Preliminary Environmental Information Report Volume 1

Chapter 19 Intertidal and Subtidal Benthic Ecology

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LIONLINK

Contents

Glossary of Project Terminology

This Glossary has been provided to define terms used across a number of the LionLink Proposed Scheme documents.

Term	Definition
Applicant, the	National Grid Lion Link Limited (NGLLL)
Co-ordination	The process of people or entities working together.
Co-location	Where different elements of a project, or various projects, are located in one place.
Development Consent Order (DCO)	An order made by the Secretary of State pursuant to the Planning Act 2008 (as amended) granting development consent for a Nationally Significant Infrastructure Project. It grants consent to develop the approved project and may include (among other things) powers to compulsorily acquire land and rights where required and deemed marine licences for any offshore works.
Draft Order Limits	The area of land identified as being subject to the DCO application. The Draft Order Limits are made up of the land required both temporarily and permanently to allow for the construction, operation and maintenance, and decommissioning of the Proposed Scheme. All onshore parts of the Proposed Onshore Scheme are located within England and offshore parts of the Proposed Offshore Scheme are located within English territorial waters to 12 Nautical Miles and then up to the United Kingdom (UK) Exclusive Economic Zone (EEZ) boundary at sea.
Dutch Offshore Components	Is the term used when referring to the offshore elements of the Project within Dutch waters.
Environmental Impact Assessment (EIA)	The EIA is a systematic regulatory process that assesses the potential likely significant effects of a proposed project or development on the environment.
EIA Scoping Report	An EIA scoping report defines the proposed scope and methodology of the EIA process for a particular project or development. The EIA Scoping Report for the Proposed Scheme was submitted to the Planning Inspectorate with a request for the Secretary of State to adopt a scoping opinion in relation to the Proposed Scheme on 6 March 2024.
Environmental Statement (ES)	The ES is a document that sets out the likely significant effects of the project on the environment. The ES is the main output from the EIA process. The ES is published as part of the DCO application.
Exclusive Economic Zone (EEZ)	The zone in which the coastal state exercises the rights under Part V of the United Nations Convention on the Law

Term	Definition
	of the Sea. These rights relate principally to the water column and may extend to 200 nautical miles from baselines. This is distinct from territorial waters, which for the UK extend 12 nautical miles from the coast.
Landfall	The proposed Landfall is where the proposed offshore HVDC Submarine Cables are brought ashore and meets with the onshore proposed Underground HVDC Cables. This includes the Transition Joint Bay (TJB). The proposed Landfall will be located at Walberswick, and there will be no permanent above ground infrastructure at the proposed Landfall.
Landfall Site	The area where the Landfall may be located.
Multi-purpose interconnector (MPI)	A project where GB interconnection is combined with transmission of offshore generation within GB (and optionally within a connecting state).
National Grid Lion Link Limited (NGLLL)	The Applicant, a joint venture between National Grid Ventures and TenneT. NGLLL is a business within the wider National Grid Ventures portfolio.
National Grid Ventures (NGV)	Operates and invests in energy projects, technologies and partnerships to accelerate the development of a clean energy future. This includes interconnectors (such as the LionLink Project), allowing trade between energy markets and the efficient use of renewable energy resources.
Nationally Significant Infrastructure Projects (NSIP)	Major infrastructure developments in England and Wales for which development consent is required, as defined within Section 14 of the Planning Act 2008 (as amended). This includes any development which is subject to a direction by the relevant Secretary of State pursuant to Section 35 of the Planning Act 2008.
Offshore Hybrid Asset (OHA)	A project that combines cross-border interconnection with the transmission of offshore generation, this is an overarching term which covers both multi-purpose interconnectors (MPI) and non-standard interconnectors (NSI).
Order Limits	The maximum extent of land within which the Proposed Scheme may take place, as consented.
Outline Offshore Construction Environmental Management Plan (Outline Offshore CEMP)	Describes the control measures and standards proposed to be implemented to provide a consistent approach to the environmental management of the construction activities of the Proposed Offshore Scheme.
Outline Onshore Code of Construction Practice (Outline Onshore CoCP)	Describes the control measures and standards proposed to be implemented to provide a consistent approach to the environmental management of the construction activities of the Proposed Onshore Scheme.
Planning Act 2008	The Planning Act 2008 being the relevant primary legislation for national infrastructure planning.
Planning Inspectorate (PINS)	The Planning inspectorate review DCO applications and make a recommendation to the Secretary of State, who will then decide whether to approve the DCO.

Term	Definition
Preliminary Environmental Information Report (PEIR)	The PEIR is a document, compiled by the Applicant, which presents preliminary environmental information, as part of the statutory consultation process. This is defined by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 as containing information which "is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development (and of any associated development)" (Section 12 2. (b)). This PEIR describes the Proposed Scheme, sets out preliminary findings of the EIA undertaken to date, and the mitigation measures proposed to reduce effects. The PEIR is published at Statutory Consultation stage for information and feedback.
Project (the)	The LionLink Project (hereafter referred to as the 'Project') is a proposal by National Grid Lion Link Limited (NGLLL) and TenneT. The Project is a proposed electricity link between Great Britain (GB) and the Netherlands with a capacity of up to 2.0 gigawatts (GW) of electricity and will connect to Dutch offshore wind via an offshore platform in Dutch waters. The Project is the collective term used to refer to the proposal for all aspects (onshore and offshore) of the proposed interconnector between GB and the Netherlands.
Proposed Offshore Scheme	The term used when referring to the offshore elements of the Proposed Scheme, seaward of the mean high-water springs to the EEZ boundary at sea.
Proposed Scheme	Used when referring to the GB scheme components of the Project, not including Dutch components. This includes both the onshore and offshore scheme components which are within UK territorial waters and up to the UK EEZ boundary at sea.
Scoping Opinion	A scoping opinion is requested from the Planning Inspectorate on behalf of the Secretary of State, to inform the requirements of EIA process and ultimately the ES which will be submitted as part of the application for development consent. Through the scoping process, the views of the statutory consultees and other relevant organisations on the proposed scope of the EIA are sought. A Scoping Opinion for the Proposed Scheme was issued by the Planning Inspectorate (on behalf of the Secretary of State) on 16 April 2024. The Applicant received a separate EIA Scoping Opinion from the Marine Management Organisation (MMO) (Reference DCO/2024/00005, dated 04 September 2024) as the MMO were unable to provide opinion to the Planning Inspectorate in time for the April 2024 deadline.
Scottish Power Renewables (SPR) East Anglia One North (EA1N) and East Anglia 2	The Orders made following the Scottish Power Renewables applications for development consent for the following projects:

Term	Definition
(EA2) Consents (SPR EA1N and EA2 Consents)	The East Anglia ONE North Offshore Wind Farm Order 2022; and East Anglia TWO Offshore Wind Farm Order 2022
Statutory Consultation	Consultation undertaken with the community and stakeholders in advance of the application for development consent being submitted to the Planning Inspectorate, on behalf of the Secretary of state, in accordance with the PA 2008.
TenneT	Operator of the electricity transmission network across the Netherlands.
Transition Joint Bay (TJB)	An underground structure at the Landfall Site that house the joints between the offshore cables and the onshore cables.

Terms and abbreviations specific to this technical chapter contained herein are provided at the end of the document in the **Topic Glossary and Abbreviations.**

19 INTERTIDAL AND SUBTIDAL BENTHIC ECOLOGY

19.1 Introduction

19.1.1 This chapter provides a preliminary assessment of the potential likely significant effects in relation to the intertidal and subtidal benthic ecology from the construction, operation and maintenance, and decommissioning of LionLink (hereafter referred to as 'the Proposed Scheme').

19.1.2 This chapter outlines legislation, policy and guidance that is relevant to intertidal and subtidal benthic ecology, summarises the engagement undertaken to date, sets out the scope and methodology of assessment, and describes the baseline environment. Following this, the likely significant effects of the Proposed Offshore Scheme on intertidal and subtidal benthic ecology are assessed taking account of mitigation measures within the design. The need for any additional mitigation is then considered along with any proposals for monitoring and/or enhancement. The chapter concludes with a summary of residual effects.

19.1.3 Intertidal and subtidal benthic ecology aspects considered within this chapter for the Proposed Offshore Scheme are:

a. current baseline conditions;
b. designated sites;
c. protected species; and
d. future baseline conditions.

19.1.4 This chapter should be read in conjunction with **Chapter 2 Description of the Proposed Scheme** of this Preliminary Environmental Information Report (PEIR), which describes the development parameters against which the effects considered in this chapter have been assessed, and **Chapter 5 EIA Approach and Methodology** of this PEIR where the project-wide approach to the assessment methodology is set out.

19.1.5 In addition, there may be interrelationships related to the potential effects on intertidal and subtidal benthic ecology and other disciplines. Therefore, this chapter should be read alongside relevant parts of other chapters; namely:

a. **Chapter 8 Ecology and Biodiversity** of this PEIR - due to the intertidal area which is also covered within the Proposed Onshore Scheme;
b. **Chapter 18 Marine Physical Environment** of this PEIR - due to sediment dispersion potentially affecting sensitive benthic habitats and species; and
c. **Chapter 20 Fish and Shellfish** of this PEIR - due to the overlap with demersal fish species and shellfish with benthic ecology receptors and the potential for fish and shellfish to be affected by the Proposed Offshore Scheme.

