone; and**
- **Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area**

19.1.5 This chapter is supported by the following appendices:

- **Volume 2, Part 1, Appendix 1.2.A: Regulation and Planning Context;**
- **Volume 2, Part 1, Appendix 1.2.B: Marine Plan Assessment;**
- **Volume 2, Part 1, Appendix 1.4.A: Electromagnetic Field (EMF) Study;**
- **Volume 2, Part 1, Appendix 1.4.B: EGL 3 Heat Calculations;**
- **Volume 2, Part 1, Appendix 1.4.C: EGL 4 Heat Calculations;**
- **Volume 2, Part 1, Appendix 1.5.C: Outline Construction Environmental Management Plan;**
- **Volume 2, Part 1, Appendix 1.5.A: Outline Register of Design Measures;**
- **EGL 3 and EGL 4 Draft Habitats Regulations Assessment (HRA) Report (May 2025) (document reference EGL-WSP-CONS-XX-RP-Y-001);**
- **Volume 2, Part 3, Appendix 3.17.A: Marine Conservation Zone (MCZ) Assessment Screening;**
- **Volume 2, Part 3, Appendix 3.17.B: Marine Conservation Zone (MCZ) Stage 1 Assessment; and**
- **Volume 2, Part 3, Appendix 3.17.C: In-principal MEEB Strategy**

19.1.6 As set out in **Volume 1, Part 1, Chapter 1: Introduction**, cable installation and some associated activities beyond 12 nautical miles (NM) are exempt under the Marine and Coastal Access Act (MCAA) as well as repair of the installed cable. This chapter presents a preliminary assessment of the cable route from MHWS at the Anderby Creek Landfall to the border with Scottish adjacent waters. This is to provide a holistic view of the English Offshore Scheme and any associated impacts, however consent is not being sought for the exempt cable (either installation or repair) and only cable protection and dredging for sandwave levelling will be included in the deemed Marine Licence (dML) beyond 12 NM.

Limitations

19.1.7 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 (NGET) consultation duties in accordance with Section 42 of the PA2008 and enable consultees to develop an informed view of the preliminary significant effects of the English Offshore Scheme.

19.1.8 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 19.5.**

19.1.9 The optimal marine survey window, especially for intertidal surveys, is during the summer months to obtain an accurate representation of the marine life that is present, as they may experience mortality or be in hiding during the winter months. The Anderby Creek intertidal survey for the English Offshore Scheme occurred between late October and early November. Given the small intertidal area surveyed and the annual beach nourishment that occurs at Anderby Creek, the data gathered from the intertidal survey is still considered to be representative of the area.

19.1.10 The EGL 4 environmental deoxyribonucleic acid (eDNA) data provided by the EGL 4 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 known to be 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' deoxyribonucleic acid (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.

19.1.11 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 has three main limitations:

- It can be difficult to interpolate data collected from discrete sample locations to cover the whole study area 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. In particular, there is still poor coverage of circalittoral rock and sediment habitats occurring in waters deeper than 50 m.

19.1.12 Despite these limitations, every effort has been made to obtain data 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

19.1.13 The preliminary intertidal and subtidal benthic ecology environmental assessment presented in **Section 19.11** has for the most part concluded that the potential significant effects assessed are either **Negligible** or **Minor** adverse effects and are considered to be **Not Significant**. These adverse effects are ones that can be adequately controlled by best practice and legal controls and opportunities to reduce the significance of effects through mitigation may be limited. Further details of the methodology behind the assessment, and a detailed narrative of the assessment itself are provided within the sections below.

19.1.14 **Section 19.11.11** and **19.11.41** has identified two potentially **Significant** effects on **Atlantic circalittoral soft rock** and specifically the Level 5 biotope 'piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251). This biotope is found interspersed along the EGL 3 Project between approximately Kilometre Point (KP) 25 and KP 40. This habitat demonstrates **high sensitivity** to seabed penetration and permanent habitat loss and **medium sensitivity** to seabed abrasion. The preliminary assessment concluded that for the impact of temporary habitat loss there would be an effect of **Moderate adverse significance** and for the impact of permanent habitat loss there would be an effect of **Major adverse significance**.

19.1.15 The benthic survey data was received immediately prior to the publication of PEIR, thus survey information and data is still under review. It is possible that this preliminary assessment is overly precautionary, especially as it is unknown if external cable protection would be required within the Atlantic circalittoral soft rock habitat. Further assessment will be completed for the ES to increase the level of certainty and determine if environmental measures to mitigate a significant effect are required. These could include the potential to micro route around areas of MC1251 within the draft Order Limits.

19.2 Relevant Technical Guidance

19.2.1 The legislation and planning policy which has informed the assessment of effects with respect to intertidal and subtidal benthic ecology is provided within **Volume 2, Part 1, Appendix 1.2.A: Regulatory and Planning Context**. Further information on policies relevant to the English Offshore Scheme is provided in **Volume 1, Part 1, Chapter 2: Regulatory and Policy Overview.** A preliminary marine plan assessment is provided as **Volume 2, Part 1, Appendix 1.2.B: Marine Plan 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.

Technical Guidance

Table 19-1 - 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 (CIEEM, 2018, and updated April 2022 Ref 19.1)	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 (Natural England and JNCC, 2022 REF 19.2).	Identifies the main pressures of subsea cables and sensitive habitats, as well as best practices during development in United Kingdom (UK) waters.

Technical guidance document	Context
Natural England best practice guidance advice to facilitate sustainable development (Natural England, 2022 REF 19.3)	Uses high-quality data to assess impacts on key ecological receptors like seabirds and marine mammals. Documents for all four project phases 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 (Cefas, 2012 REF 19.4)	Provides guidance in the design, review and implementation of environmental data collection and analysis associated with all stages of offshore renewable energy development.
Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (Ware & Kenny, 2011 REF 19.5)	Provides guidance on the reporting of benthic surveys to ensure consistency between consultants conducting an ES.
Environmental impact assessment for offshore renewable energy projects – Guide. PD 6900:2015 (The British Standards Institution, 2015 REF 19.6)	Provides guidance on writing EIAs for offshore wind projects, outlining all aspects of the EIA process.
The identification of the main characteristics of Annex I stony reef habitats under the Habitats Directive (Irving, 2009 REF 19.7)	Outlines the key features of stony reefs to aid identification of Annex 1 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 (Golding *et. al*., 2020 REF 19.8)	Provides a definition for Annex 1 habitats. Provides a definition for habitats that are of ‘low resemblance’ to stony reefs and provides examples of areas with a ‘low resemblance’ to Annex 1 stony reefs in UK waters.
Defining and managing *Sabellaria spinulosa* reefs (Gubbay, 2007 REF 19.9)	Provides a definition for *Sabellaria spinulosa* reefs.
Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Parker et al., 2022 REF 19.10)	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) (Marlin, 2021 REF 19.11) (Tyler-Walters et al. 2018 REF 19.12)	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.

19.3 Consultation and Engagement

Overview

19.3.1 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 **Chapter 5: PEIR Approach and Methodology**.

Scoping Opinion

19.3.2 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 05 September 2024. A summary of the relevant responses received in the Scoping Opinion in relation to intertidal and subtidal benthic ecology and confirmation of how these have been addressed within the assessment to date is presented in **Table 19-2**.

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

Table 19-2 - Summary of EIA Scoping Opinion Responses for Intertidal and Subtidal Benthic Ecology Assessment

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate	ID 5.2.1, . Temporary Habitat Loss/seabed disturbance during operation and decommissioning – trenchless solution and duct installation and open cut trenching at landfall cable burial and trenching on intertidal habitats. The Planning Inspectorate notes that the explanation for scoping this matter out relates to requiring a separate Marine Licence to maintain the cable during operation, should a trenchless technique be employed. The Scoping Report does not reference the likely significant effects should an open-cut technique be used. As the Proposed Development could utilise either method, the Planning Inspectorate does not agree to scope this matter out on the information provided. In relation to decommissioning effects, the scoping report relies on scoping this matter out 'if' the cables are left in situ. Furthermore, it is noted that other matters are scoped in in relation to this aspect as a result of uncertainty	A trenchless solution would be used to install the marine cable. Open cut trenching at the landfall is not planned and is not included in **Volume 1, Part 1, Chapter 4: Description of the Projects**. The scoping justification with respect to scoping out the matter for operation and decommissioning remain valid and therefore this matter continues to remain scoped out for these phases.

Consultee	Consideration	How addressed in this PEIR
	regarding the decommissioning methods. The Planning Inspectorate would expect the ES to consider all possible scenarios and as such does not agree to scope this matter out at present.	
Planning Inspectorate	ID 5.2.2, . Temporary increase and deposition of suspended sediments during operation – pre-sweeping on subtidal habitats. The Planning Inspectorate agrees that where a cable is likely to require repair, pre-sweeping is unlikely to be necessary and where a scenario could arise where pre-sweeping is necessary, this is unlikely to result in significant effects due to the limited spatial extent of the works.	Receptor and impact pathway remains scoped out in preliminary environmental assessment.
Planning Inspectorate	ID 5.2.3, . Underwater noise changes during construction, operation and decommissioning – geophysical survey and presence of project vessels and equipment on subtidal species. The Planning 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. It is also noted that the Marine Management Organisation (MMO), the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and the Environment Agency (EA) did not agree that this matter could be scoped out in their consultation responses. Furthermore, in the absence of confirmed construction details the Planning Inspectorate considers that this matter should be scoped in for further assessment.	**Section 19.11.108** provides a preliminary environmental assessment of the impact of underwater noise changes on subtidal species.
Planning Inspectorate	ID 5.2.4,. Electronic changes/barrier to species movement during operation – presence of cables on subtidal species.	**Section 19.11.124** provides a preliminary environmental assessment of the impact of electromagnetic changes on subtidal species.

Consultee	Consideration	How addressed in this PEIR
	The Planning Inspectorate notes the comments from the Joint Nature Conservation Committee (JNCC) in relation to the presence of ocean quahog (*Arctica islandica)* and therefore does not agree to scope this out at present. The Planning Inspectorate would also expect this matter to provide sufficient assessment and cross-referencing to the shellfish and fish aspect chapter, where this matter has been scoped in.	
Planning Inspectorate	ID 5.2.5,. Temperature increase during operation – presence of cables on subtidal habitats and species. The Planning Inspectorate is content to scope this matter out for construction and decommissioning as at these phases the cables are not in operation. During operation, the Planning Inspectorate notes the findings from the study undertaken on Viking Link and notes that the Proposed Development commits to burying the cables at 1.0 - 2.5 m, which is deeper than 0.75 m where an increase in 2 °C could occur. The Planning Inspectorate also notes comments by the E A and therefore does not agree to scope this matter out at this time.	**Section 19.11.127** provides a preliminary environmental assessment of the impact of temperature changes on subtidal species during operation.
Planning Inspectorate	ID 5.2.6,. Accidental spills during construction, operation and decommissioning – presence of project vessels and equipment on intertidal and subtidal habitats. The Planning Inspectorate is content to scope this matter out noting the legal requirements upon vessels to manage any accidental releases or spills of materials or chemicals. The ES should include details of the mitigation and explain how its delivery is assured with reference to relevant documents.	Receptor and impact pathway remains scoped out in preliminary environmental assessment. Several management plans will be provided as outline management plans with the Development Consent Order (DCO) application to be secured as a condition of the dML. These will include an Outline Construction Environmental Management Plan (CEMP) and Outline Marine Pollution Contingency Plan. 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.

Technical Engagement

19.3.4 Technical engagement with consultees in relation to intertidal and subtidal benthic ecology is ongoing. A summary of the technical engagement undertaken to March 2025 is outlined in **Table 19-3.**

Table 19-3 - Technical Engagement on the Intertidal and Subtidal Benthic Ecological Assessment

Consultee	Consideration	How addressed in this PEIR
Natural England , JNCC	The Applicant sought advice to inform route selection for the EGL 3 Project and the EGL 4 Project with respect to the interaction with the protected features of the Holderness Offshore Marine Conservation Zone (MCZ). JNCC and Natural England's joint opinion was to follow the mitigation hierarchy and that where avoidance of the site is not possible, their preference would be for the route that crosses the site for the shortest distance in the southeast corner. In providing their preference they considered the potential for impacts on the North Sea glacial tunnel valley, Silver Pit, determining that the geological feature is a topographical bedform and therefore activities such as cable trenching and burial in surficial sediments should not affect the feature.	The design of the English Offshore Scheme took stakeholder advice into consideration. The EGL 3 Project avoids the Holderness Offshore MCZ completely. The EGL 4 Project crosses the site in the southeast corner but minimises interaction with the Holderness Offshore MCZ as much as possible, whilst considering other constraint factors such as cable separation distances which is necessary to mitigate the risk of anchor strike impacting multiple seabed assets.
Natural England	Based on applications from other developers including Viking Link, Natural England raised that sediments within the Holderness Offshore MCZ would not be conducive to cable burial and remedial cable protection would likely be required. Natural England stated that given the volume of rock protection applied for in Marine Licences that overlapped with the Holderness Offshore MCZ, they believed that the threshold for the site (with respect to a permanent change to sediments) had been reached and any additional external cable protection would hinder the conservation objectives for the site. If a project could not demonstrate that it would not	The Applicant has engaged with National Grid Ventures (NGV) and the Viking Link Project team to understand the engineering challenges faced within the Holderness Offshore MCZ and determine where, why, and how much external cable protection was required during installation. Information on rock deposition volumes and locations has been shared and supported the Applicants' decisions with respective cable route selection. Engagement has been held with other marine developers to understand future interactions with the Holderness Offshore MCZ e.g., from proposed offshore wind export cables.

Consultee	Consideration	How addressed in this PEIR
	adversely hinder the conservation objectives, Natural England would be advising the competent authority that the project carry out a Stage 2 MCZ Assessment and provide Measures of Equivalent Environmental Benefit (MEEB).	**Volume 2, Part 3, Appendix 3.17.A: Marine Conservation Zone (MCZ) Assessment Screening** and **Volume 2, Part 3, Appendix 3.17.B: Marine Conservation Zone (MCZ) Stage 1 Assessment** has been provided with this PEIR. The assessment of preliminary environmental impacts on Holderness Offshore MCZ is provided in **Section 19.11** of this chapter.
Natural England	Natural England raised that other projects in the Lincolnshire area have had trouble with Horizontal Directional Drilling (HDD) (reference was made to development of sink holes and frac-outs) and advised the Applicant to speak to RWE and Ørsted to get a better understanding from an engineering perspective of the difficulties faced and learn lessons from the relevant projects. Natural England's knowledge and understanding from these projects and others around The Wash led to them advising against a landfall selection within the Saltfleetby-Theddlethorpe and Gibraltar Point Special Area of Conservation (SAC).	The EGL 3 Project and the EGL 4 Project teams spoke to Ørsted to understand the issues that Hornsea 2 had throughout the installation process in the intertidal area and visited the landfall site on multiple occasions to assess the remediation work. Engagement was also carried out with members of RWE who worked on Triton Knoll. Knowledge and lesson learnt with regard to bentonite frac-outs, clean up methods and geological site investigations have been shared. A competent contractor with experience working in a similar environment would be employed, as lesson learnt from analogous projects. Information gathered during the engagement has informed the selection of the landfall and the design of the trenchless technique at the landfall.
Natural England, JNCC, Cefas and MMO	The scope of the marine characterisation surveys for the EGL 3 Project and EGL 4 Project was discussed with Natural England, JNCC, Cefas and the MMO. Advice was sought on the number of replicate samples to be taken, the spacing of environmental baseline samples, the spacing of additional samples to inform herring and sandeel habitat assessment and the sediment sampling plan for potential areas of pre-sweeping in sandwaves.	Points raised by the consultees were incorporated into the design of the marine characterisation surveys. Consultees were advised of the initial sampling strategy and updated as the sample positioning altered slightly to take comments onboard, and in light of geophysical data; this included reducing the distance between benthic sampling stations from 5 km to 2.5 km in historic herring and sandeel spawning grounds. An overview of the marine characterisation sampling approach is presented in **Section 19.4.10** of this chapter. The survey data has informed the description of

Consultee	Consideration	How addressed in this PEIR
		the baseline presented in **Section 19.5.**
Lincolnshire Wildlife Trust	Indicated preference for marine route that avoids crossing Silver Pit, suggesting that some of the broadscale habitat features within the Holderness Offshore MCZ are less sensitive than the habitats within the glacial tunnel valley. However, recognised Natural England and JNCC concerns regarding the use of external cable protection within the Holderness Offshore MCZ would take precedent. Requested therefore that draft Order Limits avoid the main part of Silver Pit. The steep slopes in this area support high levels of biodiversity.	To avoid or minimise interaction with the Holderness Offshore MCZ, as per NE guidance, the draft Order Limits cannot avoid Silver Pit in its entirety. However, the majority of Silver Pit has been avoided by routeing across the northern extent of the pit where the slope gradient is less, thus avoiding the main part where the slope features are ecologically important.
JNCC	JNCC queried what options are being considered to reduce the deposition of remedial external cable protection e.g., partial seabed burial and rock fill to seabed surface, taking surrounding substrate size into consideration when sourcing rock fill.	An outline Cable Burial Risk Assessment based on desk-based information has informed the preliminary assessment. Cable Burial Risk Assessments for the English Offshore Scheme will be available to inform the ES. All options to reduce the permanent footprint of the English Offshore Scheme are being considered. Further engagement with consultees will be undertaken ahead of ES submission as the results of the marine characterisation survey and subsequent engineering studies are available. A bundled cable solution would be used for the EGL 3 Project and the EGL 4 Project, reducing the number of trenches per Project requiring external cable protection from two to one. Trenching would be used as the primary source of cable protection. Where cable burial is not possible, or inadequate cable burial depth achieved, external cable protection would be used.
Cefas	Advised using the Cefas OneBenthic tool – regional seabed monitoring programme, to inform baseline description.	OneBenthic has been used to inform the description of the macrofauna baseline within study area (**Section 19.5.17**)

19.3.5 Monthly meetings are scheduled with JNCC, Natural England and the MMO between PEIR and ES. Expert topic groups will be established to discuss relevant ecological topics and any issues that may arise. Engagement will also continue with Cefas and Lincolnshire Wildlife Trust.