19.1.6 This chapter is supported by the following appendices and figures, contained within Volume 2 and Volume 3 of this PEIR, respectively:

a. **Appendix 2.2 Outline Offshore Construction Environmental Management Plan** of this PEIR;
b. **Appendix 2.2 Outline Schedule of Environmental Commitments and Measures** of this PEIR;
c. **Appendix 2.3 Electromagnetic Field Assessment** of this PEIR;
d. **Appendix 2.4 Offshore Thermal Emissions Technical Note** of this PEIR;
e. **Appendix 2.5 Outline Cable Burial Risk Assessment** of this PEIR;
f. **Appendix 4.1 Legislation and Policy Register** of this PEIR;
g. **Appendix 4.2 Marine Plan Assessment** of this PEIR;
h. **Appendix 5.1 Transboundary Screening** of this PEIR;
i. **Appendix 19.1 Benthic Survey Report** of this PEIR; and
j. **Figure 19.1** to **Figure 19.4** of this PEIR.

19.1.7 As set out in **Chapter 4 Policy & Legislation** of this PEIR, 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 Proposed Offshore Scheme from mean high-water spring (MHWS) at the proposed Landfall Site to the boundary between the United Kingdom (UK) and Netherlands Exclusive Economic Zone (EEZ) including all exempt elements which would not be consented as part of the Development Consent Order (DCO). This is to provide a complete and holistic view of the Proposed Offshore Scheme and any associated impacts. Beyond 12NM, only cable protection and dredging for sandwave levelling will be included in the Deemed Marine Licence (DML).

19.1.8 Kilometre points (KP) have been used as a frame of reference to discuss sections of the proposed Offshore High Voltage Direct Current (HVDC) Cable Corridor. Kilometre points begin at KP0 at the MHWS of the proposed Landfall and extend to KP182 where the Proposed Offshore Scheme reaches the limits of the UK EEZ border. The 12NM boundary falls between KP31 and KP32. Kilometre points set against the identified broadscale habitat features along the route are presented in **Figure 19.4**.

19.2 Legislation and policy framework

19.2.1 This section identifies the legislation, policy and guidance that has informed the assessment of the likely significant effects on intertidal and subtidal benthic ecology.

19.2.2 The legislation and planning policy which has informed the assessment of effects with respect to intertidal and subtidal benthic ecology is provided within **Appendix 4.1 Legislation and Policy Register** of this PEIR. A preliminary marine plan assessment is provided as **Appendix 4.2 Marine Plan Assessment** of this PEIR.

19.2.3 **Table 19.1** lists the legislation relevant to the assessment of the likely significant effects on intertidal and subtidal benthic ecology.

Table19.1: List of relevant legislation for intertidal and subtidal benthic ecology assessment

Legislation	Relevance to assessment
National Legislation	
The Planning Act 2008 (Ref 1)	An Act to establish the Infrastructure Planning Commission and make provision about its functions; to make provision about, and about matters ancillary to, the authorisation of projects for the development of nationally significant infrastructure.
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (Ref 2)	This Act transposes EU Directive 2011/92/EU (the EIA Directive) into UK law for nationally significant infrastructure projects, ensuring environmental safeguards while potentially streamlining the process.
The Marine and Coastal Access Act 2009 (Ref 3)	The Marine and Coastal Access Act is the legal mechanism to create a more sustainable and integrated approach to the UKs Marine and Coastal Resources. It does this through enforcing a framework for marine spatial planning, through the establishment of a licencing system for certain offshore activities and promotes the conservation of marine biodiversity through the designation of protected sites.
Marine Works (Environmental Impact Assessment) Regulations 2007 (Ref 4)	The Marine Works (Environmental Impact Assessment) Regulations 2007 require certain types of projects that have the potential to significantly affect the environment to submit an Environmental Impact Assessment before a marine licence decision is made.
The Conservation of Habitats and Species Regulations 2017 (Ref 5)	The Conservation of Habitats and Species Regulations 2017 (Ref 5) transposes the Habitats Directive (92/43/EEC) (Ref 8) into UK legislation. These Regulations, along with The Wildlife and Countryside Act are collectively referred to as the Habitats Regulations. The Conservation of Habitats and Species Regulations apply out to 12NM from the coastline; the Conservation of Offshore Marine Habitats and Species Regulations apply from 12NM to the boundary of the UK EEZ. The Habitats Regulations provide a framework for the protection of European Sites, which include Special Areas of Conservation (SACs), designated to protect sensitive benthic habitats and species. Under the Regulations, Applicants must demonstrate that a proposed development will not adversely affect the integrity of a European site either alone or in combination with other plans or projects. This is done through the Habitats Regulations Assessment (HRA) process. The proves requires 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect an SAC, to seek advice from Natural England (NE) and/or the Joint Nature Conservation Committee (JNCC), and to not approve an
The Conservation of Offshore Marine Habitats and Species Regulations 2017 (Ref 6)	

Legislation	Relevance to assessment
	application that would have an adverse effect on the integrity of an SAC.
Wildlife and Countryside Act 1981 (Ref 7)	Wildlife and Countryside Act 1981 includes provisions relating to nature conservation, including marine habitats and species within 12NM of the UK coastline.
The Marine Strategy Regulations 2010 (Ref 9)	The Marine Strategy Regulations 2010 retains the Marine Strategy Framework Directive (2008/56/EC)(Ref 10) into UK legislation from the European Union. It requires signatories to take measures to achieve or maintain Good Environmental Status.
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (Ref 11)	The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 'WFD') retains the EU Water Framework Directive (2000/60/EC) (Ref 12) into UK legislation from the European Union. The regulations are aimed at improving and protecting the quality of water resources. The WFD protects surface waters including rivers, lakes, transitional waters (referred to in this advice as estuarine waters), coastal waters and groundwater. These waters directly influence sensitive benthic habitats and species where they occur within coastal waters.
Natural Environment and Rural Communities Act 2006 (Ref 13)	The Act requires competent authorities to have due regard for protecting and enhancing species and habitats when making public decisions. In particular, Section 41 refers to a published list of habitats and species which are of principal importance for the conservation of biodiversity in England. There are eleven sensitive subtidal habitats listed under this act; five of which are found within the wider region the Proposed Offshore Scheme occurs within and could potentially be encountered.
Environment Act 2021 (Ref 14)	The Environment Act 2021 sets clear statutory targets for the recovery of the natural world in four priority areas: air quality, biodiversity, water and waste.
International Legislation	
Convention for the Protection of the Marine Environment of the North East Atlantic (the 'OSPAR' convention) adopted in 1992 (Ref 15)	The OSPAR convention provides a binding framework of environmental protection and sustainable development management to ensure offshore development is conducted in an environmental responsible manner.

National policy

19.2.4 The primary policy basis for deciding whether to grant a Development Consent Order (DCO) for the Proposed Scheme are the National Policy Statements (NPSs), and of primary relevance the overarching NPS for Energy (NPS EN-1) (Ref 16), the NPS for Renewable Energy Infrastructure (NPS EN-3) (Ref 17) and

the UK Marine Policy Statement (Ref 18). These set out policies to guide how applications for development consent for energy infrastructure should be decided and how the effects of such infrastructure are considered.

19.2.5 **Table 19.2** lists the paragraphs from the NPS and other national policies which are relevant to the intertidal and subtidal benthic ecology assessment. It also sets out where these policy requirements are addressed within the chapter.

Table19.2: List of relevant national policy for intertidal and subtidal benthic ecology assessment

Relevant paragraph reference	Summary of policy requirement	Where addressed in PEIR
NPS EN-1		
5.4.17	"Where the development is subject to EIA, the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats."	Details of designated sites, protected species and habitats potentially affected by the works are presented within **Section 19.6.**
5.4.19	"... The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests."	Details of opportunities are included within **Section 19.7** Embedded design mitigation and control measures**.**
5.4.35	"Applicants should include appropriate avoidance, mitigation, compensation and enhancement measures as an integral part of the proposed development...."	Detains of how the Proposed Offshore Scheme has complied with the mitigation hierarchy are presented in **Section 19.7**.
NPS EN-3		
2.8.105	"In developing proposals applicants must refer to the most recent best practice advice originally provided by Natural England under the Offshore Wind Enabling Action Programme."	The Applicant has considered best practice advice within this assessment. Details of guidance considered is presented within **Section 19.4.**
2.8.106	"Any relevant data that has been collected as part of post-construction ecological monitoring from existing operational offshore wind farms should be referred to where appropriate"	The Applicant has considered data collected by relevant offshore developments within the study area. Details of

Relevant paragraph reference	Summary of policy requirement	Where addressed in PEIR
		baseline evidence is presented in **Section 19.6**.
2.8.104	"Applicants should consult at an early stage of pre-application with relevant statutory consultees, as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options should be undertaken**."**	Details of consultations are presented in **Section 19.3.**
2.8.126	Whilst these paragraphs focus on the assessments that offshore wind development should undertake to evaluate the effects on subtidal habitats, certain elements are applicable to the Proposed Offshore Scheme such: • potential loss of habitat due to seabed clearance, cable protection; • habitat disturbance during cable installation, maintenance/repairs and removal (decommissioning); • increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs; • predicted rates at which the intertidal/subtidal zone might recover from temporary effects, based on existing monitoring data; • potential impacts from EMF on benthic fauna; and • protected sites.	**Section 19.8** provides a preliminary environmental assessment, which includes an evaluation of the potential impacts of the Proposed Offshore Scheme on the intertidal and subtidal environment.
National Planning Policy Framework (2024) (Ref 19)		
Paragraph 188	"Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework; take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries"	The Proposed Offshore Scheme has sought to avoid designated sites with benthic components through its routeing choices. Where indirect impacts remain these are assessed in **Sections 19.6** and **19.8.**
Paragraph 192	"To protect and enhance biodiversity and geodiversity, plans should: a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for	Details of identified sites, priority habitats and species likely impacted by the Proposed Offshore Scheme are presented and assessed within **Sections 19.6** and **19.8**.