19.3.6 Technical 'walk throughs' with stakeholders have been proposed to enable statutory consultees the opportunity to gain a detailed understanding of the data sets prior to ES submission.

19.4 Data Gathering Methodology

19.4.1 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 is noted in Table 19-4 - Data Sources Used to Inform the Intertidal and Subtidal Benthic Ecology Assessment**Table 19-4**.

Study Area

19.4.2 The English Offshore Scheme would route from Anderby Creek across the Southern and Central North Sea to the boundary between the English and Scottish Exclusive Economic Zones (EEZ). The draft Order Limits for the English Offshore Scheme is illustrated in **Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area.**

19.4.3 The study area for intertidal and subtidal benthic ecology includes the draft Order Limits up to MHWS, which encompasses both the EGL 3 Project and the EGL 4 Project, plus an additional 15 km buffer either side of the draft Order Limits (**Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**). This buffer is based on local tidal excursion distances as defined in **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**, and acts as a precautionary maximum zone of influence (ZoI). The ZoI incorporates the area in which there is potential for indirect impacts associated with the deposition of suspended sediments to benthic receptors (during construction and operation phases of the English Offshore Scheme).

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

Tidal River Works

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

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

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

19.4.7 The River Nene Temporary Quay is an option being explored within the Projects design for delivery of components for the English Onshore Scheme. At this stage feasibility of the temporary quay is still being explored, and insufficient information is available to complete a preliminary assessment. If taken forward, the ES will include a full assessment of effects of the temporary quay. **Section 19.13** outlines the further work that will be undertaken to inform the assessment.

Desk Study

19.4.8 A summary of the organisations that have supplied data, together with the nature of that data is outlined in Table 19-4 - Data Sources Used to Inform the Intertidal and Subtidal Benthic Ecology Assessment**Table 19-4.**

Table 19-4 - Data Sources Used to Inform the Intertidal and Subtidal Benthic Ecology Assessment

Organisation	Data source	Data provided
Natural England (REF 19.13)	https://designatedsites.naturalengland.org.uk/	Conservation advice for Marine Protected Areas
JNCC (REF 19.14)	https://jncc.gov.uk/our-work/offshore-mpas/	Conservation advice for Marine Protected Areas
JNCC (REF 19.15)	https://jncc.gov.uk/our-work/marine-habitat-data-product-ukseamap/	Marine Habitats Data – UKSeaMap
JNCC (REF 19.16)	https://hub.jncc.gov.uk/assets/ad834dfe-cd31-432b-ac0b-89c6b1ae03e4	Habitat suitability Model for *Sabellaria spinulosa* reefs in the UK:2020
National Biodiversity Network (NBN) (REF 19.17)	https://nbnatlas.org/	Records for benthic species and habitats
The Marine Life Information Network (MarLIN) (REF 19.18)	https://www.marlin.ac.uk/	Habitat and species sensitivity information
EMODnet (REF 19.19)	https://emodnet.ec.europa.eu/en/seabed-habitats	European Union Nature Identification System (EUNIS) broadscale seabed predictive habitat map(EUSeaMap)
Cefas (REF 19.20)	https://rconnect.cefas.co.uk/onebenthic_portal/	Marine Habitats data - Cefas OneBenthic Baseline Tool

Organisation	Data source	Data provided
Marine Aggregate Levy Sustainability Fund (REF 19.21)	https://nora.nerc.ac.uk/id/eprint/15037/1/OR10054.pdf	The Humber Regional Environmental Characterisation (REC) Study (2021)
Magic Maps (REF 19.22)	https://magic.defra.gov.uk/magicmap.aspx	An interactive mapping system developed by Department for Environment Food and Rural Affairs that holds spatially referenced data on the natural environment for England.
Inshore Fisheries and Conservation Authorities (REF 19.23)	https://association-ifca.org.uk/	Website with information about fishing and the species in the different regional IFCAs
Department for Environment Food and Rural Affairs (REF 19.24)	https://www.data.gov.uk/dataset/6efcebae-874e-4691-bf46-53057bdebda1/intertidal-substrate-foreshore-england-and-scotland	Intertidal substrate foreshore data

Survey Work

19.4.9 An intertidal survey was completed for the English Offshore Scheme at Anderby Creek between 26 October 2023 and 02 November 2023 over several tidal cycles. 10 transects were completed using a handheld Global Positioning System (GPS) device and a digital camera to capture habitat and sediment changes. 11 sediment samples were acquired from across the lower, middle and upper shore zones for particle size, heavy metals, hydrocarbons and macrofaunal analysis and to aid with ascribing background conditions and habitat mapping.

19.4.10 Marine characterisation surveys consisting of geophysical, geotechnical and environmental survey techniques were undertaken on a nominal 500 m wide corridor on the EGL 3 Project and EGL 4 Project between September 2023 and November 2024. The dates for the survey campaigns are provided in **Table 19-5.**.

Table 19-5 - Marine Characterisations Survey Campaign Dates

Survey	EGL 3	EGL 4
Anderby Creek Intertidal	26 Oct 2023 – 02 Nov 2023	26 Oct 2023 – 02 Nov 2023
Geophysical – Nearshore	21 Aug 2023 – 22 Aug 2023 (onboard SHORE Presence)	18 Sep 2023 – 29 Nov 2023
	22 Aug 2023 – 09 Sep 2023 (onboard SHORE Opportunity)	
	18 Sep 2023 – 30 Sep 2023 (onboard Deep Seapal)	
	01 Oct 2023 – 05 Oct 2023 (onboard SHORE Possibility)	
	08 Nov 2023 – 25 Jan 2024 (onboard Miranda)	
Geophysical – Offshore	14 Aug 2023 – 10 Nov 2023 (onboard Ievoli Cobalt)	03 Nov 2023 – 28 Mar 2024
Geotechnical – Nearshore	07 Jul 2024 – 15 Sep 2024 (onboard Viking Energy)	07 Jul 2024 – 03 Sep 2024 (onboard Viking Energy)
	01 Nov 2024 – 06 Nov 2024 (onboard NG Driller)	05 Nov 2024 – 06 Nov 2024 (onboard NG Driller)
Geotechnical - Offshore	15 Dec 2023 – 25 Jun 2024 (onboard Ievoli Grey)	21 Jul 2024 – 04 Sep 2024 (onboard Geo Ocean III)
Environmental – Nearshore	16 Sep 2024 – 25 Sep 2024 (onboard Viking Energy)	-16 Sep 2024 – 25 Sep 2024 (onboard Viking Energy)
	21 Sep 2024 – 08 Oct 2024 (onboard Ievoli Grey)	21 Sep 2024 – 08 Oct 2024 (onboard Ievoli Grey)
Environmental - Offshore	20 Jun 2024 – 05 Aug 2024 (onboard Ievoli Grey)	12 Jun 2024 – 20 Jul 2024 (onboard Geo Ocean IX)

19.4.11 The scope of the geophysical and geotechnical surveys is described in **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**. These surveys were used to focus the environmental survey strategy and subsequent data interpretation. The objective of the environmental survey was to:

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

19.4.12 To achieve these objectives, the surveys recorded seabed morphology and characterised habitats and macrofauna present through grab sample collection and analysis of drop-down video camera and transect data. The subtidal survey strategy was broadly split into three main categories: EBS, sandeel & herring spawning grounds and potential sand pre-sweeping locations.

19.4.13 All sampling stations were positioned based on a sampling plan agreed with Cefas, NE and JNCC. Exact positions were refined based on review of geophysical data to ensure that stations were positioned on sediment representative of the area.

19.4.14 Separate EBS were conducted for the EGL 3 Project and the EGL 4 Project. At each sampling station, drop-down video was initially acquired. Images were reviewed by an experienced marine biologist on board to confirm the presence/absence of any potentially sensitive habitats or features of conservation importance, prior to grab sampling. A 0.1 m^2 Dual van Veen grab (or 0.1 m^2 Mini-Hammon grab in the presence of hard substrate) then collected two samples for benthic invertebrate macrofauna analysis and one sample for physio-chemical analysis. The physio-chemical samples were split into three subsamples for analysis of particle size distribution (PSD), heavy and trace metal presence and hydrocarbon presence. In addition, selected locations were picked from a review of the geophysical data, for subtidal camera transects to collect information on bathymetric changes, spatial variability and seabed features.

19.4.15 It should be noted that not all sampling stations selected to target potential herring and sandeel habitat were co-located with camera transects. Where review of geophysical data identified featureless homogeneous sediment, drop down video was not used prior to grab sampling.

19.4.16 The Applicant has a portfolio of submarine cable projects to develop over the next decade. They took a strategic decision to trial eDNA sampling on one project to test the effectiveness of the method in informing the characterisation of the baseline for cable EIAs. The EGL 4 Project was selected as the trial and selected stations (equally spaced along the Project) were chosen for eDNA sampling. At these sites, the physio-chemical sample was split into four subsamples to include eDNA sediment analysis. Water samples were also collected in the water column at the same locations.

19.4.17 Sample stations and camera transects were chosen to ensure data on a diverse range of features of interest (including potential *Sabellaria spinulosa* reefs, Annex 1 reefs and herring spawning and sandeel habitat sites) was acquired.

19.4.18 **Table 19-6** summarises the number of sampling stations and camera transects acquired for the EGL 3 Project and the EGL 4 Project. **Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area** illustrates the position of sampling stations and camera transects within the draft Order Limits.

Table 19-6 - Summary Of Environmental Survey Data Collection

Survey technique	EGL 3	EGL 4
Subtidal camera transects	152	170
Grab sample stations >10 m water depth	180	133 (combined depths)
eDNA sample stations (co-located with grab samples)	-	67 (33 eDNA water and 34 eDNA sediment)
Grab sample stations <10 m water depth	20	133 (combined depths)

19.4.19 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. Details of failed sampling sites and camera transects will be outlined in the ES.

19.4.20 It should be noted that draft survey reports were being received as the preliminary environmental assessment was being drafted and not all results were available to inform this chapter. Full details will be provided in the ES including:

- EGL 3 Project macrofauna baseline;
- Consideration of the EGL 4 Project eDNA survey results;
- Details of failed sample stations and camera transects;
- Photographs of identified habitats; and,
- Site specific habitat maps for the English Offshore Scheme.

19.5 Overall Baseline

19.5.1 The following section presents the broad regional characterisation of the intertidal and subtidal benthic ecology study area. This PEIR provides an outline of the baseline of the study area, as informed by EMODnet (2023, REF 19.19) and OneBenthic Baseline Tool, the EGL 4 Project baseline as informed by the EGL 4 EBS (2025, REF 19.25) and the EGL 3 Project baseline as informed by the EGL 3 EBS (Benthic Solutions, 2025, REF 22.26). Detailed baseline descriptions, including that of the missing EGL 3 Project baseline information, and univariate and multivariate analyses will be presented in the ES. This baseline section should be read in conjunction with **Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**.

19.5.2 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 are covered in **Volume 1, Part 3, Chapter 20 - Fish and Shellfish**, whilst habitats and species landward of MHWS have been considered in **Volume 1, Part 2, Chapter 6 - Biodiversity.**

19.5.3 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 according to EUNIS for classifying benthic habitats (2019, REF 19.27) and using the new EUNIS codes established in 2019, to match the style of reporting used within the benthic survey reports.

Current Baseline

Intertidal Ecology

19.5.4 The intertidal zone is defined as the area of the shore exposed at low tide and submerged at high tide. The landfall lies at Anderby Creek where the foreshore sediments are composed of a diverse range of habitats, including sand dunes with marram grass (N1) in the supralittoral zone, coarse sediment, and a strand line of shell debris and washed-up fauna (MA521). The upper eulittoral consists of coarse sand (MA5231) with finer mobile sand patches (MA523). A tidal stream marks the transition to the lower eulittoral, which contains finer sand and occasional puddles. Sand mason (*Lanice conchilega)* habitats were observed at low tide, along with crabs, large whelks, bivalves, and polychaetes.

Subtidal Ecology

19.5.5 The definition of subtidal zone is the area where the seabed is below the reach of the lowest spring tide. This section provides a description of the subtidal habitats and subtidal macrofauna in the study area (using data from EMODNet and OneBenthic, respectively) and then individually by the EGL 3 Project and the EGL 4 Project. Any Project specific baseline information that is missing in this PEIR has been identified and will be provided in the ES

Subtidal Habitats

Study Area

19.5.6 The nearshore sections of the study area are dominated by circalittoral coarse sediment with interspersed patches of circalittoral mixed sediments and fine and muddy sand habitats. Further offshore, toward the northern region of the study area, the dominating habitat transitions to circalittoral sand with interspersed patches of circalittoral coarse sediment. All habitats present within the study area, as reported by EMODnet, are summarised in **Table 19-7** and illustrated in **Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**.

Table 19-7 - Summary of Subtidal Broad-Scale Habitats Identified within the Study Area

EUNIS Habitat Classification (2021, REF 19. 27)	
Level 2	**Level 3**
Sublittoral sediments	Circalittoral coarse sediment (MC3)
	Offshore circalittoral coarse sediment (MD3)
	Offshore circalittoral sand (MD5)
	Circalittoral mixed sediment (MC4)
	Offshore circalittoral mixed sediment (MD4)
	Circalittoral rock

19.5.7 A total of 11 EUNIS biotopes, across 10 habitat complexes, were observed across the English Offshore Scheme. The following section provides a summary of the subtidal habitat data for the English Offshore Scheme; a detailed interpretation of benthic habitats across the EGL 3 Project and EGL 4 Project will be presented in the ES.

19.5.8 The subtidal habitats within the Anderby Creek Landfall were similar between the EGL 3 Project and the EGL 4 Project. The habitats present were dominated by coarse and mixed sediment, with the presence of cobbles and boulders. The subtidal sands and gravels habitat was noted to be present for both the EGL 3 Project and the EGL 4 Project.

EGL 3

19.5.9 The subtidal benthic habitats identified along the EGL 3 Project are summarised in **Table 19-8**.

19.5.10 The nearshore section of the EGL 3 Project is dominated by circalittoral coarse sediment (MC321) with interspersed patches of circalittoral mixed sediment. From approximately KP 22 to KP 40 the sediment type transitions to predominantly circalittoral coarse sediment with moderate energy rock and patches of circalittoral rock with sublittoral very soft clay or chalk.

19.5.11 Coarse sediments continue to dominate within the EGL 3 Project until approximately KP 85 where the dominant habitat type transitions to mixed sediments. This transitions to circalittoral sand at approximately KP 97. Circalittoral sand continues to dominate until approximately KP 160 where large patches of circalittoral muddy sand occur. This mix of predominantly circalittoral sand with large, interspersed patches of circalittoral muddy sand continues for the remainder of the EGL 3 Project.

Table 19-8 - Summary of Subtidal Broad-Scale Habitats and Biotope Complexes Identified within the EGL 3 Project EUNIS Habitat Classification (2021, REF 19.27)

Level 2	Level 4	Level 5
Circalittoral rock	Faunal turf communities on Atlantic circalittoral rock (MC121)	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock (MC1216)
	Communities on Atlantic circalittoral soft rock (MC125)	Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)
Sublittoral sediments	Faunal communities in full salinity Atlantic infralittoral coarse sediment (MB323)	
	Faunal communities of Atlantic circalittoral coarse sediment (MC321)	
	Faunal communities on full salinity Atlantic infralittoral mixed sediment (MB423)	
	Faunal communities of Atlantic circalittoral mixed sediment (MC421)	
	Faunal communities of Atlantic circalittoral sand (MC521)	
	Faunal communities in Atlantic offshore circalittoral sand (MD521)	

EGL 4

19.5.12 The subtidal benthic habitats identified along the EGL 4 Project are summarised in **Table 19-9**.0

19.5.13 The nearshore shallow areas of the EGL 4 Project, from where the EGL 3 Project and EGL 4 Project split at approximately KP 25, are characterised by mixed sediment and coarse sediment which are associated with the rock outcrops and boulder field seabed features.

19.5.14 This continues until approximately KP 39, where the seabed transitions to muddy sand and sand with dispersed patches of coarse sediment and mixed sediment as the draft Order Limits run parallel to the Yorkshire and Humberside coastlines. Minor

ripples, mega ripples and sandwaves occur along this stretch of the draft Order Limits.

19.5.15 The EBS found circalittoral coarse sediment (MC32) and circalittoral mixed (MC42) within the EGL 4 Project where it crosses the Holderness Offshore MCZ. This is supported by EMODnet (2023, REF 19.19) data.

19.5.16 Further North, at approximately KP 170, the habitats are dominated by muddy sand with patches of coarse sediment and moderate rock energy, with interspersed areas of circalittoral sand and circalittoral mud. This continues for the remainder of the EGL 4 Project.

Table 19-9 - Summary of Subtidal Broad-Scale Habitats and Biotope Complexes Identified within EGL 4 Project

EUNIS Habitat Classification (2021, REF 19.27)		
Level 2	**Level 4**	**Level 5**
Circalittoral rock	Faunal turf communities on Atlantic circalittoral rock (MC121)	Bryozoan turf and erect sponges on tide-swept Atlantic circalittoral rock (MC1213)
		Flustra foliacea and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock (MC1216)
Sublittoral sediments	Atlantic circalittoral coarse sediment (MC32)	*Glycera lapidum, Thyasira spp*. and *Amythasides macroglossus* in offshore gravelly sand (MD3211)
		Mediomastus fragilis, Lumbrineris spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)
		Protodorvillea kefersteini and other polychaetes in impoverished circalittoral mixed gravelly sand (MC3213)
	Atlantic circalittoral mixed sediments (MC42)	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment
	Atlantic circalittoral sand (MC52)	*Thyasira spp.* and *Nuculoma tenuis* in Atlantic circalittoral sandy mud (MC6212)
		Amphiura filiformis and *Ennucula tenuis* in circalittoral and offshore sandy mud (MC6213)
		Echinocyamus pusillus, Ophelia borealis and *Abra prismatica* in circalittoral fine sand (MC5211)

EUNIS Habitat Classification (2021, REF 19.27)		
Level 2	**Level 4**	**Level 5**
	Atlantic offshore circalittoral mud (MD62)	*Paramphinome jeffreysii, Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud (MD6218)

Subtidal Macrofauna

Study Area

19.5.17 Using the OneBenthic baseline tool (OneBenthic Baseline Tool, 2021, REF 19.28) the characteristic macrofauna along the study area was examined. The OneBenthic database integrates benthic macrofauna and sediment particle size data from multiple sources, spanning from 1969 to the present. These data are collected from various repositories and organisations, including government bodies, industry and academia.

19.5.18 The nearshore area of the English Offshore Scheme is characterised by the presence of polychaetes, such as the catworm Nephtyidae, Spionidae, the shovelhead worm Magelonidae, the red threads worm Cirratulidae and the paddle worm Phyllodocidae and the bivalve family Tellinidae. As the English Offshore Scheme transitions further offshore, the dominant taxa include catworms, Spionidae, and shovelhead worms.

19.5.19 The richness and abundance of these clusters vary significantly, with nearshore clusters generally exhibiting higher diversity and complexity. The nearshore environment supports a wide range of species, contributing to a rich and varied benthic community. In contrast, the offshore area tends to have fewer species but higher concentrations of the dominant taxa.

19.5.20 The following section provides a summary of the macrofauna data for the English Offshore Scheme; a detailed interpretation of the macrofauna present across the EGL 3 Project and the EGL 4 Project will be presented in the ES.

EGL 3

19.5.21 A full description of the subtidal macrofauna was not available to inform the PEIR but will be provided in the ES.

EGL 4

19.5.22 6035 individuals, spread across 344 taxa, were identified along the EGL 4 Project. Polychaeta were the most common phylum, making up 37.5 % of all recorded taxa, followed by Crustacea (20.9 %) and Mollusca (15.7 %). The variation in the number of individuals was significantly positively correlated with depth and mean particle size. This highlights that sediment type, particularly gravel content, is an important determinant of community composition; mixed, coarse and rocky habitats (present at nearshore sites) demonstrated greater fauna diversity and abundance, due to the increased availability of hard substrate for epifauna to colonise. Other physiochemical parameters such as total organic carbon (TOC), total organic matter

(TOM) and heavy metal concentrations were secondary factors in the distribution of macrofaunal communities.

Designated Sites

19.5.23 There are several designated sites within the study area. Habitats Regulations Assessment (HRA) Screening and MCZ Assessment Screening have been undertaken for the English Offshore Scheme and are provided in **EGL 3 and EGL 4 Draft Habitats Regulations Assessment (HRA) (May 2025) (document referenceEGL-WSP-CONS-XX-RP-Y-001)** and **Volume 2, Part 3, Appendix 3.17.A: Marine Conservation Zone (MCZ) Assessment Screening**. Screening identified the designated sites listed within **Table 19-10** 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 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area.**

19.5.24 The English Offshore Scheme does not intersect any inshore or offshore SACs and Highly Protected Marine Areas (HPMAs) with benthic ecology features designated.

19.5.25 Four MCZs are present within the study area. The English Offshore Scheme avoids Farnes East MCZ and North East of Farnes Deep MCZ, however, the EGL 4 Project overlaps with the Holderness Offshore MCZ for approximately 8.7 km (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**). The Holderness Offshore MCZ is characterised by several broadscale habitat protected features including subtidal coarse, mixed and sand sediments, the North Sea glacial tunnel valley and the presence of ocean quahog, as presented in **Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**. The EGL 4 Project overlaps the North Sea glacial tunnel valley for approximately 3.5 km. 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.

Table 19-10 - Relevant Sites Designated for Benthic Habitats and Species within the Study Area

Site Name and Code	Distance to the draft Order Limits		Relevant Designated Features
	EGL 3 Project	EGL 4 Project	
Holderness Offshore MCZ UKMCZ0078	0.14 km	Overlaps for 8.7 km	• Subtidal coarse sediment • Subtidal mixed sediments • Subtidal sand • North Sea glacial tunnel valley • Ocean quahog (*Arctica islandica*) ***Species of Conservation Importance**

Site Name and Code	Distance to the draft Order Limits		Relevant Designated Features
	EGL 3 Project	EGL 4 Project	
North East of Farnes Deep HPMA UKEHPMA003	5.1 km	0.5 km	• The marine ecosystem of the area
North East of Farnes Deep MCZ UKMCZ0024	5.1 km	0.5 km	• Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediments • Subtidal mud • Ocean quahog (*Arctica islandica*) ***Species of Conservation Importance**
Farnes East MCZ UKMCZ0042	40.3 km	6.6km	• Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediments • Subtidal mud • Sea-Pens and burrowing megafauna communities*Species of Conservation **Importance**
Firth of Forth Banks Complex NCMPA EU555560478	50 km	1.8 km	• Quaternary of Scotland: Moraines representative of the Wee Bankie Key Geodiversity Area • Offshore subtidal sands and gravels • Shelf banks and mounds • Ocean quahog (*Arctica islandica*) *** Priority Marine Feature**

Protected Species and Priority Features within Study Area

Annex I Reefs

19.5.26 Annex I reef habitats are protected under the Conservation of Habitats And Species Regulations 2017 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) (the Habitats Regulations). The definition of an Annex I reef, based on the Interpretation Manual of European Union Habitats, is as follows:

19.5.27 '*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'*.

19.5.28 Within UK waters, three types of Annex I reef have been identified: stony, bedrock and biogenic, (Golding *et al.,* 2020, REF 19.29)

19.5.29 ‘Rocky reefs’ (stony and bedrock) are variable in structure and in the communities they support. A range of topographical reef forms meet the definition of this habitat type under the current conservation regulations. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. Rocky reefs are characterised by communities of attached algae on the shore and in the shallow subtidal, where there is sufficient light, invertebrates, and fish. In deeper water, where photosynthesis is not possible, rocky reefs are dominated by animals. The specific communities that occur vary according to the nature and topography of the substrate, light penetration, as well as exposure to waves and tides (JNCC 2022, REF 19.30).

19.5.30 Biogenic reefs are those created by animals and include reef-building worms such as the ross worm *Sabellaria spinulosa. S. spinulosa* is a small, tube-building polychaete worm found in the subtidal and lower intertidal/sublittoral fringe and is widely occurring throughout waters around the UK. In most parts of its geographical range, it does not form reefs but is solitary or found in small groups, encrusting pebbles, shell, kelp holdfasts and bedrock. When conditions are favourable, dense aggregations may be found, forming reefs up to about 60 cm high and extending over several hectares (OSPAR Commission, 2013, REF 19.31). *S. spinulosa* reefs are also listed as a habitat of principal importance in England under Section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act.

Study Area

19.5.31 The JNCC Annex I Reefs in UK waters data set (Version 8.3, 2022, REF 19.32) was used to identify Annex I reef habitat within the study area. This data is illustrated in **Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area**.

19.5.32 Within the wider study area there is only one Annex I stony reef which is closer to the EGL 4 Project than the EGL 3 Project. This occurs in the southern region of the study area and is situated 0.8 km from the EGL 4 Project, in-line with KP 142.

19.5.33 In the southern region of the study area, an Annex I stony reef overlapping the EGL 3 Project is present at KP 142 and is followed by further small, interspersed patches of Annex I stony reefs throughout the 7.5 km study area until KP 177. Further north, between KP 239 and KP 270, there is a large aggregation of Annex I stony reefs, with the closest reef 0.45 km from the EGL 3 Project and the largest reef 10 km in length.

19.5.34 Annex I *S. spinulosa* reefs are present within the southern region 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.

EGL 3

19.5.35 No Annex I Stony Reefs are present within the EGL 3 Project. Of the stony reef habitats analysed, 41 patches were classified as ‘Low Reef’ structures and 23 patches as ‘Possible Low Reef’ structures however none met the criteria required to be classed as an Annex I habitat due to the absence of key reef species.

19.5.36 A rocky reef assessment demonstrated the presence Annex I rocky reefs with low biodiversity within the EGL 3 Project; camera transects between KP 233 to KP 218 and KP 172 to KP 147 demonstrated the presence of Annex I Rocky Reef characterising species including: *Nemertesia*, hornwrack (*Flustra foliacea),* dead man's finger (*Alcyonium digitatum), Abietinella abietina*, and *Polymastia boletiformis*.

19.5.37 30 'low reef' Annex I *S. spinulosa* reefs were identified across the EGL 3 Project. Survey data was only available immediately prior to publication of PIER, thus survey information and data is still under review. Impact assessments for Annex 1 *S. spinulosa* reefs will be provided in the ES and discussed with stakeholders and Statutory Nature Conservation Bodies (SNCBs).

19.5.38 Serpulidae[1] were found to be present within the EGL 3 Project, however no vertical growth forms were observed indicating no reef structures were present.

EGL 4

19.5.39 Three patches of stony reefs across the EGL 4 Project indicated the potential presence of Annex I stony reefs. Rock outcrops and boulder fields were recorded within nearshore shallow areas of the EGL 4 Project, whilst coarse and mixed sediments were present throughout the EGL 4 Project. Camera transect data indicated cobbles and boulders were present in sufficient density with sufficient key reef species which presents characteristics of 'low' to 'medium' resemblance Annex I stony reef habitats (KPs 118, 190 and 311 - 312). A rocky reef assessment also indicated the presence of Annex I Rocky Reef with Low Biodiversity' (KP 251) within the EGL 4 Project. These Annex I habitats are presented in **Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area**.

19.5.40 Camera transect data demonstrated a limited presence of *S. spinulosa* across the EGL 4 Project. The still images predominantly showed 'Low Reef' features, with *S. spinulosa* forming an encrusting structure on stable, hard substrates and small, isolated aggregations present in muddy sand habitats interspersed with coarse sediment. Five transects were assessed for Annex I *S. spinulosa* reefs; four between KP 129 and KP 135 and one transect was assessed between KP 351 and KP 352. All instances of *S. spinulosa* were assigned 'Not a Reef' meaning an Annex I habitat is unlikely to be present across the EGL 4 Project.

19.5.41 Serpulidae were found to be present within mixed and coarse sediment habitats within the EGL 4 Project, however no vertical growth forms were observed indicating no reef structures were present.

Subtidal Sands and Gravels

19.5.42 Subtidal sands and gravels area broad habitat type listed as a Habitat of Principal Importance under Section 41 of the 2006 NERC Act.

[1] Serpulidae are a family of tube building polychaetes, commonly referred to as fanworms, and have the potential to form biogenic reefs through the construction of the hard, calcareous tubes in which they live.

Study Area

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

EGL 3

19.5.44 Various habitats linked to subtidal sands and gravels, such as circalittoral muddy sand (MC52) and circalittoral coarse sediment (MC32), were identified along the EGL 3 Project indicating the presence of subtidal sands and gravel.

EGL 4

19.5.45 Several habitats associated with subtidal sands and gravels, including circalittoral muddy sand (MC52) and circalittoral coarse sediment (MC32), were present within the EGL 4 Project indicating the presence of subtidal sands and gravels.

Seapens and Burrowing Megafauna Communities

19.5.46 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 habitats and species is based on its ecological significance and its decline, the latter associated with habitat quality rather than extent (OSPAR Commission, 2020, REF 19.33). This habitat is a designated feature of the Farnes East MCZ.

Study Area

19.5.47 The only occurrence of seapens and burrowing megafauna communities within the study area is to the east of the EGL 4 Project (between KP 336 and 361). Frequent, tiny patches of these communities run adjacent to the draft Order Limits for approximately 25 km with the closest patches situated 0.6 km from the EGL 4 Project. Seapens and burrowing megafauna communities are a protected feature of the North East of Farnes Deep MCZ and HPMA.

EGL 3

19.5.48 Camera transect data demonstrated the 'Occasional' occurrence (as defined by the SACFOR[2] scale) of burrows in mud and coarse sediment habitats along the EGL 3 Project.

[2] Super abundant, abundant, common, frequent, occasional, rare

19.5.49 Seabed video footage from six transects, between KP 290 and KP 239, revealed burrows in mud-dominated sediments. The phosphorescent seapen *Pennatula phosphorea* was recorded along 31 transects, with six showing noticeable burrows. However, the Norway lobster was not observed within these burrows. Burrows present in circalittoral coarse sediment within the EGL 3 Project were associated with squat lobsters (*Munida sp*.) which are not included in the 'Seapen and Burrowing Megafauna Communities' and were therefore not assessed.

19.5.50 The overall mean densities of the observed burrows were below the 0.2 m² threshold required to be classified as an OSPAR habitat. Therefore, there were no Seapens and Burrowing Megafauna Communities within the EGL 3 Project.

EGL 4

19.5.51 Camera transect data demonstrated the ‘Common’ and ‘Frequent’ (SACFOR scale) occurrence of large burrows in mud and sandy mud habitats along the EGL 4 Project. However, a burrows assessment concluded there was no strong justification to assign this OSPAR habitat due to a lack of burrowing megafauna, including the Norway lobster.

Ocean quahog

19.5.52 The ocean quahog is a marine bivalve that occurs in sandy and muddy sediments from the low intertidal zone to 400 m water depths within the Irish Sea and North Sea. The ocean quahog is one of the longest lived and slowest growing marine bivalves; the growth rate of quahog is rapid in juveniles but very slow and indeterminate in adults. Individual growth rates are highly variable between different regions in the North Atlantic, within sites, between seasons and daily, depending on temperature, salinity, hydrography and food supply. They are the longest-unitary species with the oldest recorded specimen found being 507 years old (Tyler-Walters H & Sabatini M., 2017, REF 19.34). Ocean quahog are thought to have a high sensitivity to physical loss of habitat and are a protected feature of the Holderness Offshore MCZ, Farnes East MCZ and North East of Farnes Deep MCZ and HPMA. It is also included in the OSPAR list of threatened and/or declining species (OSPAR, 2008, REF 19.35), with seabed disturbance from anthropogenic activities being a main threat to this species (OSPAR Commission, 2009, REF 19.36).

Study Area

19.5.53 Ocean quahog are present at several points within the study area; most notably within the Holderness Offshore MCZ, Farnes East MCZ and North East of Farnes Deep MCZ and HPMA. **Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area** shows the known distribution of ocean quahog within the study area.

EGL 3

19.5.54 EMODnet (2023, REF 19.19) demonstrated the presence of ocean quahog at the northernmost section of the EGL 3 Project, at the boarder between English and Scottish waters. However, ground truthing from the EGL 3 EBS (Benthic Solutions, 2025, REF 19.26) concluded ocean quahog is not present within the EGL 3 Project; no camera transects across the EGL 3 Project identified the presence of ocean quahog (including those near the Holderness Offshore MCZ, which ocean quahog is a protected feature for), and no individuals were present within macrofauna grab samples.

EGL 4

19.5.55 Four camera transects demonstrated an 'Occasional' (as defined by the SACFOR scale) presence of ocean quahog in mud and sand habitats between KP 142 to KP 395 within the EGL 4 Project, outside any of the designated sites.

Marine Invasive Non-Native Species (MINNS)

Study Area

19.5.56 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' (Tillin and Watson, 2023 REF 19.37).

19.5.57 *Goniada gracilis*, an invasive non-native polychaete, and *Mya arenaria*, an invasive non-native bivalve, are known to be present within North East of Farnes Deep MCZ (*Hawes et al.,* 2020, REF 19.38).

EGL 3

19.5.58 Underwater video data demonstrated the presence of the American slipper limpet at 12 stations within the EGL 3 Project. No other MINNS were recorded.

EGL 4

19.5.59 Two MINNS were identified within the EGL 4 Project: the American slipper limpet and the polychaeta *G. gracilis.*

Future Baseline

19.5.60 This section will set out how the current baseline is predicted to change in the absence of the English Offshore Scheme by the time the English Offshore Scheme is in operation.

19.5.61 The existing baseline conditions for intertidal and subtidal benthic ecology within the study area are relatively stable. The existing habitats within the English Offshore Scheme are dominated by sand, with mixed and coarse sediment habitats interspersed throughout the route. The existing macrofauna is dominated by polychaetes, with the occasional presence of *S. spinulosa* and ocean quahog. It is important to note that, while stable, the existing baseline conditions for intertidal and subtidal benthic ecology is fluid and 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.