Relevant paragraph reference	Summary of policy requirement	Where addressed in PEIR
	biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity."	
Paragraph 194	"The following should be given the same protection as habitats sites: a) potential Special Protection Areas and possible Special Areas of Conservation; b) listed or proposed Ramsar sites; and c) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites."	No potential Special Protection Areas (SPAs), possible Special Areas of Conservation or proposed Ramsar sites were identified within the study area. The Minsmere to Walberswick Ramsar partially overlaps with the study area and has therefore been considered within this assessment. There is current ongoing work to establish possible site extensions as part of strategic compensation measures for various offshore wind projects, to the Applicant's knowledge none of these areas fall within the study area.
UK Marine Policy Statement		
General	The UK Marine Policy Statement (MPS) was adopted in 2011 and provides a policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made.	The Applicant acknowledges this policy, and it is addressed in **Section 19.7** and **Section 19.8.**

19.2.6 The local policies listed in **Table 19.3** are considered relevant to the intertidal and subtidal benthic ecology assessment of the Proposed Offshore Scheme.

Table 19.3: List of relevant local policy for intertidal and subtidal benthic ecology assessment

Local planning authority	Relevant local policy	Relevance to assessment
Marine Management Organisation (MMO)	East Inshore and East Offshore Marine Plans (Ref 20)	Marine plans set out the priorities and direction for future planning within the plan area and provide guidance on activities to avoid or promote. **Appendix 4.2 Marine Plan Assessment** of this PEIR outlines how the Proposed Offshore Scheme complies with the policies and objectives for the East Inshore and East Offshore Marine Plan area. Of relevance to this assessment are Policy BIO1 which requires Applicants to consider the need to protect biodiversity as a whole. The preliminary assessment of effects is presented in **Section 19.8** and embedded design mitigation and control measures are presented in **Section 19.7** of this chapter.
Suffolk County Council and East Suffolk Council	The intertidal area of the Proposed Scheme lies within the jurisdiction of Suffolk County Council, East Suffolk Council and the Suffolk Coastal Local Plan (Ref 21).	As the landfall would be achieved using a trenchless technique, there are no activities occurring at the surface within in the intertidal area.

19.3 Consultation and engagement

19.3.1 This section describes the outcome of, and response to EIA Scoping Report (Ref 22) and the EIA Scoping Opinion (Ref 23) in relation to the marine physical environment assessment.

19.3.2 It also provides details of the ongoing technical engagement that has been undertaken with key stakeholders and provides a brief overview of the non-statutory public consultation undertaken to date.

19.3.3 Feedback from engagement and consultation are used to define the assessment approach and to ensure that appropriate baseline information is used.

19.3.4 It should be noted that feedback is also used to drive the design of the Proposed Scheme to avoid, prevent and reduce any likely environmental effects. **Chapter 3 Alternatives and Design Evolution** of this PEIR reports how the Proposed Scheme design has evolved in response to feedback and details of proposed embedded design (Primary) mitigation and standard good practice (Tertiary) mitigation measures relevant to the intertidal and subtidal benthic ecology assessment are provided in **Section 19.7** of this chapter.

Consultation

Non-Statutory consultation

19.3.5 Feedback received from stakeholders following the close of our 2022 and 2023 consultation is outlined within the **Interim Non-Statutory Consultation Feedback Summary Report 2023** (Ref 24) and **Supplementary Non-Statutory Consultation Summary Report 2024** (Ref 25).

Table 19.4: Key non statutory feedback for intertidal and subtidal benthic ecology assessment

Non-Statutory Feedback	Feedback	How this is addressed
Supplementary Non-Statutory Consultation Summary Report. 03. Local Ecology and Biodiversity.	Although most respondents continue to support increasing our supply of renewable energy, it was considered by some that the expected environmental impact of LionLink would be too great, and that renewable energy projects should not be constructed at the expense of damaging sites with environmental protections. Concerns were also expressed around coastal and marine environments, including increased erosion and flooding risks. In Walberswick, concerns were raised about the potential threat to over 100 bird species, especially the Marsh Harriers, and the impact on reedbed habitat. The G2 landfall site, with over 63 bird species spotted in 2023, also raised environmental apprehensions.	As part of the route selection process, designated sites with Benthic features have been avoided. For mor information please see **Chapter 3 Alternatives and Design Evolution** of this PEIR

EIA Scoping Opinion

19.3.6 An EIA Scoping Opinion was adopted by the Planning Inspectorate on behalf of the Secretary of State on 16 April 2024 (Ref 23)

19.3.7 The Applicant received a separate EIA Scoping Opinion from the Marine Management Organisation (MMO) (Ref 26) as the MMO was unable to provide its opinion to the Planning Inspectorate in time for the April 2024 deadline. MMO deferred to Natural England's comments received by the Planning Inspectorate with respect to the suitability of the assessment with regards to Marine Protected Areas.

19.3.8 Comments received from the Planning Inspectorate and MMO in relation to intertidal and subtidal benthic ecology are provided in **Table 19.5**.

Table 19.5: Preliminary response to Planning Inspectorate and MMO Scoping Opinion comments for intertidal and subtidal benthic ecology

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
Planning Inspectorate ID 2.1.13	Paragraphs 2.3.105, 2.4.29 to 2.4.32, and 5.4.17 to 5.4.18. Decommissioning. The Inspectorate considers that a high-level environmental assessment of the decommissioning of the Proposed Development should be provided in the ES.	This is noted, a high-level assessment of decommissioning effects has been provided within **Section 19.8**.
Planning Inspectorate ID 2.2.5	Paragraphs 19.5.3. Offshore Electromagnetic fields (EMF) assessment The EIA Scoping Report states that a full offshore EMF assessment will be undertaken during the detailed design phase. It is unclear whether this would be available to inform the impact assessments for relevant aspects, including intertidal and benthic ecology and fish and shellfish. The Inspectorate advises that there should be sufficient information available to inform the assessment and any design measures proposed as a means of avoiding, minimising or reducing likely significant effects. Any such measures should be described in the ES and demonstrably secured through the DCO.	This is noted; an offshore EMF assessment has been conducted and is included in **Appendix 2.3 Electromagnetic Field Assessment** of this PEIR. The assessment has been informed the preliminary environmental assessment presented in **Section 19.8**.
Planning Inspectorate ID 3.14.1	Paragraph 19.3.29 Indirect impacts to the Orford Inshore Marine Conservation Zone (MCZ). The Inspectorate agrees that indirect impacts to the MCZ can be scoped out of the assessment based on its distance from the study area boundary (being 8.5km at the closest point), which is stated to be beyond the maximum zone of influence (ZoI).	Orford Inshore MCZ is the closest MCZ and is around 25km from the nearest point of the Draft Order Limits so outside the max zone of impact for indirect impacts
Planning Inspectorate ID 3.14.2	Table 19-5 Effects to intertidal and nearshore ***habitats from temporary habitat loss/seabed disturbance during construction and operation.*** Paragraph 2.3.90 of the EIA Scoping Report notes potential for a cofferdam at the HDD exit point, this is not referenced in Table 19-5. The Inspectorate considers that there is insufficient detail about the construction activities that might be needed to facilitate	A cofferdam will not be used by the Proposed Scheme, and it has been removed from **Chapter 2 Description of the Proposed Scheme** of this PEIR. Temporary habitat loss/ seabed disturbance to intertidal habitats during

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
	transition between the onshore and offshore components, and whether these could lead to significant effects from temporary habitat loss or seabed disturbance. In addition, the feasibility of HDD has not yet been demonstrated. The ES should include an assessment of construction phase effects, where significant effects are likely to occur. It is also noted that permanent habitat loss to these habitats is not referenced and thus it is not explained whether such an impact could occur. The ES should include an assessment of permanent loss of intertidal and nearshore habitats during construction and operation, where likely significant effects could occur. On the basis that there would be no requirement for repair to HDD ducts in the intertidal and nearshore area (with any new HDD duct installation being subject to a separate consenting and assessment process), the Inspectorate agrees that significant effects during operation are unlikely if HDD and this matter can be scoped out of the assessment.	construction has been assessed within **Section 19.8.**
Planning Inspectorate ID 3.14.3	Table 19-5 Effects to subtidal - broadscale habitats from temporary habitat loss/seabed disturbance during construction and operation. The Inspectorate notes that there is limited information about the potential cable burial techniques, which are not yet decided, and that short-term could encompass up to seven years (Table 19-7), the Inspectorate does not have confidence that the possibility of likely significant effects can be excluded. This matter should be scoped into the assessment.	Further information on cable lay and burial techniques is presented in **Chapter 2 Description of the Proposed Scheme** of this PEIR**.** Temporary habitat loss/seabed disturbance during operations and maintenance on subtidal broadscale habitats has been assessed within **Section 19.8.**
Planning Inspectorate ID 3.14.4	Table 19-5 Effects to subtidal – Annex I habitats from temporary habitat loss/seabed disturbance during operation. The EIA Scoping Report seeks to scope this matter out on the basis that any remedial works required as part of repair and maintenance would be of lower magnitude than construction works during installation. Noting that there is limited information about how remedial works	Impacts to subtidal Annex I habitats from temporary habitat loss and seabed disturbance during operations and maintenance has been scoped into the assessment within **Section 19.8.** Details of construction and operations and