19.5.62 Currently, *S. spinulosa* occurs throughout the English Offshore Scheme in small patches and is not present in big enough aggregations to form Annex I *S. spinulosa* reefs. Due to the dynamic nature in which *S. spinulosa* grows, it cannot be correctly predicted if these small patches would remain static or grow to form Annex I *S. spinulosa* reefs without installation of the English Offshore Scheme.

19.5.63 Rising sea temperatures, as a result of anthropogenic climate change, can cause northerly migration of benthic species. At a large scale, this can change the biodiversity within a given area, consequently changing habitat composition. This was supported by the findings of Hiddink *et al.,* (2014, REF 19.39) who evaluated changes in the distribution of 65 common benthic invertebrate species between 1986 and 2000. These species demonstrated a north-westerly 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 without installation of the English Offshore Scheme.

19.6 Environmental Measures

19.6.1 As set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, the environmental measures are characterised as design measures or control and management measures. A range of environmental measures would be implemented as part of the English Offshore Scheme and will be secured in the DCO as relevant. **Table 19-11** outlines how these design and control measures will influence the intertidal and subtidal benthic ecology assessment. Compliance with these measures will be secured by way of a condition through dML / via DCO submission.

19.6.2 Several management plans will be provided as Outline Management Plans with the DCO application to support the dMLs. These will include an Outline CEMP and an Outline Marine Pollution Contingency Plan. These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme. Final management plans will be submitted in accordance with the dMLs to discharge the licence conditions. An Outline CEMP can be found in **Volume 2, Part 1, Appendix 1.5.C: Outline Construction Environmental Management Plan**. In addition, design measures identified through the EIA process have been applied to avoid or reduce potential significant effects. Design measures included that are relevant to Intertidal and Subtidal Benthic Ecology receptors are included in **Table 19-11** below and are also included in **Volume 2, Part 1, Appendix 1.5.A: Outline Register of Design Measures**.

Table 19-11 - Summary of Environmental Measures

Receptor	Potential changes and effects	Embedded measures
Intertidal habitats and species	Temporary habitat loss/seabed disturbance	Intertidal zone would be crossed by horizontal directional drill to avoid disturbance to surface sediments and habitats.
Subtidal habitats and species	Temporary habitat loss/seabed disturbance	The intention is to bury the cables in the seabed, except in areas where trenching is not possible e.g. where ground conditions do not allow burial or at infrastructure crossings.
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.
Subtidal habitats and species	Permanent habitat loss due to the deposit of external cable protection	Cable protection 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 depth of lowering is not achieved and at infrastructure crossings.
Subtidal habitats and species	Permanent habitat loss due to the deposit of external cable protection	Where possible, 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 and material as the receiving environment should be used as an alternative to the current normal approach of using terrestrially sourced granite).
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, would be from a suitable source or cleaned to ensure no MINNS can be introduced.
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. Specific avoidance measures would include: • the use of biodegradable drilling fluids (pose little or no risk (PLONOR) substances) where practicable, • drilling fluids would be tested for contamination to determine possible reuse or disposal; and • if disposal is required drilling fluids would be transported by a licensed courier to a licensed waste disposal site.

Receptor	Potential changes and effects	Embedded measures
		Chemicals would be chosen from the list of chemicals approved under the Offshore Chemical Notification Scheme (REF 19.40). https://www.cefas.co.uk/data-and-publications/ocns/ and a chemical risk assessment will be provided as part of the Outline CEMP.
Subtidal species (including ocean quahog)	Electromagnetic changes	High-Voltage Direct Current (HVDC) poles would be bundled to minimise the effects of electromagnetic fields (EMFs) for electrosensitive receptors.

19.7 Scope of the Assessment

Spatial Scope and Study Area

19.7.1 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 study area for intertidal and subtidal benthic ecology described in **Section 19.5.**

Temporal Scope

19.7.2 The temporal scope of the assessment of intertidal and subtidal benthic ecology is consistent with the period over which the English Offshore Scheme would be carried out. It assumes construction of the English Offshore Scheme would commence at the earliest 2028 and cover a period of 6 years of total construction time. Operation would commence in 2033 with periodical maintenance required during the operational phase of the English Offshore Scheme. It is assumed that maintenance and repair activities could take place at any time during the life span of the English Offshore Scheme.

19.7.3 The English Offshore Scheme is expected to have a life span of more than 40 years. If decommissioning requires cessation of operation and removal of infrastructure at this point in time, then activities and effects associated with the decommissioning phase are expected to be of a similar level to those during the construction phase works, albeit with a lesser duration of two years. 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 project has concluded that impacts from decommissioning would be no greater than those during the construction phase. Furthermore, should decommissioning take place, it is expected that an assessment in accordance with the legislation and guidance at the time of decommissioning would be undertaken.

Identification of Receptors

19.7.4 **Table 19-12** 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 be present within the draft Order Limits following the EGL 3 Project and the EGL 4 Project marine characterisation surveys. Receptors that have been scoped out of the assessment are identified in **Table 19-14.**

19.7.5 The Scoping Report identified a potential receptor as 'broadscale subtidal habitats'. Following the marine characterisation surveys, greater clarity has now been provided, and **Table 19-12** includes specific 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 19-12 - Intertidal and Subtidal Benthic Ecology Receptors Subject to potential Effects

Receptor	Reason for consideration
National sites designated with benthic features including the Holderness MCZ, Farnes East MCZ, North East of Farnes Deep HPMA and North East of Farnes Deep MCZ	These sites are considered relevant by the MCZ Assessment Screening (**Volume 2, Part 3, Appendix 3.17.A: Marine Conservation Zone (MCZ) Assessment Screening)**
Intertidal habitats	Whilst the majority of direct impacts would be avoided as a trenchless technique would be used at the Anderby Creek Landfall, intertidal habitats would be impacted if there is a drilling fluid breakout.
Subtidal broadscale habitats	The draft Order Limits and wider study area contains commonly occurring infralittoral and circalittoral habitats that are widely distributed within the North Sea region. The construction, operation 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 HDVC 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.

Receptor	Reason for consideration
Subtidal Annex 1 stony reefs and Annex I rocky reefs	The study area contains Annex I habitats. Annex I reef habitats are protected under the Habitats Regulations. The construction, operation 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 1 habitats are highly sensitive to the listed impacts.
Annex I *Sabellaria spinuolsa* reefs	Annex I *S. spinulosa* reefs are protected under the Habitats Regulations and the 2006 NERC Act. Whilst not present in the EGL 4 Project, they are present in the EGL 3 Project and are known to be present within the study area. Increased suspended sediment could cause smothering of these habitats and mobilise contaminants within the marine environment, interfering with natural biological processes of *S. spinulosa.*
Annex I *Modiolus modiolus* and *Mytils edulis* beds	Mussel beds are protected under the definition of Annex I reef under the Habitats Regulations and under the 2006 NERC Act. Activities during construction and decommissioning could cause increased levels of suspended sediments and subsequent deposition. *M. modiolus* are unable to actively emerge if buried, with instances of smothering lasting longer than eight days causing mortality. *M. edulis* are more resistant to smothering and can move within deposited sediment. However, mortality may still occur depending on the duration of smothering.
Sea-pen and burrowing megafauna communities	Feature of conservation importance and a protected feature of Farnes East MCZ.
Subtidal species	Subtidal benthic species live within and on the sediment of marine habitats and are subject to disturbance during marine cable construction, operation and decommissioning.
Ocean quahog (*Arctica 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, Farnes East MCZ and North East of Farnes Deep MCZ and HPMA. It is also included in the OSPAR list of threatened and/or declining species (OSPAR, 2008, REF 19.35), with seabed disturbance from anthropogenic activities being a main threat to this species (OSPAR Commission, 2009, REF 19.36).

Potential Effects Considered within this Assessment

19.7.6 The effects on intertidal and subtidal ecology receptors which have the potential to be significant and have been taken forward for detailed assessment are summarised in **Table 19-13**.

Table 19-13 - 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 stony reefs and Annex I rocky reefs • National sites designated with benthic features including the Holderness Offshore MCZ, Farnes East MCZ, North East of Farnes Deep HPMA and MCZ • Ocean quahog • Annex I *Sabellaria spinulosa* reefs (assessment to be provided in the ES)	**Temporary habitat loss/seabed disturbance** from boulder clearance and pre-sweeping of sandwaves
• Subtidal broadscale habitats and species • Subtidal sands and gravels • Subtidal Annex I stony reefs and Annex I rocky reefs • National sites designated with benthic features including the Holderness Offshore MCZ, Farnes East MCZ, North East of Farnes Deep HPMA and MCZ • Ocean quahog • Annex I *Sabellaria spinulosa* reefs (assessment to be provided in the ES)	**Permanent habitat loss** from external cable protection
• Intertidal habitats • Subtidal broadscale habitats and subtidal species • Subtidal sands and gravels • Subtidal Annex I stony reefs and Annex I rocky reefs • National sites designated with benthic features including the Holderness Offshore MCZ, Farnes	**Temporary increase and deposition of suspended sediments**

Receptor	Likely significant effects
East MCZ, North East of Farnes Deep HPMA and North East of Farnes Deep MCZ • Ocean quahog • *Annex I Sabellaria spinulosa reefs* (assessment to be provided in the ES)	
• Subtidal species (including ocean quahog)	**Underwater noise changes** from project vessels and equipment
• Subtidal broadscale habitats • Subtidal sands and gravels • Subtidal Annex I stony reefs and Annex I rocky reefs • Ocean quahog • Subtidal Annex I *Sabellaria spinulosa* reefs (assessment to be provided in the ES)	**Introduction of marine invasive non-native species** from project vessels and equipment and external cable protection
• Subtidal species (including ocean quahog)	**Electromagnetic changes and barrier to species movement** from the presence of marine cables
• Subtidal species (including ocean quahog)	**Temperature increases** from the presence of marine cables

19.7.7 The receptors/effects detailed in **Table 19-14** have been scoped out from being subject to further assessment because the potential effects are not considered likely to be significant.

Table 19-14 - Summary of Effects Scoped Out of the Intertidal and Subtidal Benthic Ecology Assessment

Receptors/potential effects	Justification
Intertidal and subtidal habitats and species **Accidental spills *(Hydrocarbon & PAH contamination*) due to presence of project vessels and equipment**	Project vessels and contractors would comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 which relate to pollution from oil from equipment, fuel tanks etc 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 would be sufficient to minimise the risk to the environment.
Temporary increase and deposition of suspended sediments from pre-sweeping to subtidal habitats during operation	Generally during operation, 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

Receptors/potential effects	Justification
	damage). Pre-sweeping would not be required during a cable repair for third-party damage or from sediment mobility as the cable would already be exposed on the seabed. Therefore, the only scenario pre-sweeping might be required is where the cable has been damaged during construction and develops a fault in an area where pre-sweeping was used during construction. In this scenario the significance of the effect will be of lower magnitude than during construction and has therefore been scoped out of the assessment. The Planning Inspectorate agrees that where a cable is likely to require repair, pre-sweeping is unlikely to be necessary and where a scenario could arise where pre-sweeping is necessary, this is unlikely to result in significant effects due to the limited spatial extent of the works.
Annex I *Modiolus modiolus* and *Mytils edulis* beds	These species are not present within the study area of English Offshore Scheme and therefore these Annex I beds are not present.
Seapens and Burrowing Megafauna Communities	Burrow assessments conducted during the EBS concluded there was no strong justification to assign this OSPAR habitat to the burrow present within English Offshore Scheme. This was due to a lack of burrowing megafauna, including the Norway lobster, along the EGL 4 Project and the overall mean densities of the burrows observed along the EGL 3 Project were below the 0.2 m^2 threshold required to be classified as an OSPAR habitat.

19.8 Key Parameters for Assessment

Realistic Worst-Case Design Scenario

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

19.8.2 In relation to intertidal and subtidal benthic ecology **Table 19-15** and **Table 19-16** summarises the assumptions made regarding the EGL 3 Project and the EGL 4 Project design parameters in order to ensure a realistic worst-case assessment has been undertaken.

Table 19-15 - Summary of Parameters and Worst-Case Scenarios for the EGL 3 Project

Impact Pathway	Construction	Operation	Decommissioning	Most sensitive location or scenario
Temporary habitat loss/ seabed disturbance	13.02 km^2	To be confirmed	Similar footprint as is disturbed during construction and operation combined.	Within Annex I reef habitat
Permanent habitat loss	0.915 km^2	To be confirmed	No new deposits but assumes cable protection remains in place.	Within Annex I reef habitat
Temporary increase and deposition of suspended sediments in the offshore subtidal	**Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes** concluded that the majority of suspended sediment will settle within 700 m of the cable trench during trenching and very fine sands (<63 µm) may travel as far as 17.5 km dependant on the peak flow speed. However, sediment deposition beyond 700 m will be <2 mm. Material discharged from the trailing suction hopper dredger will settle within 3.15 km of the disposal location.			Holderness Offshore MCZ Burrowing macrofauna can remain buried within the sediment for a few days. If sequential construction occurs, suspended sediment and smothering could occur for longer periods, causing species mortality
Temporary increase and deposition of suspended sediments in the nearshore subtidal				HDD break out occurs and drilling continues with full bentonite loss.

Table 19-16 - Summary of Parameters and Worst-Case Scenarios for the EGL4 Project

Impact Pathway	Construction	Operation	Decommissioning	Most sensitive location or situation
Temporary habitat loss/ seabed disturbance	12.64 km^2 [0.26 km^2 within the Holderness Offshore MCZ]	To be confirmed	Similar footprint as is disturbed during construction and operation combined.	Holderness Offshore MCZ
Permanent habitat loss	1.135 km^2 [estimated 0.068 km^2 within the Holderness Offshore MCZ]	To be confirmed	No new deposits but assumes cable protection remains in place.	Holderness Offshore MCZ
Temporary increase and deposition of suspended sediments in the offshore subtidal	**Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes** concluded that the majority of suspended sediment will settle within 700 m of the cable trench during trenching and very fine sands (<63 µm) may travel as far as 17.5 km dependant on the peak flow speed. However, sediment deposition beyond 700 m will be <2 mm. Material discharged from the trailing suction hopper dredger will settle within 3.15 km of the disposal location.			Holderness Offshore MCZ
Temporary increase and deposition of suspended sediments in the nearshore subtidal	N/A			HDD break out occurs and drilling continues with full bentonite loss.

Consideration of Construction Scenarios

19.8.3 As detailed in **Volume 1, Part 1, Chapter 4: Description of the Projects**, the timing of construction activities set out within this PEIR is indicative. To allow for any unexpected circumstances and a realistic worst-case assessment, the impact assessment for the English Offshore Scheme considers the following construction scenarios to ensure the worst-case scenario for intertidal and subtidal benthic ecology can be identified and assessed as this will depend on the impact pathway. Each scenario's worst-case effects were combined and considering in coming to the conclusions discussed in the preliminary assessment. The effects in reality should be significantly less than the worst-case examples:

- The EGL 3 Project and the EGL 4 Project are constructed sequentially and construction activities do not overlap temporally or spatially. This is equivalent to the 6-year period, mentioned in **Section 19.7**, over which intertidal and subtidal benthic ecology receptors would be subject to effects.

- The EGL 3 Project and the EGL 4 Project are constructed simultaneously, whereby sediment plumes would overlap temporally and spatially.

19.9 Assessment Methodology

Overview

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

19.9.2 The criteria for characterising the value and sensitivity and magnitude for intertidal and subtidal benthic ecology are outlined in **Table 19-17** and **Table 19-18**, respectively.

19.9.3 The assessment of sensitivity will be made with consideration of the vulnerability of the receptor to an impact and its ability to recover and adapt. Vulnerability can differ between different groups and species of benthic invertebrates and will also vary depending on the impact pathway. For example, sessile species are more sensitive to smothering than mobile species. Reference has been made to the MarESA published by MarLIN and the advice on operations from NE designated sites to aid in the categorisation of sensitivity.

19.9.4 Note that this classification has been amended since the scoping consultation. On reflection all protected habitats and species within an internationally or nationally designated site are likely to be considered as high value. This also extends to protected species and habitats outside of the boundary of a designated site.

19.9.5 Ocean quahog are a Species Feature of Conservation Interest (FOCI) and is listed on the OSPAR Threatened and/or Declining Species list. Therefore, it is highly sensitive to the effects of construction, operation and decommissioning and of marine cables.

19.9.6 A species may be of international importance (e.g., a designated feature of an MCZ) and initially categorised as 'highly' sensitive according to **Table 19-10**. However, if baseline studies and species characteristics show that the species is only rarely or occasionally present in the draft Order Limits, or if it is not sensitive to the impact pathway, professional judgment may justify lowering its sensitivity category. Where such assessments have been made, justification has been provided.

19.9.7 Where a species or habitat is a designated feature of a MCZ these features will also be assessed in the MCZ Assessment processes. Screening has been provided with this preliminary environmental assessment as **Volume 2, Part 3, Appendix 3.17.A: Marine Conservation Zone (MCZ) Assessment Screening.** Where it cannot be ruled out that conservation objectives of the site would not be hindered the impacts on the relevant MCZ are consider in **Volume 2, Part 3, Appendix 3.17.B: Marine Conservation Zone (MCZ) Stage 1 Assessment**.