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
	would be carried out nor the expected frequency, and to what extent these are of reduced magnitude than construction works, and the high importance of the habitat, the Inspectorate advises that this matter should be assessed in the ES.	maintenance activity have been further developed and is presented in **Chapter 2 Description of the Proposed Scheme** of this PEIR**.**
Planning Inspectorate ID 3.14.5	Table 19-5 Effects to subtidal habitats and species from temporary increase and deposition of suspended sediments during construction and operation (excluding pre-sweeping). The Planning Inspectorate noted that the Applicant sought to scope out this matter, for similar reasons as they sought to scope out 'Changes to water quality and seabed substrates from temporary increase in suspended sediments and deposition during construction and operation (excluding pre-sweeping) in ID 13.3.3. The Inspectorate advised that this matter should be scoped into the assessment.	Impacts from temporary increase and deposition of suspended sediments on subtidal habitats has been assessed within **Section 19.8.**
Planning Inspectorate ID 3.14.6	Table 19-5 Effects to subtidal species from changes in underwater noise during construction and operation. The EIA Scoping Report proposes to scope this matter out on the basis that the type and duration of underwater sound that will be generated by the Proposed Offshore Scheme will not have any significant effects on benthic invertebrates or benthic communities. In the absence of confirmed construction details (including activities associated with repair during operation) the Inspectorate considers that this matter should be scoped in for assessment.	Changes in underwater noise during construction and operation and maintenance has been assessed within **Section 19.8.** This has been informed by underwater noise modelling which is presented in **Appendix 22.1 Underwater Noise Modelling Report** of this PEIR.
Planning Inspectorate ID 3.14.7	Table 19-5 Effects to subtidal species from introduction or spread of marine invasive non-native species (MINNS) during construction and operation. The Inspectorate agrees that this matter can be scoped out on the basis that the mitigation measures proposed should be sufficient to address the likely impacts and avoid a likely significant effect. The ES should include details	The introduction of MINNS has been scoped out. The Applicant is committing to provision of a biosecurity plan – see **Section 19.7**

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
	of the mitigation and explain how its delivery is assured with reference to relevant documents.	
Planning Inspectorate ID 3.14.8	Table 19-5 Effects to intertidal and subtidal habitats and species from changes in marine water quality (from accidental spills or increase in suspended sediment) during construction and operation. For accidental spills, including release of drilling fluid, the Inspectorate agrees that this matter can be scoped out on the basis that the control and management measures should be sufficient to address the likely impacts and avoid a likely significant effect. The ES should include details of the mitigation and explain how its delivery is assured with reference to relevant documents. The Inspectorate advises that potential changes in marine water quality arising from increases in suspended sediment concentrations should be assessed noting that this impact pathway is scoped in given the potential for likely significant effects (Table 19-5 of the EIA Scoping Report and ID 3.14.5 of this Scoping Opinion).	Mitigation and control measures for accidental spills, including release of drilling fluid is addressed within **Section 19.7**. Specifically, control measure OCO1 commits the Applicant to providing a Marine Pollution Contingency Plan (MCMP). The effects of changes in marine water quality arising from increases in suspended sediment concentrations have been assessed within **Section 19.8.**
Planning Inspectorate ID 3.14.9	Table 19-5 Effects to subtidal habitats and species from temperature increases during operation. This matter should be scoped into the assessment, or the ES should demonstrate, with evidence of agreement from relevant consultation bodies, an absence of likely significant effects.	Details of the models used to calculate heat impact thresholds are presented in **Appendix 2.4 Offshore Thermal Emissions Technical Note** of this PEIR**.** The effects of localised temperature increase during operation and maintenance have been assessed within **Section 19.8.**
Planning Inspectorate ID 3.14.10	Table 19-5 Transboundary effects from the impact pathways described at ID 3.14.3 to ID 3.14.6. The Inspectorate is not able to agree to scope this matter out until it has undertaken its own transboundary screening. See the	Details of supporting information for transboundary screening are presented in **Appendix 5.1 Transboundary Screening** of this PEIR.

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
	Inspectorate's comments at ID 2.2.2 of this Scoping Opinion.	
Planning Inspectorate ID 3.14.11	Section 19.7 Site specific survey. The EIA Scoping Report proposes site specific surveys including geophysical survey/grab sampling. It is stated that no Phase 1 habitat walkover survey of the intertidal area is proposed as a trenchless installation method is proposed in the intertidal area, and characterisation will be based on the subtidal methodology. The Inspectorate notes that it has not yet been demonstrated that a trenchless installation method is feasible and that there remains uncertainty about whether access to the intertidal area may be required for other activities during construction.	The feasibility of a trenchless installation method and associated access requirements to the intertidal area has been addressed within **Chapter 2 Description of the Proposed Scheme** of this PEIR.
MMO Paragraph 3.1.2	The second paragraph regarding the temporary habitat loss/seabed disturbance impact to subtidal Annex I habitats during construction and operation relates to remedial works being scoped out when the assessment has considered this impact to be scoped in.	This is an error in the scoping assessment. Temporary habitat loss/seabed disturbance impact to subtidal Annex I habitats during construction and operation and maintenance have been assessed within **Section 19.8.**
MMO Paragraph 3.1.3	The MMO regards it as prudent to scope in the temporary increase and deposition of suspended sediment to subtidal habitats and species at this stage of the EIA. The significance of this potential impact will ultimately depend on the exact nature of habitats and species and thus should be assessed following the acquisition and interpretation of the characterisation data.	Temporary increase and deposition of suspended sediment to subtidal habitats and species have been assessed within **Section 19.8.**
MMO Paragraph 3.1.4	In statement 19.7.2 of the EIA Scoping Report regarding the broad plan for the characterisation survey, while it is acknowledged that ground truth sample location will depend on the preliminary interpretation of the geophysical data, with which the MMO endorse, it is also stated that they are likely to be located approximately every 5km along the proposed route. The MMO	The Applicant notes the MMO position on establishing a sample distance prior to acquiring geophysical survey data. Indicative sampling distance were provided as a guide to present stakeholders with an overview of survey

Scoping Opinion ID	Scoping Opinion Comment	How this is addressed
	advises that you should refrain from any a prior prediction of numbers of location of sampling stations and consider these to be exclusively dependent on the geophysical data (as these might require a very different sample number and a very non-linear strategic design to that currently proposed).	activity prior to finalisation of the survey scope. As noted within the scoping assessment, final sample locations were refined on review of geophysical data to ensure identified habitats were sufficiently characterised in line with existing guidance. Survey strategy was agreed with relevant stakeholders prior to survey operations and maintenance. See for details of stakeholder consultation.

Engagement

19.3.9 This paragraph provides details of the ongoing technical engagement that has been undertaken with stakeholders in relation to intertidal and subtidal benthic ecology and is outlined below.

Key stakeholders

19.3.10 Key stakeholders with views and concerns regarding intertidal and subtidal benthic ecology have been identified as including:

a. NE;
b. JNCC;
c. MMO;
d. Centre for Environment, Fisheries and Aquaculture Science (Cefas);
e. Suffolk Wildlife Trust; and
f. East Suffolk Council.

Table 19.6: Key stakeholder feedback for intertidal and subtidal benthic ecology assessment

Stakeholder	Comment	Applicant response
NE	Concerns over the timing of the characterisation survey in September due to potential reduced visibility for ground truthing potential Annex I reef features	The Applicant noted NE's concern with the proposed survey timing. However, the Applicant believe that they have been able to evidence Annex I reef features within the Draft Order Limits to sufficiently characterise their presence along the route. The proposed mitigation

Stakeholder	Comment	Applicant response
		(micro-siting cable installation to avoid features) would be informed by a pre-construction survey post consent. Identification of Annex I reef in the pre-construction survey would be informed by the results of the 2024 benthic characterisation survey.
JNCC	Email dated 27 March 2024 confirming that outstanding comments with the survey scope had been addressed.	No further comment
Suffolk Wildlife Trust	Energy cables and infrastructure in the marine environment, placed in the wrong location, can cause habitat damage and loss. Several Marine Protected Areas (MPAs) are in unfavourable condition due to the impact of cabling infrastructure.	The route has been selected to avoid as many designated sites, features and species as possible. Where it has not been possible to avoid a feature, an assessment of potential impacts is presented in **Section 19.8.**
Suffolk Wildlife Trust	Suffolk Wildlife Trust (SWT) was approached for input on suitable nature recovery projects to which the Proposed Scheme could contribute as enhancement measures. SWT responded that most recovery efforts focus on estuarine and coastal habitats and raised concerns about whether cable protection enhancements would provide habitat compatible with those in the southern North Sea. SWT agreed to review and identify any relevant nature recovery projects that could align with the Proposed Scheme.	The Applicant notes the SWT position on enhancement of cable protection and would consider any suitable nature recovery projects that are raised for the purposes of enhancement.
NE	Offshore geophysical surveys identified large sandwave and seabed ridge features further offshore between KP106 and KP178 where they project reaches the UK EEZ. Natural England noted preference for alternative route.	The Draft Order Limits have been selected to avoid as many protected sites, features and species as possible. Where it has not been possible to avoid a feature, an assessment of potential impacts is presented in **Section 19.8.**
NE	Biogenic reef to be ground- truthed through environmental survey. Concerns raised over the timing of survey (early September preferred) as late season surveys may yield poor visibility for camera transects.	These comments were noted. The offshore sections of the marine characterisation survey were conducted as planned in September. This did not limit the survey's ability to identify and classify potential biogenic reef features on the seabed and is in line with guidance on Sabellaria reef monitoring from Natural Resources Wales (Ref 98) which states surveys should be conducted late

Stakeholder	Comment	Applicant response
		summer or early autumn. assessing For example ground truth images please see **Section 3.7** of **Appendix 19.1 Benthic Characterisation Report** of this PEIR.
East Suffolk Council	The consultation documents do not appear to consider the potential for impacts on UK Priority habitats (under Section 41 of the NERC Act); protected species or UK Priority species, again these must be considered as part of the assessment of potential options for this development.	UK priority habitats and species have been included with the impact assessment. An assessment of impact is presented in **Section 19.8.**

19.4 Assessment methodology

19.4.1 This section outlines the methodology followed to assess the potential likely significant effects of the Proposed Offshore Scheme in relation to intertidal and subtidal benthic ecology including:

a. effects scoped into the assessment;
b. study area;
c. assessment scenarios;
d. methodology;
e. assessment criteria; and
f. assessment of cumulative effects.

19.4.2 This section is a description of how receptor sensitivity, magnitude of impact and significance of effects are all described and assigned to the assessment.

19.4.3 The project-wide approach to the assessment methodology is set out in **Chapter 5 EIA Approach and Methodology** of this PEIR.

Scope of the assessment

19.4.4 Potential likely significant effects requiring assessment may be temporary or permanent and may occur during construction, operation and maintenance, and decommissioning. Potential likely significant effects on intertidal and subtidal benthic ecology receptors within the scope of the assessment are summarised in **Table 19.8.** The scope of the assessment has responded to feedback received as detailed in **Section 19.3.**

19.4.5 The EIA Scoping Report identified a potential receptor as 'broadscale subtidal habitats'. Following the benthic characterisation surveys, greater clarity has now been provided, and **Table 19.15** includes specific receptors present within the Proposed Offshore Scheme. For example, 'Subtidal Sands and Gravels' was identified throughout most of the Proposed Offshore Scheme and is a 'Habitat of

Principal Importance' under Section 41 of the NERC Act. Therefore, 'Subtidal Sands and Gravels' has been identified as its own receptor.

19.4.6 **Habitats Regulations Assessment (HRA) Screening Report** and **Marine Conservation Zone (MCZ) Assessment Screening** provided with this PEIR have concluded that there are no pressure-receptor pathways for the designated sites (designated for benthic features) within the study area. Annex I sandbanks which are slightly covered by seawater all of the time are designated features of North Norfolk Sandbanks and Saturn Reef SAC and Haisborough, Hammond and Winterton SAC, which are situated 13.5km and 10.3km from the Draft Order Limits, respectively. As outlined in **Chapter 18 Marine Physical Environment** of this PEIR, sedimentation at these distances would only occur from fine sediment particulates and will be less than 0.1mm thick; this is equal to natural sedimentation that occurs from wave and tidal action. Therefore, no designated sites are assessed against Project-related impacts within this PEIR chapter.

19.4.7 Ocean quahog is included in the OSPAR list of threatened and/or declining species (Ref 27), with seabed disturbance from anthropogenic activities considered a main threat to this species (Ref 28). Historical presence of ocean quahog was identified within the Draft Order Limits prior to completion of the benthic characterisation surveys. Therefore, the effect of permanent habitat loss, temporary habitat loss, temperature increase and EMF changes on ocean quahog was scoped in for further assessment. However, following publication of the EIA Scoping Report, the 2024 marine characterisation survey (see **Appendix 19.1 Benthic Survey Report** of this PEIR) did not identify the presence of ocean quahog within the Draft Order Limits. Therefore, there are no pressure-receptor pathways identified for ocean quahog as a result of the Proposed Offshore Scheme and ocean quahog is not assessed within this PEIR.

Table 19.7: Intertidal and subtidal benthic ecology receptors subject to potential effects

Receptor	Reason for Consideration
Intertidal habitats	Whilst the majority of direct impacts would be avoided as a trenchless technique would be used at the proposed Landfall, intertidal habitats would be impacted if there is a drilling fluid breakout during trenchless drilling operations and maintenance.
Subtidal broadscale habitats and species	The Draft Order Limits and study area contains commonly occurring infralittoral and circalittoral habitats that are widely distributed within the North Sea region. Subtidal benthic species live within and on the sediment of marine habitats and are subject to disturbance during submarine cable construction, operation and maintenance, and decommissioning.
Subtidal sands and gravels	This broad habitat type is listed as a Habitat of Principal Importance' under Section 41 of the NERC Act and is present within the Draft Order Limits.
Annex I Biogenic reef	Annex I Sabellaria spinulosa reefs are protected under the Habitats Regulations and Section 41 of the NERC Act. They were recorded within

Receptor	Reason for Consideration
Sabellaria spinulosa reefs Blue mussel (*Mytilus edulis)* beds	sections of the Draft Order Limits 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 *Sabellaria spinulosa.* Mussel beds are protected under the definition of Annex I reef under the Habitats Regulations and under the NERC Act. Activities during construction, operation and maintenance, and decommissioning could cause increased levels of suspended sediments and subsequent deposition. Blue mussels are resistant to smothering and can move within deposited sediment. However, mortality may still occur depending on the duration of smothering. Biogenic reefs are also susceptible to abrasion and penetration of the seabed surface which may occur from development activities.

Table 19.8: Summary of the scope for intertidal and subtidal benthic ecology assessment

Receptor	Construction	Operation and maintenance	Decommissioning
Subtidal broadscale habitats and species Subtidal sands and gravels Subtidal Annex I biogenic reefs	Temporary habitat loss/seabed disturbance	Temporary habitat loss/seabed disturbance	Temporary habitat loss/seabed disturbance
Subtidal broadscale habitats and species Subtidal sands and gravels Subtidal Annex I biogenic reefs	Permanent habitat loss to subtidal habitats and species	Permanent habitat loss to subtidal habitats and species	Permanent habitat loss to subtidal habitats and species
Subtidal broadscale habitats and species. Subtidal sands and gravels Subtidal Annex I biogenic reefs	Temporary increase and deposition of suspended sediments	Temporary increase and deposition of suspended sediments	Temporary increase and deposition of suspended sediments
Intertidal habitats and species	Temporary increase and deposition of suspended sediments	-	-
Subtidal broadscale habitats and species.	Transboundary impacts of temporary increase and deposition of suspended sediments	Transboundary impacts of temporary increase and deposition of suspended sediments	Transboundary impacts of temporary increase and deposition of suspended sediments
Subtidal species	Underwater noise changes	Underwater noise changes	Underwater noise changes

Receptor	Construction	Operation and maintenance	Decommissioning
Subtidal species	-	Electromagnetic changes/Barrier to species movement	-
Subtidal species	-	Temperature increases in sediments	-

Study area

19.4.8 This section describes the spatial scope (the area which may be impacted) for the assessment as it applies to intertidal and subtidal benthic ecology.

19.4.9 The spatial scope of the impact assessment for intertidal and subtidal benthic ecology covers the area of the Proposed Offshore Scheme contained within the Draft Order Limits, together with the study area, described as follows.

19.4.10 The Proposed Offshore Scheme routes from Walberswick across the Southern North Sea to the boundary between the English and Dutch EEZ. The Draft Order Limits for the Proposed Offshore Scheme is illustrated in **Figure 19.1** of this PEIR**.**

19.4.11 The extent of the study area incorporates a 15km wide area to either side of the Proposed Offshore Scheme Draft Order Limits. This is the area where there is potential for direct and indirect impacts (associated with the deposition of suspended sediments) to benthic receptors during the construction, operation and maintenance, and decommissioning phases of the Proposed Offshore Scheme. It is based on the conclusions of **Chapter 18 Marine Physical Environment** of this PEIR.

Assessment scenarios

19.4.12 **Chapter 5 EIA Approach and Methodology** of this PEIR, provides an overview of the Projects approach to the temporal scope (the time scales over which impacts may occur) of the EIA. This section describes the temporal scope for the assessment as it applies to the intertidal and subtidal benthic ecology.

19.4.13 The temporal scope has been informed by **Chapter 2 Description of the Proposed Scheme** of this PEIR. The temporal scope of the assessment of intertidal and subtidal benthic ecology assessment is consistent with the period over which the Proposed Offshore Scheme would be carried out. It covers the period from award of consent to the anticipated end of the Proposed Scheme lifespan.

19.4.14 It assumes construction of the Proposed Offshore Scheme will commence at the earliest 2028 and complete by 2032. Operation would commence in 2032 with periodical maintenance required during the operational phase of the Proposed Offshore Scheme. It is assumed that maintenance and repair activities could take place at any time during the life span of the Proposed Offshore Scheme.

19.4.15 It is considered that the construction phase of the Proposed Offshore Scheme presents the highest likelihood that direct impacts to intertidal and subtidal benthic ecology receptors may occur. Indirect impacts may also occur during construction and operations-related activities.