19.9.8 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 is important. Factors such as seasonality of presence or whether specific areas are required for a certain life stage which the species may be unwilling or unable to move away from are considered.

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

19.9.10 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. This is described further in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology,** and is replicated for ease in **Table 19-19.**

Table 19-17 - Criteria for Characterising the Sensitivity of Receptors

Sensitivity	Description of criteria
High	Value: The receptor is a designated feature of a protected site or is considered a protected feature outside of a site. Sensitivity: Equivalent to MarLIN MarESA sensitivity category High. Receptor has low tolerance to change i.e., recovery will take longer than 10 years following the cessation of activity or will not occur.
Medium	Value: The receptor is valued or is considered rare or unique but not protected. Sensitivity: Equivalent to MarLIN MarESA sensitivity category Medium. Receptor has intermediate tolerance to change i.e., recovery to pre-impact conditions is possible between 5 and 10 years.
Low	Value: Common and widespread habitats/species of no specific conservation value. Sensitivity: Equivalent to MarLIN MarESA sensitivity category Low. Receptor has high tolerance to change with recovery to pre-impact conditions between 1 and 5 years.
Negligible	Value: Low importance and rarity, local scale. Artificial, highly modified, and/or degraded benthic habitats/species of low/no conservation interest. Sensitivity: Equivalent to MarLIN MarESA sensitivity category Not Sensitive. The receptor has some tolerance 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 19-18 - Criteria for Characterising the Magnitude of an Impact

Magnitude	Description of criteria
High	Impacts are of medium-term (7-15 years) through to long-term/permanent duration and/or on a regional or population/habitat level or major alteration to key elements/features of the baseline condition such that post-impact baseline character will be fundamentally changed. Natural recruitment will not return the population/habitat to the baseline condition.
Medium	Impacts are of medium term (7-15 years) duration and/or on a local level (wider than project footprint) or alter an element of the baseline conditions such as that post-impact the damage to the baseline is above that experienced under natural conditions but with no permanent effect on integrity.
Low	Impacts are temporary (<1 year) or short term (1-7 years) in duration, site specific and/or a minor shift away from the baseline condition such as that experienced under natural conditions. Impacts limited to within the project footprint. Negligible contribution to cumulative effects.
Negligible	Very little or no detectable change from baseline conditions. Disturbance is within the range of natural variability. Impacts predicted to be brief (one to two days) or for a short period (up to 3 months). No contribution to cumulative effects.

Table 19-19 - Significance Matrix

		Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Negative magnitude	**High**	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible
Beneficial magnitude	**Negligible**	Minor	Minor	Negligible	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Medium	Major	Moderate	Minor	Negligible
	High	Major	Major	Moderate	Minor

19.10 Preliminary Assessment of Cumulative Effects

19.10.1 At the current stage of the EGL 3 Project and EGL 4 Project (PEIR stage), design information for the Projects is insufficient to allow for a robust cumulative assessment to be undertaken. Furthermore, given the current position in relation to baseline data collection, with much of the onshore environmental surveys still to be undertaken during 2025, the baseline identified at this PEIR stage cannot be taken as a complete picture of the potential presence and significance of sensitive receptors. Therefore, a cumulative assessment has not been undertaken at this stage; however, **Volume 1, Part 4, Chapter 28 Cumulative Effects**, presents the long and short lists of 'other developments' which will be considered at the ES stage, and the methodology which allowed for the identification of these other developments, to allow consultation bodies to form a view and provide comment on the other developments included. The long list will be reviewed and if necessary, updated, in the lead up to the ES, as the EGL 3 Project and EGL 4 Project design further evolves and in response to any comments raised at statutory consultation.

19.11 Preliminary Assessment of Intertidal and Subtidal Benthic Ecology Receptors

Preliminary Assessment of Temporary Habitat Loss and Seabed Disturbance – All Phases

19.11.1 Two of the pressures established by the Marine Pressures-Activities Database v1.5 (JNCC, 2022, REF 19.41) have been considered under this overarching category, namely: 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.

19.11.2 Aspects of the English Offshore Scheme that physically disturb the seabed e.g., seabed preparation (including unexploded ordnance (UXO) identification and pre-sweeping of sandwaves), cable burial, cable repair, and eventual cable removal, have the potential to disturb subtidal habitats and species and cause temporary habitat loss. Typically, the extent of this disturbance will be a maximum of 30 m wide along the entire English Offshore Scheme; although noting 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 or UXO identification. The worst-case installation footprint for temporary habitat loss is presented in **Section 19.8.1** and summarised in **Table 19-20.**

Table 19-20 - Summary of Footprint for Temporary Habitat Loss

Phase	Construction *	Operation	Decommissioning
EGL 3 Project	13.02 km^2	To be confirmed	Would be the same as the construction plus operation footprint
EGL 4 Project	12.64 km^2	To be confirmed	

Phase	Construction *	Operation	Decommissioning

* Equivalent to the footprint from the seabed clearance activity (pre-lay grapnel run (PLGR)), plus trial trenching and HDD exit pits. All other activities are assumed to be within these initial footprints.

19.11.3 Most activities that 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 damage to sediment habitats but does not directly remove habitats. However, a change in the habitat, even temporarily, could lead to an impact on species biodiversity and abundance within the area.

19.11.4 Sensitivity to the impact of seabed disturbance and temporary habitat loss varies between habitats and species, depending upon 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. The same is true for sessile species such as barnacles.

19.11.5 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor values/sensitivities and the magnitude of the impact. A summary of the preliminary assessment conclusions is provided in **Table 19-21** for ease of reference. Where receptors share a common sensitivity/value, magnitude and significant of effect they have been grouped together.

Table 19-21 - Summary of Preliminary Assessment Conclusions for Temporary Habitat Loss and Seabed Disturbance

Receptor	Receptor Sensitivity/Value	Magnitude	Significance of effect
Atlantic circalittoral rock Atlantic circalittoral mixed sediment Faunal communities on full salinity Atlantic infralittoral mixed sediment Atlantic offshore circalittoral mud Faunal communities of Atlantic circalittoral	Medium	Low	Minor
Atlantic circalittoral soft rock	High	Low	**Moderate**

Receptor	Receptor Sensitivity/Value	Magnitude	Significance of effect
Atlantic circalittoral coarse sediment Faunal communities in full salinity Atlantic infralittoral coarse sediment Atlantic circalittoral sand Faunal communities in Atlantic offshore circalittoral sand	Low	Negligible	Negligible
Subtidal sands and gravels Annex I Stony and Rocky Reefs	Low	Low	Minor
Holderness Offshore MCZ	Medium	Negligible	Minor
Ocean quahog	High	Negligible	Minor

Subtidal Broadscale Habitats and Species

19.11.6 There are 10 broadscale habitat complexes within the English Offshore Scheme including: Atlantic circalittoral rock (MC12), communities on Atlantic circalittoral soft rock (MC125), faunal communities in full salinity Atlantic infralittoral coarse sediment (MB323), Atlantic circalittoral coarse sediment (MC32), faunal communities on full salinity Atlantic infralittoral mixed sediment (MB423), Atlantic circalittoral mixed sediment (MC42), Atlantic circalittoral sand (MC52), faunal communities in Atlantic offshore circalittoral sand (MD521), faunal communities of Atlantic circalittoral mud (MC621) and Atlantic offshore circalittoral mud (MD62).

19.11.7 **Atlantic circalittoral rock** found within the English Offshore Scheme consists of two Level 5 biotopes; 'bryozoan turf and erect sponges on tide-swept Atlantic circalittoral rock' (MC1213), found only along the EGL 4 Project and present at 34 sampling stations interspersed between KP 7 and KP 390 and '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock' (MC1216), present at 10 sampling stations across the English Offshore Scheme . Due to the increased presence of MC1213 compared to MC1216 and its' greater sensitivity to seabed disturbance, a precautionary approach has been taken in this assessment and the sensitivity of Atlantic circalittoral rock to temporary habitat loss and seabed disturbance has been based on the habitat sensitivity of MC1213.

19.11.8 MC1213 is an Annex I habitat, a habitat of conservation interest and habitat of importance. This habitat demonstrates negligible sensitivity to seabed penetration due to the occurrence of rock but does demonstrate a medium sensitivity to seabed abrasion due to associated high levels of species mortality of sessile organisms (Readman, Lloyd and Watson, 2023, REF 19.42). Therefore, as a precautionary approach, a **sensitivity** value of **medium** will be used in this assessment.

19.11.9 Atlantic circalittoral rock habitats host a highly diverse stable community of sessile benthic macrofauna that live on pebbles, rocks, cobbles and boulders and are unable to relocate to avoid the effects of construction, operation and decommissioning. Consequently, species present in these habitats and within the draft Order Limits, such as the wrinkled barnacle (*Balanus crenatus)*, could be at risk of crushing or substrate detachment during ploughing activities. All instances of Atlantic circalittoral

rock within the English Offshore Scheme are present in small, isolated patches, thus any temporary habitat loss as a result of seabed disturbance will be isolated and will not affect the wider distribution of these habitats within the North Sea. Additionally, boulder clearance through ploughing has a narrow footprint of 20 m at each clearance site and, where possible, smaller rocks and boulders will be relocated using grabs, reducing the risk of injury to epifauna. Thus, the **magnitude** of this effect on Atlantic circalittoral rock is **low**.

19.11.10 The overall significance of the effect of temporary habitat loss and seabed disturbance to Atlantic circalittoral rock habitats is **Minor** and **Not Significant**.

19.11.11 **Atlantic circalittoral soft rock** found within the English Offshore Scheme consists of the Level 5 biotope 'piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251), found only along the EGL 3 Project and present at five sampling stations interspersed between KP 25 and KP 40.

19.11.12 MC1251 is an Annex I habitat, a habitat of conservation interest, habitat of principle importance and a UKBAP habitat. This habitat demonstrates **high sensitivity** to seabed penetration and **medium sensitivity** to seabed abrasion. Seabed penetration and abrasion can damage dense algal mats and remove sparse fauna within the biotope, resulting in the loss of piddocks and damage to the habitat (Tillin and Hill, 2016, REF 19.43).

19.11.13 Piddocks (*Pholas dactylus)* are an infaunal species, protected from surface abrasion when residing in their burrows. However, abrasion can cause damage to individuals protruding from the seabed surface. Additionally, sub-surface penetration has the potential to remove the chalk and clay substrate within this habitat, from which it cannot easily recover. Piddock individuals present within damaged burrows, or those that are removed from the substratum, are unable to rebury and will be predated by fish and other mobile species; Micu (2007, REF 19.44) observed that the round goby *Neogobius melanostomus* removed clay from damaged piddock burrows to aid feeding.

19.11.14 All instances of Atlantic circalittoral soft rock within the English Offshore Scheme are present in small, isolated patches, thus any temporary habitat loss as a result of seabed disturbance will be isolated and will not affect the wider distribution of these habitats within the North Sea. Thus, the **magnitude** of this effect on Atlantic circalittoral rock is **low**.

19.11.15 The overall significance of the effect of temporary habitat loss and seabed disturbance to Atlantic circalittoral soft rock habitat is **Moderate** and **Significant**. The benthic survey data was received immediately prior to the publication of PEIR, thus survey information and data is still under review. Further assessment will be undertaken for the ES to determine if an over precautionary approach has been taken in this preliminary assessment and will consider whether environmental measures to mitigate a significant adverse impact are required. These may include micro routeing around areas of MC1251 within the draft Order Limits.

19.11.16 **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., Atlantic circalittoral sand is present between KP 67 – KP 170 within the EGL 4 Project). These two habitats consist of a range of Level 5 biotopes, with most classified as habitats of principle importance and habitats of conservation interest, and one also classed as a United Kingdom Biodiversity Action Plan (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. 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 (MarLin, 2021 REF 19.11). 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 decommissioning, or recovery from any change would occur within less than six months. Additionally, despite their conservation status, 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.** The significance of this effect to Atlantic circalittoral coarse sediment and Atlantic circalittoral sand is **Negligible** and **Not Significant.**

19.11.17 **Atlantic circalittoral mixed sediment** is present between KP 29 - KP 39, and in small, interspersed patches between KP 10 – KP 22 and KP 294 – KP 300 within the EGL 4 Project. **Mixed sediment habitats** are present in small patches rarely occurring (SACFOR scale) along the EGL 3 Project, with the longest stretch of circalittoral mixed sediment present between KP 86 and KP 96. The characterising species of this habitat are 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 entanglement as a result of abrasion. Thus, the **sensitivity** of Atlantic circalittoral mixed sediment to abrasion and penetration has been assessed as **medium**.

19.11.18 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 is present for an approximate total distance of 17 km throughout the English Offshore Scheme and, therefore, any seabed disturbance that occurs through this habitat is confined to a small area. The **magnitude** of this effect to mixed sediment habitats is **low**. Therefore, using the sensitivity and the magnitude the significance of the effect on mixed sediment habitats has been assessed as **Minor** and **Not Significant**.

19.11.19 **Atlantic circalittoral mud** was the dominating habitat between KP 230 and KP 295 within the EGL 3 Project. **Atlantic offshore circalittoral mud** was the dominating habitat between KP 122 and KP 135 within the EGL 4 Project, and occurred in small, infrequent patches for the remainder of the northern section of the EGL 4 Project. The Atlantic offshore circalittoral mud habitat consisted of the Level 5 biotope '*Paramphinome jeffreysii, Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud' (MD6218), a habitat of principle importance and habitat of conservation interest. This biotope has been used to inform the assessment for the effect of temporary habitat loss and seabed disturbance on mud habitats within the English Offshore Scheme.

19.11.20 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 construction, operation and decommissioning of marine cables.

19.11.21 The brittlestar *Amphiura filiformis* extend their arms into the water column for feeding. Bergman & Hup (1992, REF 19.45) demonstrated 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 present within 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. Other organisms present within mud habitats of the English Offshore Scheme that have demonstrated vulnerability to seabed disturbance and temporary habitat loss include the polychaeta *Heteromastus filiformis. H. filiformis* has limited mobility and occupies the top 15 cm of muddy sand habitats (De-Bastos, 2016, REF 19.46).

19.11.22 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.**

19.11.23 Despite its conservation status, mud 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. Additionally, mud habitats were only found at 10 sampling stations 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 and infrequent within the English Offshore Scheme. Therefore, the **magnitude** of this effect to mud habitats has been assessed as **low.** The significance of the effect on mud habitats has been assessed as **Minor** and **Not Significant.**

Subtidal Sands and Gravels

19.11.24 Subtidal sands and gravels, which are commonly found in the North Sea and present within the English Offshore Scheme, are highly mobile (Irving, 2009, REF 19.58). For example, the subtidal sands and gravels habitats present within the nearshore sections off the EGL 4 Project 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 decommissioning. Thus, subtidal sands and gravels habitats have a **low sensitivity** to seabed disturbance. Due to their dynamic nature, it would be expected that these habitats would return to baseline conditions within <12 months of abrasion and penetration (RPS, 2019, REF 19.47). 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.** The significance of the effect on subtidal sands and gravels has been assessed as **Minor** and **Not Significant.**

Annex I Stony and Rocky Reefs

19.11.25 Camera transect data indicated the presence of Annex I stony reefs and Annex I rocky reefs with low biodiversity within the English Offshore Scheme. All of these Annex I reefs occur in areas of sand and coarse sediment habitats (**Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area**), where they will be exposed to natural physical disturbance from high tidal energy, similar to that produced by abrasion and penetration of the seabed.

19.11.26 Annex I reefs are associated with sessile assemblages that are unable to relocate to avoid the effects of construction, operation 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 and rocky reefs 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 (Budd, 2008, REF 19.48). The Annex I stony reefs identified within the English Offshore Scheme are considered to have low and medium resemblance to stony reefs, and, as such, are usually associated with lower biodiversity and abundance compared to those with high resemblance. This is also true for the Annex I rocky reef in the English Offshore Scheme. Therefore, the **sensitivity** of Annex I stony and rocky reefs to seabed disturbance and habitat loss is **low**. Boulder clearance through ploughing within the draft Order Limits has a narrow footprint of 20 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 and rocky reefs across the English Offshore Scheme is limited. Thus, the **magnitude** of this effect on Annex I habitats is **low**. Therefore, using the sensitivity and the magnitude, the significance of the effect on Annex I Stony and Rocky Reefs has been assessed as **Minor** and **Not Significant.**

Annex I Sabellaria Spinulosa Reefs

19.11.27 Survey data was only available immediately prior to publication of PIER, thus survey information and data is still under review. Impact assessments for Annex 1 *S. spinulosa* reefs will be provided in the ES and discussed with stakeholders and SNCBs.

National Sites

19.11.28 The Holderness Offshore MCZ is the only national site with designated benthic features that the English Offshore Scheme does not avoid; although it is avoided by the EGL 3 Project (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**). Farnes East MCZ and North East of Farnes Deep MCZ and HPMA are present within the study area, but not the draft Order Limits (**Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**) and are therefore not exposed to seabed disturbance or temporary habitat loss from abrasion or penetration.

19.11.29 The EGL 4 marine characterisation survey identified the presence of circalittoral coarse sediment and circalittoral mixed sediment within the Holderness Offshore MCZ. These two habitats are a protected feature of the Holderness Offshore MCZ. The conservation objective of the Holderness Offshore MCZ is to recover the structure, function, extent and distribution of these designated protected habitat features.