19.4.16 The Proposed Offshore Scheme would be licensed for 40 years. At this point, either an extension to the licence would be requested, supported by the necessary environmental assessment, or decommissioning would take place. If decommissioning is required, 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 and, with the removal of visible infrastructure, effects would reduce over the course of that period.

19.4.17 Acknowledging the complexities of completing a detailed assessment for decommissioning works 40 years in the future, based on the information available, the Applicant has concluded that impacts from decommissioning would be no greater than those during the construction phase. Furthermore, should decommissioning take place, it is expected that an assessment in accordance with the legislation and guidance at the time of decommissioning would be undertaken. In addition, it expected that the DCO will include a requirement for a written scheme of decommissioning for approval by the MMO and in line with The Crown Estate requirements.

Baseline methodology

Data collection

19.4.18 Baseline data collection has been undertaken to obtain information over the study area. This section provides the approach to collecting baseline data.

19.4.19 The following sources of data have been utilised to inform the baseline with respect to intertidal and subtidal benthic ecology (**Table 19.9**). In addition to these data sources, the intertidal and subtidal benthic ecology assessment draws on environmental baseline data collated for other topics, specifically, baseline data presented in **Chapter 18 Marine Physical Environment** of this PEIR.

Table 19.9: Data sources used to inform the intertidal and subtidal benthic ecology assessment

Source of data	Baseline data
NE's Conservation Advice for Marine Protected Areas 2019 (Ref 28)	Includes summaries of site characteristics and designated features. Provides the conservation objectives for the site and expands them to give detail on ecological attributes. Advice on operations, maintenance and seasonality information provides guidance on project activities and timings.

Source of data	Baseline data
JNCC Offshore MPAs 2019 (Ref 29)	JNCC has been helping to support the identification and designation of Marine Protected Areas (MPAs). Includes summaries of site characteristics and designated features. Provides the conservation objectives for the site and expands them to give detail on ecological attributes. Advice on operations, maintenance and seasonality information provides guidance on project activities and timings. Details on supporting habitat for the Southern North Sea SAC were considered in this assessment.
JNCC Annex I reefs in UK waters (Ref 30)	GIS data layer for known Annex I reef features in UK waters
JNCC Annex I sandbanks in UK waters (Ref 31)	GIS data layer for known Annex I sandbank features in UK waters
National Biodiversity Network (NBN) Atlas (Ref 32)	Records for benthic species and habitats.
The Marine Life Information Network (MarLIN) (Ref 33)	Source of habitat and species sensitivity information.
UKSeaMap (Ref 34)	Marine Habitats Data for the North Sea.
2022 European Union Nature Identification System (EUNIS) - EUSeaMap (Ref 35)	Broadscale seabed predictive habitat map.
Habitat suitability model for *Sabellaria spinulosa* reefs in the UK:2020 (Ref 36)	European Marine Observation Data Network (EMODnet) Habitat Suitability Model Sabellaria spinulosa reefs in the UK
Cefas OneBenthic Tool (Ref 37)	Marine Habitats Data
Limpenney et al. (Ref 38)	Regional Environmental Characterisation (REC) Surveys (2017) (Ref 38).
Published project specific data within the study area.	Relevant ESs and or appendices with benthic survey results for similar projects (East Anglia TWO Offshore Windfarm, Norfolk Vanguard Offshore Wind Farm, Norfolk Boreas Offshore Wind Farm) within the study area (Ref 39; Ref 40; Ref 41; Ref 42; Ref 43)

Site surveys

19.4.20 A dedicated benthic characterisation survey see **Appendix 19.1 Benthic Survey Report** of this PEIR) was undertaken along the 500m wide proposed Offshore HVDC Cable Corridor, a summary of which is provided below.

19.4.21 The approximate length of the HVDC Submarine Cables between the Landfall (Walberswick, Suffolk) and the limit of the English EEZ is 179.8km. The marine characterisation survey was undertaken between May 2024 and February 2025. The dates for the survey campaigns are provided in **.**

Table 19.10: Marine characterisation survey campaign dates

Survey	Survey Dates
Geophysical - nearshore	20/05/2024 - 29/05/2024 (onboard *Shore Presence*)
Geophysical - offshore	19/05/2024 - 10/06/2024 (Ievoli Amber and Ievoli Cobalt)
Environmental Baseline and Habitat Assessment - nearshore	31/01/2025 - 04/02/2025 (onboard *Isle of Jura*)
Environmental Baseline and Habitat Assessment - offshore	03/09/2024 -21/09/2024 (onboard *Ievoli Grey*)

19.4.22 Geophysical and environmental surveys along the subtidal regions of the Proposed Offshore Scheme included an offshore section, with water depths between 2m in nearshore areas and 50m in the offshore areas. Geophysical, geotechnical and benthic survey techniques were used to:

a. characterise the benthic community and benthic habitats; and
b. determine the presence of any features that may have conservation significance.

19.4.23 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.

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

19.4.25 The benthic environmental survey comprised of DDV recordings, Dual van Veen (DVV) grab sampler in sandy sediments and a mini-Hamon grab sampler in mixed sediment types. A total of 84 grab sample stations were investigated, and 102 camera transects along the Proposed Offshore Scheme.

19.4.26 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.

19.4.27 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.

19.4.28 The results of video and grab samples were combined to classify the habitats and associated biological communities in terms of biotopes in line with the EUNIS

habitat classification. This allowed evaluation of presence and extent of habitats, with a focus on features/habitats of conservation importance (FOCI/HOCI) including Annex I habitats and species, and any designated features of nearby MPAs and MCZs.

19.4.29 Full details of the survey methodology, data collection and analysis and the survey outcomes can be found in **Appendix 19.1 Benthic Survey Report** of this PEIR.

Table 19.11: Marine characterisation survey strategy

Method(s)	Sampling strategy/description	Start date	End date
Habitat classification mapping	Habitat classification surveys carried out to Mean Low water. Habitat boundaries defined to UKHab classification and identified using hand-held GPS Digital photos taken to illustrate habitat type Base maps derived from orthophotography Biotopes classified in field	• May 2023 and May 2024	• October 2023 and Augus 2024
Seabed sediment sampling	A total of 84 grab samples collected during survey. Dual van Veen grab (2x 0.1 m^2) successfully retrieved samples at 79 stations. Mini Hamon grab (1x 0.1 m^2) used at remaining three stations due to coarser sediments. 84 samples acquired for particle size analysis. 36 samples for physico-chemical analysis (9 of which were processed at MMO-accredited lab as sand-sweeping samples). 41 faunal replicate samples. Data acquired for environmental baseline, sandeel and herring habitat assessment and sand-sweeping investigations.	Offshore survey: • 04/09/2024 Nearshore survey: • 02/02/2025	Offshore survey: • 21/09/2024 Nearshore survey: • 03/02/2025
Seabed photography and video	A total of 102 camera transects carried out along the proposed Offshore HVDC Cable Corridor. Nine transects included to investigate the potential presence of the ross worm *Sabellaria spinulosa* and the blue mussel *Mytilus edulis*.		

Assessment methodology

19.4.30 The approach to assessment is set out in **Chapter 5 EIA Approach and Methodology** of this PEIR. This has informed the approach used in this intertidal and subtidal benthic ecology assessment.

19.4.31 **Chapter 5 EIA Approach and Methodology** of this PEIR sets out the standard EIA methodology and matrixes to be used for the assessment. The criteria for characterising the value and sensitivity and magnitude for intertidal and subtidal benthic ecology are outlined in **Table 19.12** and **Table 19.13.**

19.4.32 The assessment of sensitivity would 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 would 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 Marine Evidence-based Sensitivity Assessment (MarESA) published by MarLIN and the advice on operations and maintenance from NE designated sites to aid in the categorisation of sensitivity.

19.4.33 Note that the receptor value and sensitivity classification has been amended since the scoping consultation. At scoping various designated habitats and species had been split between the sensitivity values. On reflection, to ensure all protected habitats and species within an international or national designated site are sufficiently considered in the ecological assessment, all were considered as high value. This approach was taken to ensure that all designated habitats were given due appropriate consideration, reflecting the removal of tiered protection levels following the UK's departure from the European Union. This also extends to protected habitat and species outside of the boundary of a site. The original scoping classification had a classification of "Very High" which was defined based on receptor value only. Since amending the classification to rank all species with a designation within the highest category, “Very High” has been removed to simplify the assessment process.

19.4.34 The assessment of magnitude would 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

19.4.35 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 **Chapter 5 EIA Approach and Methodology** of this PEIR, and is replicated for ease in **Table 19.14.**

Table 19.12: Definitions of value and sensitivity for intertidal and subtidal benthic ecology Receptors

Receptor Value and Sensitivity	Description
High	Value: The receptor is a designated feature of an international or national protected site or is considered a protected feature outside of a site.

Receptor Value and Sensitivity	Description
	Sensitivity: Equivalent to MarLIN MarESA sensitivity category High. Receptor has low tolerance to change i.e., recovery will take longer than ten 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 five and ten 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 one and five 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 19.13: Definitions of impact magnitude criteria for Intertidal and Offshore Benthic Ecology

Impact Magnitude	Definition
High	Impacts last >15 years on a regional or population/habitat level or are a 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 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 on a site-specific level. Impacts limited to discrete areas within the Project footprint. Negligible contribution to cumulative effects.
Negligible	Very little or no detectable change from baseline conditions, for any length of time. Disturbance is within the range of natural variability or is a highly localised impact that the alteration to the key characteristics and features of

Impact Magnitude	Definition
	the particular receptor does not affect ecological function. Negligible contribution to cumulative effects.