19.11.30 The Holderness Offshore MCZ is characterised by 'relatively dynamic and unstable conditions', experiencing 'moderate wave and current energy at the seabed' (JNCC, 2021, REF 19.49), with strong seabed currents noted to be present within the North Sea glacial tunnel valley and at two camera transects, EGL 4_63 and EG L 4_64, within subtidal coarse sediment habitats (Benthic Solutions, 2025, REF 19.25). Thus, the sessile organisms inhabiting the coarser sediments of the Holderness Offshore MCZ are subject to and can tolerate a natural level of seabed disturbance, whilst the mobile fauna present within the softer sediments of the Holderness Offshore MCZ can temporarily relocate as sediment is displaced but return once EGL 4 Project activities have finished. Typically, species associated with subtidal coarse and mixed sediment habitats demonstrate rapid recruitment and recolonisation following seabed disturbance (Tillin and Watson, 2023, REF 19.50). Therefore, the **sensitivity** of the Holderness Offshore MCZ to this effect is **medium** (JNCC, 2021, REF 19.49).

19.11.31 The EGL 4 Project cross the site for approximately 8.7 km (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**). Approximately 0.26 km^2 of the 1,176 km^2 Holderness Offshore MCZ would be disturbed by works during construction; equivalent to 0.02% of the site. Therefore, it is only a small area of the Holderness Offshore MCZ that will experience temporary seabed disturbance. Circalittoral mixed and coarse sediment is comprised of sand, gravel, pebbles and boulders. These sediment types demonstrate quick recovery (few months to a couple of years) from seabed disturbance, attributed to the dynamic nature of these sediments which are regularly reworked by tidal currents and wave action. The **magnitude** of abrasion and penetration of the seabed in the Holderness Offshore MCZ is considered to be **negligible.** Therefore, using the sensitivity and the magnitude, the significance of the effect on the broadscale habitat features of the Holderness Offshore MCZ has been assessed as **Minor** and **Not Significant**.

Ocean Quahog

19.11.32 Four juvenile ocean quahog individuals and one adult ocean quahog were recorded across the EGL 4 Project whilst no individuals of ocean quahog were recorded in the EGL 3 Project. The closest presence of ocean quahog within the Holderness Offshore MCZ to the draft Order Limits is 18 km (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**). 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 are 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 (1976, REF 19.51) 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**.

19.11.33 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 (Tyler-Walters and Sabatini, 2017, REF 19.34). Five individuals of ocean quahog were found within the draft Order Limits and therefore 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. Therefore, the **magnitude** of this effect is **negligible**. The **significance** of effect has been assessed as **Minor** and **Not Significant**.

Preliminary Assessment of Permanent Habitat Loss – All Phases

19.11.34 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 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, it would also be required during the operation 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.

19.11.35 The worst-case installation footprint for permanent habitat loss is presented in **Section** Key Parameters for Assessment**19.8** and summarised in **Table 19-22.**

Table 19-22 - Summary of Footprint for Permanent Habitat Loss (External Cable Protection)

Phase	Construction *	Operation	Decommissioning
EGL 3 Project	0.915 km^2	To be confirmed	No new deposits but assumes cable protection remains in place.
EGL 4 Project	1.135 km^2	To be confirmed	

19.11.36 Introduction of hard substrate into a habitat via marine cables and external cable protection would replace other natural substrates, leading to permanent loss of these habitats and associated species.

19.11.37 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor values/sensitivities and the magnitude of the impact. A summary of the preliminary assessment conclusions is provided in **Table 19-23** for ease of reference. Where receptors share a common sensitivity/value, magnitude and significant of effect they have been grouped together.

Table 19-23 - Summary of Preliminary Assessment Conclusions for Permanent Habitat Loss

Receptor	Receptor Sensitivity / Value	Magnitude	Significance of effect
Atlantic circalittoral soft rock	High	High	**Major**
Atlantic circalittoral rock	High	Negligible	Minor
Atlantic circalittoral mixed sediment			
Faunal communities on full salinity Atlantic infralittoral mixed sediment			
Atlantic offshore circalittoral mud			
Faunal communities of Atlantic circalittoral mud			
Atlantic circalittoral coarse sediment			
Faunal communities in full salinity Atlantic infralittoral coarse sediment			
Atlantic circalittoral sand			
Faunal communities in Atlantic offshore circalittoral sand			
Subtidal sands and gravels			
Annex I Stony and Rocky Reefs			
Holderness Offshore MCZ			
Ocean quahog			

Subtidal Broadscale Habitats and Species and Subtidal Sands and Gravels

19.11.38 There are 10 broadscale habitat complexes within the English Offshore Scheme including: Atlantic circalittoral rock (MC12), communities on Atlantic circalittoral soft rock (MC125), faunal communities in full salinity Atlantic infralittoral coarse sediment (MB323), Atlantic circalittoral coarse sediment (MC32), faunal communities on full salinity Atlantic infralittoral mixed sediment (MB423), Atlantic circalittoral mixed sediment (MC42), Atlantic circalittoral sand (MC52), faunal communities in Atlantic offshore circalittoral sand (MD521), faunal communities of Atlantic circalittoral mud (MC621) and Atlantic offshore circalittoral mud (MD62).

19.11.39 **Atlantic circalittoral rock** habitats 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 would increase the abundance of hard substrate available for sessile organisms to colonise and, where possible, 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 and material as the receiving environment will be

used as an alternative to terrestrially sourced granite) (see **Section 19.6**). Consequently, there would not be a shift in seabed composition in areas of rock and boulders.

19.11.40 The use of matching external cable protection will encourage the attachment and settlement of sessile invertebrates within this habitat; a review of literature by Wallingford (2025, REF 19.52) reports that external rock protection is colonised by primary and secondary users, with amphipods, hydroids and anemones demonstrating colonisation of artificial rock protection within subtidal habitats in the North Sea. Primary colonisers, such as tubeworms and hydroids, initially colonise the artificial rock; these are then displaced between 2 - 4 years later by secondary colonisers, such as anemones, which can dominate the artificial rock for up to 11 years post construction. Additionally, the rock protection provides additional hard substrate for mobile demersal megafauna such as lobsters and crabs. This evidence suggests there would be a limited level of permanent habitat loss within the habitat and therefore the **magnitude** of the impact has been assessed as **negligible**. The significance of the effect on this receptor has been assessed as **Minor** and **Not Significant**.

19.11.41 **Atlantic circalittoral soft rock** present in the EGL 3 Project demonstrates a **high sensitivity** to permanent habitat loss as a result of substrate change. External cable protection material within these areas cannot be matched to the chalk or clay substrate, thus there would be a conversion of soft sediment (soft chalk or clay) to hard substrate, significantly decreasing piddock population and biotope characterisation.

19.11.42 This biotope is only present in interspersed patches between KP 25 and KP 40 in the EGL 3 Project. However, MC1251 has a restricted distribution in UK waters (Tillin and Watson, 2023, REF 19.50), thus any permanent habitat loss as a result of the English Offshore Scheme will affect the wider distribution of this habitat in the North Sea. The criteria for a magnitude of medium is defined as "*post-impact the damage to the baseline is above that experienced under natural conditions but with no permanent effect on integrity*" and the criteria for a magnitude of high is defined as "*natural recruitment will not return the population/habitat to the baseline condition*". The recovery of soft chalk or clay, even through restoration techniques, is very low (Tillin and Watson, 2023, REF 19.50). Additionally, this biotope is categorised as a habitat of principle importance, habitat of conservation interest, an Annex I habitat and a UKBAP habitat. Therefore, the **magnitude** of this effect is **high**.

19.11.43 The significance of this effect is **Major** and **Significant**. This assessment has been based upon the worst-case scenario that external cable protection will be needed within areas of 'piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', thus causing a potential significant impact. Further work between publication of PEIR and ES will be undertaken to determine the location of external cable protection within the English Offshore Scheme. Should rock protection not be required in areas of this biotope, the worst-case scenario and assessment will be refined in the ES; should rock protection be required in areas of MC1251, environmental measures will be outlined in the ES and discussed with SNCBs.

19.11.44 The placement of external cable protection in **subtidal sands and gravels** and habitats **MB323**, **MC32, MB423, MC42, MC52, MD521, MC621 and MD62** will result in the irreversible conversion of muds, sands and gravels to 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 for hard substrates while displacing infaunal organisms, such as bivalves and polychaetes, who live within softer sediments. The **sensitivity** of subtidal sands and gravels and habitats MB323, MC32, MB423, MC42, MC52, MD521, MC621 and MD62 to permanent habitat loss through rock protection is **high**. External cable protection will be a permanent addition to these habitats and it is assumed that it will not be removed following decommissioning of the EGL 3 and the EGL 4 Project. However, external cable protection would only be installed across a maximum area of 0.915 km^2 within the EGL 3 Project and 1.135 km^2 within the EGL 4 Project. Cable protection would be installed only where considered necessary for the safe operation of the English Offshore Scheme and, where possible, 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 and material as the receiving environment will be used as an alternative to terrestrially sourced granite) (see **Section 19.6**). Additionally, these habitats are common throughout the North Sea. Permanent habitat loss of small sections of these habitats would have little effect on the wider distribution of these habitats. Therefore, the **magnitude** of permanent habitat loss on subtidal sands and gravels and habitats MB323, MC32, MB423, MC42, MC52, MD521, MC621 has been assessed as **negligible**. The **significance** of this effect has been assessed as **Minor** and **Not Significant**

Annex I Stony and Rocky Reefs

19.11.45 Annex I stony and rocky reefs 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 would increase the abundance of hard substrate available for sessile organisms to colonise and, where possible, 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 and material as the receiving environment will be used as an alternative to terrestrially sourced granite). Consequently, there would not be a shift in seabed composition in areas of Annex I stony and rocky reefs.

19.11.46 The use of matching cable protection (which is intended to be secured through the Outline CEMP) will encourage the attachment and settlement of sessile invertebrates within this habitat. This would limit the level of permanent habitat loss within the habitat and therefore the **magnitude** of the impact has been assessed as **negligible**. The significance of the effect on this receptor has been assessed as **Minor** and **Not Significant**.

Annex I Sabellaria Spinulosa Reefs

19.11.47 Survey data was only available immediately prior to publication of PIER, thus survey information and data is still under review. Impact assessments for Annex 1 *S. spinulosa* reefs will be provided in the ES and discussed with stakeholders and SNCBs.

National Sites

19.11.48 The Holderness Offshore MCZ is the only national site with designated benthic features that the English Offshore Scheme does not avoid; although it is avoided by the EGL 3 Project (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**). Farnes East MCZ and North East of Farnes Deep MCZ and HPMA are present within the study area, but not the draft Order Limits (**Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**) and are therefore not exposed to permanent habitat loss.

19.11.49 The EGL 4 marine characterisation survey identified the presence of circalittoral coarse sediment and circalittoral mixed sediment within the draft Order Limits in the Holderness Offshore MCZ. These two habitats are a protected feature of the Holderness Offshore MCZ. The conservation objective of the Holderness Offshore MCZ is to recover the structure, function, extent and distribution of these designated protected habitat features.

19.11.50 The placement of cable protection within these habitats will result in the irreversible conversion of softer sediments within coarse and mixed sediment habitats to hard substrate, if left in situ following decommissioning of the EGL 4 Project, 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 for hard substrates while displacing infaunal organisms, such as bivalves and polychaetes, who live within softer sediments. The **sensitivity** of the broadscale habitats within the Holderness Offshore MCZ to permanent habitat loss is **high.**

19.11.51 A review of literature by Wallingford (2025, REF 19.52) reports that external rock protection is colonised by primary and secondary users, with amphipods, hydroids and anemones demonstrating colonisation of artificial rock protection within subtidal habitats in the North Sea. Primary colonisers, such as tubeworms and hydroids, initially colonise the artificial rock; these are then displaced between 2 - 4 years later by secondary colonisers, such as anemones, which can dominate the artificial rock for up to 11 years post construction. Additionally, the rock protection provides additional hard substrate for mobile demersal megafauna such as lobsters and crabs. This evidence suggests the introduction of hard substrate may result in increased biodiversity and faunal abundance within the Holderness Offshore MCZ. Some of the sessile species present within the Holderness Offshore MCZ, such as the beadlet anemone (*Actinia equina)* and the Dahlia anemone (*Urticina felina)*, may eventually colonise artificial rock structures whilst the crustacea present may utilise the structure for shelter.

19.11.52 The EGL 4 Project crosses Helvellyn Pipeline in the Holderness Offshore MCZ within an area of subtidal coarse sediment; external cable protection of 0.001 km^2 will be required at this infrastructure crossing. The EGL 4 Project crosses the Holderness Offshore MCZ for approximately 8.7 km. Preliminary assessment has identified four locations (two high risk and two medium risk) where cable burial in sediment may not be viable due to loose sand overlying clay or hard substrate. The Helvellyn Pipeline is present within one of these locations. As a result, the worst-case scenario for cable protection is that it would be needed for 6.8 km of the EGL 4 Project overlapping the Holderness Offshore MCZ**.** Thus, a small footprint of approximately 0.068 km^2 of the total 1,176 km^2 area of the Holderness Offshore MCZ would be covered with cable protection; equivalent to 0.006 % of the site. Additionally, the draft Order Limits do not run through any known location of ocean quahog in Holderness Offshore MCZ (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**)

and therefore the addition of cable protection in the Holderness Offshore MCZ will not affect their distribution or abundance (JNCC, 2019, REF 19.53). Therefore, the **magnitude** of permanent habitat loss in the Holderness Offshore MCZ has been assessed as **negligible.** Using the sensitivity and the magnitude, the significance of the effect on the broadscale habitat features of the Holderness Offshore MCZ has been assessed as **Minor** and **Not Significant**.

Ocean Quahog

19.11.53 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**.

19.11.54 Ocean quahog are a protected feature of the Holderness Offshore MCZ. However, the draft Order Limits do not run through any known location of ocean quahog in Holderness Offshore MCZ (**Volume 3, Part 3, Figure 19-2: Holderness Offshore Marine Conservation Zone**) and none were identified within the site during the EGL 4 marine characterisation survey. Therefore, the addition of external cable protection in the Holderness Offshore MCZ will not affect their distribution or abundance (JNCC, 2019, REF 19.53). 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 (Tyler-Walters and Sabatini, 2017, REF 19.34). Only five individuals of ocean quahog were found within the English Offshore Scheme, therefore 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**. The **significance** of effect has been assessed as **Minor** and **Not Significant**.

Preliminary Assessment of Temporary Increase and Deposition of Suspended Sediments – All Phases

19.11.55 The construction, operation and decommissioning of the English Offshore Scheme has the potential to temporarily increase suspended sediments. 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, these plumes can cause smothering of habitats and features.

19.11.56 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.

19.11.57 Once deposited on the seabed, fine particulate sediments can cause light smothering (<5 cm) of habitats and species whereas heavier sediments can cause heavy smothering (≥30 cm). Gooding *et al.* (2012, REF 19.54) 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 process 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.

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

19.11.59 Project specific data presented in **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes,** suggests coarse sediment plumes, created from seabed preparation and cable trenching activities, will settle from the water column within the draft Order Limits and will cause light smothering of <5 cm, and fine sediment will cause lighter smothering of <2 mm up to 17.5 km from pre-lay and cable trenching activities, dependent upon peak flow speed. 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 11.7 km, dependent upon peak flow speed. If the EGL 3 Project and EGL 4 Project were to be constructed simultaneously, then fine sediment deposition could overlap but this will not exceed 5 cm. There will be no heavy smothering as a result of the English Offshore Scheme and heavy smothering will not be considered in this assessment.

19.11.60 The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l is 8 km between KP 1 and KP 10 and between 2.7 and 6.5 km past KP 10. Suspended sediment concentrations exceed 10 mg/l for a maximum distance of 4 km from TSHD activities.

19.11.61 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor values/sensitivities and the magnitude of the impact. A summary of the preliminary assessment conclusions is provided in **Table 19-24** for ease of reference. Where receptors share a common sensitivity/value, magnitude and significant of effect they have been grouped together.

Table 19-24 Summary of Preliminary Assessment Conclusions for Temporary Increase and Deposition of Suspended Sediments

Receptor	Receptor Sensitivity/Value	Magnitude	Significance of Effect
Atlantic circalittoral rock Atlantic circalittoral soft rock Holderness Offshore MCZ North East of Farnes Deep MCZ/HPMA	Medium	Negligible	Minor
Atlantic circalittoral coarse sediment Faunal communities in full salinity Atlantic infralittoral coarse sediment Atlantic circalittoral sand Faunal communities in Atlantic offshore circalittoral sand Subtidal sands and gravels Annex I stony and rocky reefs	Low	Negligible	Negligible
Intertidal habitats Ocean quahog Atlantic offshore circalittoral mud Faunal communities of Atlantic circalittoral mud Atlantic circalittoral mixed sediment Faunal communities on full salinity Atlantic infralittoral mixed sediment	Negligible	Negligible	Negligible

Intertidal Habitats

19.11.62 The English Offshore Scheme installation would use a trenchless technique such as HDD at the landfall, 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. Frac-outs have been known to occur at locations close to Anderby Creek. Lessons learnt from these analogous

projects have been reviewed and considered when undertaking preliminary HDD designs for the EGL 3 Project and the EGL 4 Project.

19.11.63 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. Thus, no smothering can occur. The **sensitivity** of the habitats present within the intertidal zone to increased suspended sediment from a bentonite plume is **negligible**.