Table 19.14: Assessment of significance

Magnitude of impact	Receptor Value and Sensitivity			
	High	Medium	Low	Negligible
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Cumulative assessment

19.4.36 **Chapter 28 Cumulative Effects** of this PEIR defines the methodology for the assessment of cumulative effects. The intertidal and subtidal benthic ecology assessment of intra- and inter-project cumulative effects will be carried out and reported within the ES to be submitted with the application for development consent.

19.4.37 The ZoI for the inter-project cumulative effects assessment of the intertidal and subtidal benthic ecology assessment comprises a 15km buffer surrounding the Draft Order Limits. All sedimentation within 15km of the Draft Order Limits would not exceed 1mm thickness (**Chapter 18 Marine Physical Environment** of this PEIR) and it has been predicted that 90% of sediments suspended during cable laying activities resettle within 1km of the cable corridor (Ref 46).

Guidance

19.4.38 In addition, the intertidal and subtidal benthic ecology assessment has been undertaken in accordance with relevant guidance and has been compiled in accordance with professional standards. The guidance and standards which relate to this assessment are:

a. Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland - Terrestrial, Freshwater, Coastal and Marine (Ref 44);
b. Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters (Ref 49);
c. Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Ref 50);

d. Environmental impact assessment for offshore renewable energy projects – Guide. (Ref 51);
e. Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Ref 52);
f. Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Ref 47);
g. Defining and managing *Sabellaria spinulosa* reefs (Ref 48);
h. Marine Evidence-based Sensitivity Assessment (MarESA)(Ref 53,Ref 54); and
i. Natural England Conservation Advice for Marine Protected Areas.

19.5 Assessment assumptions and limitations

19.5.1 This section provides a description of the assumptions and limitations to the intertidal and subtidal benthic ecology assessment. The information provided in this PEIR is preliminary, the final assessment of significant effects will be reported in the ES.

19.5.2 The PEIR has been produced to fulfil the Applicant's consultation duties in accordance with Section 42 of the Planning Act 2008 and enable consultees to develop an informed view of the likely significant effects of the Proposed Offshore Scheme.

19.5.3 This PEIR has been collated based on a range of publicly available data and information and commissioned survey data. It is assumed that the publicly available data is accurate. The data has been supplemented with additional information acquired as part of the Stakeholder engagement process and has also informed the design of project specific a benthic characterisation survey undertaken.

Survey limitations

19.5.4 The optimal marine survey window 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 benthic characterisation survey for the Draft Order Limits for the Proposed Offshore Scheme occurred across two phases due to vessel availability and safe working depths for survey vessels. The offshore and majority of the nearshore survey took place in September which is consistent with recommended survey timings presented in common Standards monitoring guidance (Ref 97). Stations LL01EBS, LL_02_TR and LL03_TR of nearshore survey were conducted during February. Whilst benthic survey data collected in February is outside of the recommended survey period for inshore sublittoral habitat, the Applicant considered that some data is better than none. This seasonal difference should be noted when considering the outcomes of the benthic survey report (**Appendix 19.1 Benthic Survey Report** of this PEIR).

19.5.5 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:

a. 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.
b. 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.
c. 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 50m.

19.5.6 The full environmental sampling strategy was conducted as planned except for the following exceptions.

a. It should be noted that not all sandeel and herring spawning stations were co-located with camera transects due to the suspected featureless homogeneous sediment which was de-risked via geophysical review prior to grab deployment.
b. An additional grab sample was collected at station LL_16_SG_ADD to compensate for poor video footage acquisition, ensuring sufficient ground-truthing where video footage was unavailable.
c. At five stations, seabed turbidity restricted visibility on camera transects. To supplement habitat classification where video data could not be obtained, grab samples comprising faunal and particle size distribution samples were collected, these samples were named as per the camera transect name, with the addition of 'G'.
d. One grab sample (LL_20_SG) was excluded from particle size analysis due to the presence of small blue mussel (*Mytilus edulis*, 10mm – 30mm) aggregations. Such aggregations can distort particle size distribution results and therefore affect the accuracy of the final parameters for that sample. To address this, the grab sample location was relocated to a de-risked area identified from geophysical data, following observations of mussel aggregations in video footage at the original site. Despite this relocation, small blue mussels were still present at the new sampling site.

Intertidal study area limitations

19.5.7 The Proposed Scheme will use a trenchless solution under the transition zone between the Proposed Onshore Scheme and Proposed Offshore Scheme at the proposed Landfall (**Chapter 2 Description of the Proposed Scheme** of this PEIR). The EIA Scoping Report originally stated that impacts to intertidal habitat could be ruled out due to avoiding intertidal habitats. The EIA Scoping Opinion (**Table 19.5)** stated that further clarification within the Proposed Scheme design would be required to understand access requirements or impacts of access

activity would need to be scoped into the assessment. **Chapter 2 Description of the Proposed Scheme**, of this PEIR covers the work that would be conducted at the proposed Landfall and access requirements have been refined to ensure impacts to intertidal habitats and species are avoided. Therefore, a detailed baseline assessment of the intertidal zone has not been presented here but rather a high-level overview based on publicly available data and the outcomes of the terrestrial habitat classification survey which covered intertidal habitat.

Project description limitations

19.5.8 The assessment has been undertaken based on the description of the Proposed Offshore Scheme presented in **Chapter 2 Description of the Proposed Scheme** of this PEIR. To allow flexibility due to changing seabed conditions or features, it is assumed that the Proposed Offshore Scheme could be installed anywhere within the Draft Order Limits. Whilst indicative locations have been provided for external cable protection, it is also assumed that remedial external cable protection could be used at any point along the Proposed Offshore Scheme and therefore anywhere within the Draft Order Limits.

19.5.9 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 Proposed Offshore Scheme. It is considered that the baseline information collected and used is representative of the study area.

19.6 Baseline conditions

19.6.1 To provide an assessment of the likely significance of the Proposed Offshore Scheme (in terms intertidal and subtidal benthic ecology), it is necessary to identify and understand the baseline conditions in the study area. This provides a reference point against which potential changes in intertidal and subtidal benthic ecology can be assessed.

19.6.2 The baseline section should be read in conjunction with the following supporting Appendices and figures as found within Volume 2 and Volume 3 of this PEIR respectively:

a. **Appendix 19.1 Benthic Survey Report**;
b. **Appendix 2.3 Electromagnetic Field Assessment**;
c. **Appendix 2.4 Offshore Thermal Emissions Technical Note**;
d. **Figure 19.1 Project Overview**;
e. **Figure 19.2 Landfall Area**;
f. **Figure 19.3 Broadscale Habitat Map**; and
g. **Figure 19.4 Protected habitats**.

19.6.3 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 **Chapter 20 Fish and Shellfish** of this PEIR,

whilst habitats and species landward of MHWS have been considered in **Chapter 8 Ecology and Biodiversity** of this PEIR.

19.6.4 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 the European Union Nature Information System (EUNIS) codes revised in 2022 for classifying benthic habitats to match the reporting used within **Appendix 19.1 Benthic Survey Report** of this PEIR (Ref 56).

Current baseline

Intertidal ecology

19.6.5 The intertidal zone is defined as the area of the shore exposed at low tide and submerged at high tide. The proposed Landfall lies at Walberswick where the foreshore sediments are reflective of coastal dunes and sandy shores (N1). The nearshore area is dominated by littoral fine sand or muddy sand (MB5) and is located immediately south of the proposed Landfall and falls entirely within the study area. The nearshore region of the study area is characterised by offshore circalittoral sand (MD521).

19.6.6 Several coastal habitats of principal importance, as listed under Section 41 of NERC Act, are present within or adjacent to the proposed Landfall. Coastal saltmarsh and maritime cliffs and slopes are found along the Walberswick coastline adjacent to the Draft Order Limits of the Landfall, with mudflats and coastal sand dunes located at the mouth, and along the banks of the River Blyth which is approximately 2.5km from the intersection of the Proposed Offshore Scheme Draft Order Limits with the proposed Landfall site. The coastal saltmarsh and maritime cliffs and slopes features are specifically protected by the Minsmere to Walberswick Heaths and Marshes Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). These features are mentioned for reference only. As they lie above MHWS, the Proposed Offshore Scheme would not impact on these features. The impact assessment for the Proposed Onshore Scheme on these features is covered within **Chapter 8 Ecology and Biodiversity** of this PEIR.

Subtidal ecology

19.6.7 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 (species) in the study area using data from EMODnet (Ref 35, Ref 36) and OneBenthic (Ref 55), and the acquired subtidal survey data (**Appendix 19.1 Benthic Survey Report** of this PEIR).

19.6.8 The subtidal benthic habitats identified within the Draft Order Limits were generally dominated by four broad scale sediment types: fine/muddy sand closer to shore progressing to alternating areas of coarse sediment, mixed sediment

and sand further offshore. In total, five level 5 EUNIS biotopes were identified across three Level 4 EUNIS biotope complexes within the subtidal area. Existing habitat mapping data (Ref 35; Ref 36) are presented in **Figure 19.4** of this PEIR and with detailed habitat classification data from the benthic characterisation survey presented in **Appendix 19.1 Benthic Survey Report** of this PEIR.