19.11.64 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. The environment management plan for the English Offshore Scheme includes mitigation plans to ensure frac-outs are managed appropriately should a pollution event occur; this involves the use of an absorbent matt to remove the bentonite from the marine environment. The **magnitude** of increased suspended sediments on intertidal habitats is therefore **negligible** and the significance of the effect is **Negligible** and **Not Significant.**

Subtidal Broadscale Habitats and Species

19.11.65 There are 10 broadscale habitat complexes within the English Offshore Scheme including: Atlantic circalittoral rock (MC12), communities on Atlantic circalittoral soft rock (MC125), faunal communities in full salinity Atlantic infralittoral coarse sediment (MB323), Atlantic circalittoral coarse sediment (MC32), faunal communities on full salinity Atlantic infralittoral mixed sediment (MB423), Atlantic circalittoral mixed sediment (MC42), Atlantic circalittoral sand (MC52), faunal communities in Atlantic offshore circalittoral sand (MD521), faunal communities of Atlantic circalittoral mud (MC621) and Atlantic offshore circalittoral mud (MD62).

19.11.66 **Atlantic circalittoral rock** habitats, such as MC1216 and MC1213, host a highly diverse community of epifauna that are unable to relocate to avoid temporary increase and deposition of suspended sediments. As such, filter feeders are susceptible to injury and mortality from clogged feeding apparatus. *Balanus crenatus*, is a filter feeding barnacle and can tolerate smothering by fine particles below 5 cm. Any layer greater than 5 cm is too thick for the feeding cirri to pass through to reach the water column. Additionally, fine sediment can clog the feeding apparatus inside the barnacle, imposing excessive energetic costs on the barnacle to clear the cirri. Some epifauna present within Atlantic circalittoral rock habitats, such as encrusting sponges and bryozoa, however, demonstrate a tolerance to increased suspended sediment. For example, the Hornwrack (*Flustra foliacea)* (present within the English Offshore Scheme) occurs in highly turbid areas of the marine environment and the sponge *Cliona celata* (*Cliona spp.* found in the English Offshore Scheme) is reported to be indifferent to turbid environments. This habitat is also characterised by mobile fauna that can temporarily relocate to avoid areas of increased turbidity and smothering (Hiscock, 2008, REF 19.55) such as, *Pisidia longicornis*, the long-clawed porcelain crab, which was recorded within this habitat at station EGL 4_03_EBS_eDNA_F1.

19.11.67 The **sensitivity** of Atlantic circalittoral rock to temporary increase and deposition of suspended sediments is **medium** (Readman, Lloyd and Watson, 2023, REF 19.42).Heavy, coarse sediment, as present within MC1216 and MC1213 habitats, settles from the water column more quickly than light, fine sediment, thus exposing organisms to increased suspended sediment for shorter periods.

19.11.68 Project specific data (as per **Volume 1, Part 3, Chapter 18: 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. Sandwave pre-sweeping would not be required in this habitat. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l in areas surrounding Atlantic circalittoral rock is between 2.7 and 6.5 km. Due to the presence of boulders of varying heights within MC1216 and MC1213 habitats, sediment will demonstrate dispersed deposition. Therefore, the **magnitude** of this effect of Atlantic circalittoral rock is considered to be **negligible**, thus the significance of effect is **Minor** and **Not Significant**.

19.11.69 Piddocks, present in **Atlantic circalittoral soft rock** habitats, are an infaunal species that creates burrows within the soft chalk and clay sediment. The burrows created by piddocks become deeper as individuals transition from juvenile to adult, with the adults being unable to emerge from their burrows and relying on their short siphons for respiration and feeding at the seabed surface. Thus, piddocks are vulnerable to light and heavy smothering from deposition of suspended sediment (Tillin and Hill, 2016, REF 19.43). Therefore, the **sensitivity** of Atlantic circalittoral soft rock to temporary increase and deposition of suspended sediments is **medium**. Fine sediment, as present within MC1251, once suspended will remain in the water column for longer periods than coarse sediment but dilute and disperse within the water column more quickly.

19.11.70 Project specific data (presented in **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**) suggests fine sediment will cause light smothering of <2 mm up to 17.5 km from pre-lay and cable trench activities, and light smothering of <2 mm out to a maximum distance of 11.7 km from TSHD activities, dependent upon peak flow speed. Whilst pre-sweeping is not required within this habitat, there is an indicative pre-sweeping area to the southeast of the habitat within the range of sediment dispersion. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l in areas surrounding Atlantic circalittoral soft rock is approximately 6.5 km and 4 km for TSHD activities. Therefore, the **magnitude** of this effect of Atlantic circalittoral soft rock is considered to be **negligible**, thus the significance of effect is **Minor** and **Not Significant**.

19.11.71 Three Level 5 biotopes were identified within **coarse sediment habitats** within the English Offshore Scheme. These include: '*Glycera lapidum, Thyasria spp*. and *Amythasides macroglossus* in offshore gravelly sand' (MD3211); '*Mediomastus fragilis, Lumbrineris spp.* and venerid bivalves in Atlantic circalittoral coarse sand or gravel' (MC3212) and '*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand' (MC3213). MC3212 demonstrates the highest levels of sensitivity to temporary increase and deposition of suspended sediments of the three biotopes and therefore has been used inform the assessment for Atlantic circalittoral coarse sediment within the English Offshore Scheme.

19.11.72 Veneridae, a family of bivalves, are suspension feeders, trapping food particles on their gill filaments. Increases in suspended sediment is likely to clog these gill filaments, adversely affecting feeding and respiration. *Timoclea ovata,* a characterising species of this habitat and found within the English Offshore Scheme, occurs in areas with low concentrations of suspended sediments where organic particle sorting is unnecessary. Thus, this species of bivalve has adapted to only have a small mid-gut with tiny palps. Therefore, *T. ovata* and other venerid bivalves may struggle to sort organic materials during periods of increased suspended

sediments from increased levels of suspended sediments. However, this biotope has a demonstrated high resilience to increased turbidity, therefore demonstrates a low sensitivity to increased suspended sediments.

19.11.73 Tellinidae (species present within the English Offshore Scheme include *Fabulina fabula* and *Asbjornsenia pygmaea)*, a family of habitat characterising bivalves, can migrate up to 40 cm in mud and up to 50 cm in sand. Any smothering greater than this can prevent these bivalves from reaching the sediment surface for respiration and feeding, resulting in mortality. Atlantic circalittoral coarse sediments are likely to be dominated by mobile infauna, such as crustacea, that can temporarily relocate during periods of increased turbidity and to avoid smothering from sediment deposition but can return once cable construction and decommissioning is completed within the area. For example, the Bryer's nut crab (*Ebalia tumefacta*) was present within this habitat at station EGL 4_35_EBS_F1. Therefore, MC3212 demonstrates a low sensitivity to light smothering. MC3212 only occurs at 14 of the 62 sampling stations along the EGL 4 Project where Atlantic circalittoral coarse sediments occur. The remaining 48 sampling stations are characterised by MC3213 and MD3211 which demonstrate no sensitivity to increased suspended sediments. The EGL 3 Project survey data does not provide specific biotope information. As a precautionary approach, a **sensitivity** value of **low** is used in this assessment to inform the impact significance score for coarse habitats.

19.11.74 Subtidal coarse sediments include coarse sand, gravel, pebbles, shingle and cobbles. Project specific data (as per **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**) suggests very coarse sand and gravels will settle back into the trench. Sand particles ranging between very coarse sand and fine sand will settle within 135 m of the trench, and will cause light smothering of <5 cm. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l in coarse sediment habitats within the English Offshore Scheme is km between KP 1 and KP 10 and between 2.7 and 6.5 km past KP 10. Suspended sediment concentrations exceed 10 mg/l for a maximum distance of 4 km from TSHD activities. The **magnitude** of this effect is **negligible**, thus the significance of the effect has been assessed as **Negligible** and **Not Significant.**

19.11.75 **Mixed sediment habitats** comprise of mobile and sessile fauna. Whilst mobile fauna can temporarily relocate to avoid temporary increase and deposition of suspended sediments, the epifauna within this habitat is vulnerable. Hydroids are a characterising group of organisms of the '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment' (MC4214) habitat found within the English Offshore Scheme. 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, as discussed previously, *F. foliacea* demonstrates a tolerance to increased concentrations of suspended sediment due to its occurrence 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. Heavy smothering would bury all characterising species, except those present on boulders, leading to increased mortality.

19.11.76 *S. spinulosa* was found to present within Atlantic circalittoral mixed sediments and is a tube building polychaete that thrives in areas of increased suspended sediment. *S. spinulosa*, requires a supply of suspended sediment sufficient for feeding and tube

formation activities. Additionally, this polychaete can tolerate 5 cm of smothering for several weeks, suggesting a high adaptability to sediment deposition (Jackson and Hiscock, 2008, REF 19.56).

19.11.77 Mixed sediment habitats are considered to have **negligible sensitivity** to increased suspended sediment and light smothering.

19.11.78 The average particle size distribution across the English Offshore Scheme was 87.9 % (± 11.4 SD) sand at the EGL 4 offshore stations and 45.8 % (± 17.5 SD) gravel with 4.0 % (± 4.1 SD) fine sediments at the EGL 4 nearshore stations. On average, stations sampled in the EGL 3 Project demonstrated a greater proportion of coarse sand (>70 %) compared to other sediment types, with fine sediment, such as mud and silt, contributing <10 % to the total sediment composition. Project specific data (**Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes)** suggests very coarse sand and gravels will settle back into the trench. Sand particles ranging between very coarse sand and fine sand will settle within 135 m of the trench, with very fine sand travelling up to 700 m before settling, dependant on peak flow speed. Light smothering <5 cm is expected within the draft Order Limits. Further than the draft Order Limits, deposited fines will settle in thicknesses <2 mm. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l is 8 km between KP 1 and KP 10 and between 2.7 and 6.5 km past KP 10. Suspended sediment concentrations exceed 10 mg/l for a maximum distance of 4 km from TSHD activities.

19.11.79 The **magnitude** of this effect on mixed sediment habitats within the English Offshore Scheme is **negligible** and the significance of the effect has been assessed as **Negligible** and **Not Significant**.

19.11.80 **Sand habitats** found within the English Offshore Scheme consist of three Level 5 biotopes: '*Thyasira spp.* and *Nuculoma tenuis* in Atlantic circalittoral sandy mud' (MC6212); '*Amphiura filiformis* and *Ennucula tenuis* in circalittoral and offshore sandy mud' (MC6213) and '*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand' (MC5211). MC5211 is the most prevalent of the three biotopes within the English Offshore Scheme and the most sensitive to temporary increase and deposition of suspended sediments. Therefore, habitat MC5211 has been used to inform this assessment.

19.11.81 Temporary increase and deposition of fine suspended sediments could alter the sediment type present within Atlantic circalittoral sand habitats, reducing the suitability of the habitat for its characterising infauna. Atlantic circalittoral sand is characterised by the presence of burrowing infauna, some of which rely on the water column for feeding and respiration. During periods of increased turbidity, suspension feeders are vulnerable to clogged feeding apparatus, causing decreased feeding efficiency and increased energy costs. Smothering from the deposition of suspended sediments could also impose energetic costs to organisms who need to re-establish burrow openings or ascend through a greater volume of sediment to reach the seabed surface. Catworm (*Nephyts hombergii),* a characterising species of this habit and present within the English Offshore Scheme, can migrate through up to 90 cm of sand of a rate of 20 cm/day. *F. fabula* and *A. pygmaea* are characterising species of this habitat and can migrate up to 50 cm in sand. Sand habitats have a **low sensitivity** to increased suspended sediment and light smothering.

19.11.82 The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l is 8 km between KP 1 and KP 10 and between 2.7 and 6.5 km past KP 10. Suspended sediment concentrations exceed 10 mg/l for a maximum distance of 4 km from TSHD activities.

19.11.83 Atlantic circalittoral sand is predominantly surrounded by coarse or mixed sediment within the English Offshore Scheme, with 87.9 % (± 11.4 SD) sand present at the EGL 4 offshore stations and the majority of EGL 3 stations comprising of >70 % sand. Project specific data (**Volume 1 Part 3, Chapter 18: Coastal and Marine Physical Processes**) suggests very coarse sand and gravels will settle back into the trench. Sand particles ranging between very coarse sand and fine sand will settle within 135 m of the trench, with very fine sand travelling up to 700 m before settling, dependant of peak flow speeds. Light smothering of <5 cm is expected within the draft Order Limits. Further than the draft Order Limits deposited fines will settle in thicknesses <2 mm. For 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 11.7 km, dependent upon peak flow speed. Filter/suspension feeders will only be exposed to increased turbidity from fine sand material and any potential corresponding adverse effects for a short period of time. Additionally, most organisms can re-establish burrow openings within a few hours to a few days of covering and can therefore quickly recover from any smothering that might cover their burrows.

19.11.84 Sand habitats co-occur with mud habitats in the northern section of the EGL 4 Project and are present as muddy sand habitats in the north of the EGL 3 Project. Fine sediment will cause lighter smothering of <2 mm up to 17.5 km from pre-lay and cable trenching activities and 11.7 km from TSHD activities, dependent upon peak flow speed. Therefore, any fine particles that were to settle on the sand habitats within the English Offshore Scheme would be insufficient to change the character of the habitat.

19.11.85 The **magnitude** of the effect on sand habitats is considered to be **negligible**. Therefore, the significance of increased suspended sediment and light smothering on sand habitats has been assessed as **Negligible** and **Not Significant.**

19.11.86 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 reduced 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.

19.11.87 *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 (Last *et al.* 2011, REF 19.57) 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**

19.11.88 Project specific data (**Volume 1 Part 3, Chapter 18: Coastal and Marine Physical Processes**) suggests very coarse sand and gravels will settle back into the trench. Sand particles ranging between very coarse sand and fine sand will settle within 135 m of the trench, with very fine sand travelling up to 700 m before settling. Light smothering of<5 cm is expected within the draft Order Limits. Further than the draft Order Limits deposited fines will settle in thicknesses <2 mm. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l is between 2.7 and 6.5 km in areas of sand habitats. Suspended sediment concentrations exceed 10 mg/l for a maximum distance of 4 km from TSHD activities. The **magnitude** of temporary increase and deposition of suspended sediment on mud habitats is **negligible**. The significance of increased suspended sediment and light smothering on this habitat is **Negligible** and **Not Significant**

Subtidal Sands and Gravels

19.11.89 Subtidal sands and gravels, which are commonly found in the North Sea and present within the English Offshore Scheme, are highly mobile (Irving, 2009, REF 19.58). For example, the subtidal sands and gravels habitats present within the nearshore sections off the EGL 4 Project 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 decommissioning. Additionally, this moderate high tidal energy is likely to remove all light smothering (<5 cm) from sediment deposition. 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**.

Annex I Stony and Rocky Reefs

19.11.90 Annex I stony reefs 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 low sensitivity to increased sediment suspension and smothering. For example, the coral *A. digitatum*, a characterising species of Annex I stony reefs 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 (Budd, 2008, REF 19.48). Adult *A. digitatum* can also dislodge settled particles with large amounts of mucous, demonstrating a high tolerance to increased suspended sediment (Hill *et al.,* 1997, REF 19.59). Juvenile colonies, however, that initially form crusts of 5 – 10 mm, can experience decreased respiration ability in periods on increased turbidity or smothering.

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

19.11.92 Project specific data (as per **Volume 1, Part 3, Chapter 18: 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; sandwave pre-sweeping would not be required in this habitat. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l in areas surrounding Annex I stony and rocky reefs is between 2.7 and 6.5 km and 4 km for TSHD activities. However, suspended sediment concentrations have been shown to fall to ambient levels within 66 m of trenching activity in hard ground areas (Gooding *et al.,* 2012, REF 19.54). Due to the presence of boulders of varying heights within this habitat, sediment will demonstrate dispersed deposition. Therefore, the **magnitude** of this effect on Annex I habitats is considered to be **negligible**, thus the significance of effect is **Negligible** and **Not Significant**.

Annex I Sabellaria Spinulosa Reefs

19.11.93 Survey data was only available immediately prior to publication of PIER, thus survey information and data are still under review. Impact assessments for Annex 1 S. spinulosa reefs will be provided in the ES and discussed with stakeholders and SNCBs.

Designated Sites

19.11.94 The nationally designated sites within the study area that could be subject to temporary increase and deposition of suspended sediments from construction, operation and decommissioning of the English Offshore Scheme are the Holderness Offshore MCZ (the EGL 4 Project crosses the Holderness Offshore MCZ for approximately 8.7 km), and the North East of Farnes Deep MCZ and HPMA (where the EGL 4 Project is situated 0.5 km to the west of the site and the EGL 3 Project is situated 5.1 km to the east of the site, at the closest approach) (**Volume 3, Part 3, Figure 19-1: Subtidal Benthic Sampling Stations, Camera Transects and Broadscale Habitats within Benthic Study Area**)

Holderness Offshore MCZ

19.11.95 The designated features of the Holderness Offshore MCZ are subtidal coarse sediment, subtidal mixed sediments, subtidal sand, the North Sea glacial tunnel valley and ocean quahog. The conservation objective of the Holderness Offshore MCZ is to recover the structure, function, extent and distribution of these designated protected habitat and biological features and maintain the geological feature.

19.11.96 The stretch of the EGL 4 Project that runs through the Holderness Offshore MCZ is comprised of circalittoral coarse sediment (MC32) and circalittoral mixed sediment (MC42). Using Quantum Geographic Information System (QGIS) (2025) and a map of the distribution of ocean quahog within the Holderness Offshore MCZ (JNCC 2019 REF 19.53) it has been calculated that the closest presence of ocean quahog within the Holderness Offshore MCZ to the draft Order Limits is 18 km.

19.11.97 Project specific data presented in **Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**, suggests coarse sediment plumes, created from pre-lay and cable trenching activities, will settle from the water column within the draft Order Limits and will cause light smothering of <5 cm, and fine sediment will cause lighter smothering of <2 mm up to 17.5 km from pre-lay and cable trenching activities, dependent upon peak flow speed. Thus, construction, operation and decommissioning of the EGL 4 Project will not impact ocean quahog presence within the Holderness Offshore MCZ.

19.11.98 The sediment presents within the subtidal coarse sediment habitats within the Holderness Offshore MCZ is dominated by gravel; for example, grab sample EGL4_63_EBS is comprised of 49.8 % gravel. The sediments present within the subtidal mixed sediment habitats within the Holderness Offshore MCZ are sand and gravel. Finer sediment such as mud and sand are present within the subtidal coarse sediment habitats within the Holderness Offshore MCZ, with mud contributing <10 % of the total sediment composition. Increased suspended sediment can clog the feeding apparatus and gill filaments of suspension feeders, such as bivalves, reducing respiration and feeding (Readman, Lloyd and Watson, 2023, REF 19.42). However, bivalves can burrow into the sediment and anemones can retract their tentacles to avoid periods of increased turbidity. Additionally, mobile fauna present within subtidal coarse and mixed sediment, such as crabs, can temporarily relocate during periods of increased turbidity and to avoid smothering from sediment deposition. Holderness Offshore MCZ demonstrates a **medium sensitivity** to temporary increase and deposition of suspended sediment (JNCC, 2021 REF 19.49)

19.11.99 The potential need for pre-sweeping has been identified within the draft Order Limits adjacent to the northeast corner of the Holderness Offshore MCZ (**Volume 2, Part 3, Appendix 3.17.B, Figure 5-2**). Suspended coarse sediment will settle within the draft Order Limits and cause <5 cm of smothering (from one pass of the TSHD), and suspended fine sediments can travel up to 11.7 km from TSHD activities. Thus, suspended sediment from pre-sweeping outside of the Holderness Offshore MCZ will settle on the subtidal sand habitat within the Holderness Offshore MCZ, causing light smothering of <5 cm thickness in limited areas (the disposal sites are located outside of the MCZ boundary). The subtidal sands within the Holderness Offshore MCZ are subject to moderately high current strengths, which is likely to remove all light smothering (<5 cm) from sediment deposition. The species present have low sensitivity to light smothering, with bivalve species able to migrate through up to 50 cm of sediment easily.

19.11.100 It is not anticipated that a temporary increase and deposition of suspended sediment will have a adverse effect on the subtidal sand habitats within the Holderness Offshore MCZ, therefore **magnitude** of this effect is considered to be **negligible**. The significance of the effect has been assessed as **Minor** and **Not Significant**.

North East of Farnes Deep HPMA and MCZ

19.11.101 The designated features of the North East of Farnes Deep MCZ are subtidal coarse sediment, subtidal sand, subtidal mixed sediments, subtidal mud and ocean quahog, with the conservation objective to recover the current state of the MCZ. The designated features of the North East of Farnes Deep HPMA are the entire ecosystem. North East of Farnes Deep MCZ and HPMA demonstrates a **medium sensitivity** to temporary increase and deposition of suspended sediment (JNCC, 2023, REF 19.60).

19.11.102 The stretch of the EGL 4 Project that runs parallel to the sites is characterised by circalittoral muddy sand (MC52) and circalittoral coarse sediment (MC32), as found within the North East of Farnes Deep HPMA and MCZ. Using QGIS (2025) and a map of the distribution and biomass of ocean quahog within the North East of Farnes Deep MCZ (Hawes *et al.,* 2020 Ref 19.38) it has been calculated that the closest presence of ocean quahog within the MCZ to the EGL 4 Project is 1 km but the areas of greatest abundance of ocean quahog are situated >10 km from the EGL 4 Project (**Volume 3, Part 3, Figure 19-3: Designated Sites, Protected Species and Priority Features within Benthic Study Area**). Ocean quahog does not demonstrate

sensitivity to smothering or increased suspended sediment, thus will not be affected by sediment plumes and deposition within North East of Farnes Deep MCZ and HPMA from construction, operation or decommissioning of the English Offshore Scheme.

19.11.103 Subtidal coarse sediments include coarse sand, gravel, pebbles, shingle and cobbles and muddy sand habitats are comprised of muds, silts, fine sand and coarser sand. Increased suspended sediment can clog the feeding apparatus and gill filaments of suspension feeders, such as bivalves, reducing respiration and feeding (Readman, Lloyd and Watson, 2023, REF 19.42); however, bivalves can burrow into the sediment to avoid periods of increased turbidity. Additionally, mobile fauna present within subtidal coarse sediment, such as crabs, can temporarily relocate during periods of increased turbidity and to avoid smothering from sediment deposition.

19.11.104 Project specific data (**Volume 1, Part 3, Chapter 18: Coastal and Marine Physical Processes**) suggests very coarse sand and gravels will settle back into the trench. Sand particles ranging between very coarse sand and fine sand will settle within 135 m of the trench, with very fine sand travelling up to 700 m before settling. Light smothering of <5 cm is expected within the draft Order Limits. Further than the draft Order Limits and overlapping NEFD MCZ and HPMA deposited fines will settle in thicknesses <2 mm. TSHD activities will not be conducted near North East of Farnes Deep HPMA and MCZ. Thus, the greatest amount of smothering of protected features within the North East of Farnes Deep MCZ is < 2 mm, which is indistinguishable from background levels. The maximum distance from trenching activities where suspended sediment concentrations exceed 10 mg/l is between 2.7 and 6.5 km. The magnitude of temporary increase and deposition of suspended sediments on North East of Farnes Deep MCZ and HPMA is considered to be **negligible.** The significance of effect on North East of Farnes Deep MCZ and HPMA has been assessed as **Minor** and **Not Significant**.

Ocean Quahog

19.11.105 The **sensitivity** of ocean quahog to temporary increase and deposition of suspended sediment is **negligible**. 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, Kleine and Leuchs (2006, REF 19.61) recorded no significant change to population or growth rates of ocean quahog when buried 1.5 m deep in sediment. Additionally, Powilliet *et al.* (2009, REF 19.62) 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.

19.11.106 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** and the significance of effect has been assessed as **Negligible** and **Not Significant**.

Preliminary Assessment of Underwater Noise Changes – All Phases

19.11.107 All works undertaken during the construction, operation and decommissioning of the English Offshore Scheme will generate underwater sound. Sound is readily transmitted in the underwater environment and can be categorised into impulsive sources or continuous sources. Impulsive noises are typically transient, brief (less than one second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI, 1986 and 2005, REF 19.63; NIOSH, 1998 REF 19.64). 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 rapid rise/decay time that impulsive noises do (ANSI, 1995; NIOSH, 1998). This category includes sound sources such as continuous running machinery, sonar, and vessels.

19.11.108 Primary sources of underwater sound from 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 etc) and UXO clearance (noting that UXO clearance will not be a licensable activity under the deemed Marine Licences). Most of the source types generate continuous (non-impulsive) sound, with the exception of UXO clearance.

19.11.109 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 (2011, REF 19.65) that although sensitive to vibration, no evidence has been found to suggest that underwater noise and sound from passing vessels or construction have an effect (Tyler-Walters and Sabatini, 2017, REF 19.34). A further review of MarESA sensitivity assessments for habitats and marine invertebrates identified within the English Offshore Scheme identified that bivalves and polychaetes are considered likely to be able to detect vibrations and probably withdraw 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; considered by MarESA to be the regular passing 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**.

19.11.110 The temporary nature of the noise-generating activities and the lack of long-term acoustic disturbance to the seabed, suggests the magnitude of effects on benthic communities is limited and the **magnitude** of the impact has been assessed as **negligible**.

19.11.111 Although there is currently very limited evidence on the effects of underwater sound on marine invertebrates the current data suggests 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**.

Preliminary Assessment of the Introduction or Spread of Marine Invasive Non-Native Species – All Phases

19.11.112 Project vessels, equipment and external cable protection have 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.

19.11.113 The American slipper limpet 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' (Tillin and Watson, 2023, REF 19.50). At high densities, the species physically smothers the sediment surface, and the resultant build-up of silt and faeces is deposited within 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.

19.11.114 The carpet sea squirt (*Didemnum vexillum)* is native to Japan but present in UK waters (Gibson-Hall and Bilewitch, 2018, REF 19.66). 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 (Valentine *et al*., 2007, REF 19.67).

19.11.115 The following section has been sub-divided to consider each receptor, providing a preliminary assessment that provides justification for the assigned receptor values/sensitivities. Due to the vessel regulations and mitigation plans that will be followed during construction, operation and decommissioning of the English Offshore Scheme, the magnitude of effect on each receptor is the same. To avoid repetition of the same information, the magnitude and significance of the effect on each receptor has thus been reported under a separate subheading, after the description of receptor sensitivities. A summary of the preliminary assessment conclusions is provided in **Table 19-25** for ease of reference.

Table 19-25 - Summary of Preliminary Assessment Conclusions for MINNS

Receptor	Receptor Sensitivity/Value	Magnitude	Significance of effect
Atlantic circalittoral coarse sediment Faunal communities in full salinity Atlantic infralittoral coarse sediment Subtidal sands and gravels	High	Negligible	Minor
Atlantic circalittoral mixed sediment Faunal communities on full salinity Atlantic infralittoral mixed sediment Atlantic circalittoral sand	Medium	Negligible	Minor

Receptor	Receptor Sensitivity/Value	Magnitude	Significance of effect
Faunal communities in Atlantic offshore circalittoral sand			
Atlantic circalittoral rock	Negligible	Negligible	Negligible
Atlantic circalittoral soft rock			
Atlantic offshore circalittoral mud			
Faunal communities of Atlantic circalittoral mud			
Annex I stony and rocky reefs			
Ocean quahog			

Subtidal Broadscale Habitats and Subtidal sands and gravels

19.11.116 **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. The average particle size distribution across English Offshore Scheme was 87.9 % ± 11.4 SD sand at the EGL 4 offshore stations, and sand contributed to be >70 % of the sediment composition at the majority of EGL 3 offshore sites. This shows 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., the shells of *C. fornicata*). Blanchard (2009, REF 19.68) suggested this transition becomes irreversible at 50 % slipper limpet cover and De Montaudouin *et al*. (2018, REF 19.69) 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.

19.11.117 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. The boulders, rocks, gravel present within **Atlantic circalittoral rock** habitats 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. Atlantic circalittoral soft rock habitats are subject to continuous erosion and high turbidity. As a result, this biotope is

unsuitable for invasion by sessile MINNS and invasive algae. Therefore, **sensitivity** value of **negligible** has been assigned to these three receptors.

Annex I Stony and Rocky Reefs

19.11.118 The boulders, rocks, gravel present within Annex I stony and rocky reefs 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 and rocky reefs to MINNS is **negligible**.

Annex I Sabellaria Spinulosa Reefs

19.11.119 Survey data was only available immediately prior to publication of PIER, thus survey information and data are still under review. Impact assessments for Annex 1 *S. spinulosa* reefs will be provided in the ES and discussed with stakeholders and SNCBs.

Ocean Quahog

19.11.120 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 to 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 (Marlin, 2021, REF 19.11), 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

19.11.121 During construction, operation and decommissioning of the English Offshore Scheme, project vessels will follow all relevant guidelines (GB Non-native Species Secretariat, 2015, REF 19.70). This includes using 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 use (see **Section 19.6**) . 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.

19.11.122 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 adversely impacted the distribution of the described broadscale habitats within the study area and, if introduced through the English Offshore Scheme, will have little effect on the wider distribution of these described habitats in

the North Sea. 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.**

19.11.123 The preliminary assessment concluded that the significance of the effect of MINNS on each described receptor is as follows:

- Atlantic circalittoral coarse sediment, Atlantic circalittoral mixed sediment, Atlantic circalittoral sand, Subtidal sands and gravels: **Minor and Not Significant**
- Atlantic circalittoral rock, Atlantic offshore circalittoral mud, Annex I stony and rocky reefs, ocean quahog: **Negligible and Not Significant**

Preliminary Assessment of Electromagnetic Changes – Operation

19.11.124 During the operation of an HVDC cable electromagnetic fields are generated. 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 1.4.A: Electromagnetic Field (EMF) Study.** They show that for bundled HVDC poles the magnetic field dissipates to below background geomagnetic levels within 20 m when cables are buried at 1 m below the seabed. The magnetic field directly above the cables at the seabed is 123.8µT (or 76.4 µT without the earth's magnetic field).

19.11.125 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.* (2020, REF 19.71) reported 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 **negligible**.

19.11.126 Where possible, the marine cables used within the English Offshore Scheme will be buried at depths of <2.25 m. Given the background geomagnetic field of around 49 µT, the background induced electric field could range between 5.0 and 65.0 µV/m in tidal velocities ranging between 0.1 m/s and 1.35 m/s (**Volume 2, Part 1, Appendix 1.4.A: Electromagnetic Field (EMF) Study**). 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*. (2020, REF 19.71). Thus, the **magnitude** of the effect is **negligible**. The significance of effect the effect has been assessed as **Negligible** and **Not Significant**.

Preliminary Assessment of Temperature Increase - Operation

19.11.127 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 2 °C change between seabed surface and 0.2 m depth is used as a guideline in Germany (Federal Maritime and Hydrographic Agency, 2020, REF 19.72). The benchmark for sensitivity used by MarESA is a 5 °C increase in temperature for one month, or 2 °C for one year.

19.11.128 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.

19.11.129 An increase in temperature may affect spawning and recruitment levels in ocean quahog. Distribution of the species appears to be restricted by water temperature, with 16 °C being the upper threshold, with larvae tending to grow optimally between 13 °C and 15 °C. MarESA suggested a **sensitivity** of **medium** to temperature increases for the species (Tyler-Walters & Sabatini, 2017, REF 19.34). 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 ocean quahog has been used in the overall preliminary assessment.

19.11.130 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 directly buried in a bundle to differing depths and contained within a duct at the Anderby Creek Landfall at various depths. The calculations are presented in **Volume 2, Part 1, Appendix 1.4.B: EGL 3 Heat Calculations** and **Volume 2, Part 1, Appendix 1.4.C: EGL 4 Heat Calculations**. They show that for cables operating at full power, the temperature is raised in the immediate vicinity of the cable but reduces with distance. Assuming an ambient seabed temperature of 12 °C, seabed temperatures at 0.2 m immediately above the cables are estimated to be 13 - 14 °C, with the cables operating at maximum operating temperatures. The actual system is unlikely to reach these temperatures as the system 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 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 surface laid with external cable protection, there is the potential for fauna to be exposed to higher temperature gradients. However, there is negligible capacity to heat the overlying water, meaning there will be no effects on epibenthic communities.

19.11.131 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. Coupled with the fact that temperature changes will be isolated to immediately above the cables, the **magnitude** of the impact on benthic ecology has been assessed as **low**.

19.11.132 The significance of the effect on subtidal habitats, species and ocean quahog has been assessed as **Minor** and **Not Significant**.

19.12 Transboundary Effects

19.12.1 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. As outlined in the Planning Inspectorate's Advice Note Twelve the screening process for transboundary effects will be carried out by the Planning Inspectorate. Information to inform this screening assessment will be provided as part of the application for the DCO. No transboundary impacts are predicted for intertidal and subtidal benthic ecology.

19.13 Further Work to be Undertaken

19.13.1 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

19.13.2 An extensive programme of marine characterisation surveys has been undertaken for the English Offshore Scheme as outlined in **Section 19.4.9**. Survey reports were being issued by the survey contractor as the Preliminary Environmental Assessment was nearing completion. Whilst efforts have been made to include initial survey findings, further work will be undertaken for the ES to ensure all survey results and analyses are incorporated and cross referenced. It is expected that for the final ES the following would be provided:

- The EGL 3 Project macrofauna baseline.
- Consideration of the EGL 4 Project eDNA survey results.
- Photographs of identified habitats.
- Site specific habitat maps for the English Offshore Scheme.
- Details of failed sampling stations and camera transects.

19.13.3 Data 'walk throughs' with technical stakeholders have been proposed to enable statutory consultees the opportunity to gain a detailed understanding of the data sets prior to ES submission.

19.13.4 With respect to the temporary quay, if the option is taken forward, further information would be gathered in respect to the habitats within this area. Assessment would be included in **Volume 1, Part 2, Chapter 6: Biodiversity** of the ES**.**

Assessment

19.13.5 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, so changes to Not Significant assessments are not expected. It is expected that for the final ES the following would be assessed:

- Refinement of the assessment of permanent habitat loss on Atlantic circalittoral soft rock, including environmental measures if needed
- Assessment of the effect of temporary habitat loss/seabed disturbance, permanent habitat loss, temporary increase and deposition of suspended sediment and MINNS on Annex I *Sabellaria spinulosa* reefs

19.14 Further Environmental Measures

19.14.1 If it is identified that additional environmental measures are required, these will be discussed and agreed with technical stakeholders and detailed as part of the ES.

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