Subtidal habitats

19.6.9 A detailed interpretation of benthic habitats across the Draft Order Limits is presented in **Appendix 19.1 Benthic Survey Report** of this PEIR. These are summarised in **Table 19.15** and in the paragraphs below. A detailed overview of protected habitats and species of conservation interest noted within the study area is summarised in **Table 19.16.** The survey corridor was split into survey blocks with block 1 at the nearshore and block 19 at the EEZ.

19.6.10 Broadscale regional habitat mapping (Ref 35), as illustrated in **Figure 19.3** of this PEIR, suggests that the dominant EUNIS level 4 biotope complexes were Atlantic offshore circalittoral sand (MD521) with patches of Atlantic offshore circalittoral mixed sediment (MD421) and Faunal communities in Atlantic offshore circalittoral coarse sediment (MD321).

19.6.11 These findings were consistent with the findings of the east coast regional environmental characterisation (Ref 57) and site-specific survey data collected within the Former East Anglia Zone and various offshore windfarm sites that fall within the study area (Ref 39).

19.6.12 The southern portion of the Draft Order Limits for the Proposed Offshore Scheme, which is located closer to shore, was dominated by higher frequency of MD521 Atlantic offshore circalittoral sand with patches of MD421 Atlantic offshore circalittoral mixed sediment and MD321 Atlantic offshore circalittoral coarse sediment. The majority of the Draft Order Limits had large areas of rippled and mottled seabed, with several associated biotopes meaning areas of transition may include overlapped or impoverished versions of offshore circalittoral mixed sediment and offshore circalittoral coarse sediment, particularly towards the southern high-energy nearshore area where the seabed becomes more variable and water depth shallower. In survey blocks 6 and 7 between KP20 and KP31, the Level 5 biotope classification MC6215 (*Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud) was identified.

19.6.13 The centre portion of the Draft Order Limits for the Proposed Offshore Scheme transitioned into more variable biotopes with rippled sand waves alternating dominated by MD521 Atlantic offshore circalittoral sand, with patches of MD421 Atlantic offshore circalittoral mixed sediment and MD321 Atlantic offshore circalittoral coarse sediment, which collected in the troughs of the sand waves. Where fauna community data allowed, offshore circalittoral sand was further classified to the Level 5 biotope '*Albra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment', '*Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud' (MC6215) and '*Sabellaria spinulosa on stable Atlantic*

circalittoral mixed sediment' (MC2211). Patches of the Level 5 biotope MC2211 were identified to be present around KP52.5 in survey block 10. Offshore circalittoral mixed sediment was further classified as the Level 5 biotope 'polychaete-rich deep Venus community in offshore mixed sediments' (MD4211).

19.6.14 The furthermost offshore area of the Draft Order Limits, closest to the boundary of the English EEZ, was characterised by the Level 5 biotope *Albra alba* and *Nucala nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214) which is a sub-classification of the broadscale habitat Atlantic offshore circalittoral sand. The biotope was broadly homogenous across the furthest reaches of the Draft Order Limits. The presence of MC5214 was noted from KP80 until the end of the Draft Order Limits interspersed with a patch of Atlantic offshore circalittoral coarse sediment (MD321).

Table 19.15: Summary of broad scale habitats, habitat complexes, and biotope complexes based on survey data

JNCC Marine Habitat Classification (Ref 67)	EUNIS 2022 Habitat Classification (Ref 60)	
Level 4	Level 4	Level 5 [1]
SS.SSa.CMuSa Circalittoral muddy sand	Faunal communities in Atlantic offshore circalittoral sand (MD521)	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)
		Lagis koreni and *Phaxas pellucidus* in circalittoral sandy mud (MC6215)
		Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment (MC2211)
		Mytilus edulis beds on Atlantic circalittoral sediment (MC2235)
SS.SSa.OSa Offshore circalittoral sand		*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)
		Lagis koreni and *Phaxas pellucidus* in circalittoral sandy mud (MC6215)
		Mytilus edulis beds on Atlantic circalittoral sediment (MC2235)
S.SMx.OMx Offshore circalittoral mixed sediment	Faunal communities in Atlantic offshore circalittoral mixed sediment (MD421)	Polychaete-rich deep *Verus* community in offshore mixed sediment (MD4211)
		Sabellaria spinulosa on stable *Atlantic* circalittoral mixed sediment (MC2211)
SS.SCS.OCS Offshore circalittoral coarse sediment	Faunal communities in Atlantic offshore circalittoral coarse sediment (MD321)	*Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment* (MC2211)

[1] – Some areas of the Proposed Offshore Scheme could not be classified to Level 5 biotopes and therefore remained at Level 4 classification. This column presents examples of Level 5 biotopes that were identified within these Level 4 habitats.

Subtidal macrofauna

19.6.15 The subtidal area comprised rich and diverse macrofauna communities which were generally reflective of the sediment and environmental conditions observed along the Draft Order Limits of the Proposed Offshore Scheme. A detailed assessment of the benthic macrofauna within the Proposed Offshore Scheme is presented in **Appendix 19.1 Benthic Survey Report** of this PEIR and summarised below.

19.6.16 A total of 4,259 individuals (both infauna and solitary epifauna) were identified from 38 samples analysed. Among the 147 recorded taxa, ten were colonial epifauna, two were solitary epifauna, and 135 were infauna. Annelids were the most abundant, with 69 species accounting for 45.6% of the total individuals. Crustaceans comprised 34 species (4.7% of total individuals), molluscs included 19 species (41.4% of total individuals), and echinoderms were represented by seven species (5.8% of total individuals). Other groups, such as Nemertea and Nematoda, were represented by six species, making up 1.2% of the total individuals.

19.6.17 Despite the identification of historic presence of ocean quahog in the northern most section of the Draft Order Limits from the pre-survey desk-based study, no individuals were identified from macrofauna analysis of acquired grab samples.

Designated sites

19.6.18 There are several designated sites within the study area for the Proposed Offshore Scheme.

19.6.19 HRA Screening and MCZ Assessment Screening have been undertaken for the Proposed Offshore Scheme and are presented in the **Habitats Regulations Assessment (HRA) Screening Report** and **Marine Conservation Zone (MCZ) Assessment Screening** provided with this PEIR.

19.6.20 Screening identified the designated sites listed within the potential ZoI as relevant for intertidal and subtidal benthic ecology receptors. The Draft Order Limits does not intersect any offshore SACs with designated benthic ecology features. 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 Proposed Offshore Scheme and the sites. The relevant designated sites are illustrated in **Figure 19.1** of this PEIR.

19.6.21 Sandbanks within the inshore region of the study area are considered as supporting features of the Outer Thames Estuary SPA (UK9020309). This habitat is of importance for foraging red-throated diver (*Gavia stellata*) which is a qualifying feature of the Outer Thames Estuary SPA.

19.6.22 Impacts to designated sites within the intertidal proposed Landfall Site will be avoided through the use of Horizontal Directional Drilling (Trenchless cabling technique).

19.6.23 **Table 19.16** provides further details about designated sites including their qualifying features and distance from the relevant boundary of the Draft Order Limits.

Table 19.16: Offshore designated sites within study area with benthic ecology features

Site Name and Code	Distance from Draft Order Limits (km)	Relevant Qualifying Features
North Norfolk Sandbanks and Saturn Reef SAC (UK0030358)	13.5	• Annex I Reefs (1170) • Annex I Sandbanks Slightly covered by seawater all of the time (1110)
Haisborough, Hammond and Winterton SAC (UK0030369)	10.3	• Annex I Reefs (1170) • Annex I Sandbanks Slightly covered by seawater all of the time (1110)
Outer Thames Estuary SPA (UK9020309)	Overlaps	• Supporting habitat for red-throated diver Non-Breeding: extent and distribution and availability of supporting habitat for the non-breeding season only.
Southern North Sea SAC (UK0030395)	Overlaps	• Supporting habitat for harbour porpoise: extent and distribution and availability of supporting habitat.

Table 19.17: Onshore designated sites within study area with benthic ecology features

Site Name and Code	Distance from Draft Order Limits (km)	Relevant Qualifying Features
Minsmere-Walberswick Heaths and Marshes SAC (UK0012809)	0.1	• Annex I Annual vegetation of drift lines (H1210) • Annex I Perennial vegetation of stony banks; Coastal shingle vegetation outside the reach of waves (H1220)
Benacre to Easton Bavents Lagoons SAC (UK0013104)	4.1	• Annex I Coastal Lagoons (H1150)
Minsmere-Walberswick Ramsar	0.1	Site is designated for the protection of a mosaic of marine, freshwater, marshland and associated habitats which support designated features of the Minsmere-Walberswick SPA. Natural England considers the Conservation Advice packages for the overlapping European Marine Site designations to be, in most cases, sufficient to support the management of the Ramsar interests. See Minsmere-Walberswick Heaths and Marshes SAC.

Site Name and Code	Distance from Draft Order Limits (km)	Relevant Qualifying Features
Pakefield to Easton Bavents SSSI	3.1	This site is designated for the protection of a range of coastal habitats including vegetated shingle features and saline lagoons.
Minsmere-Walberswick Heaths and Marshes SSSI	0.1	This site is designated for the protection of a range of coastal habitats including mudflats and shingle beach

Habitats and species of conservation importance

19.6.24 Several subtidal habitats were identified within the study area which are listed under Annex I of the Habitats Directive or as habitats of principal importance under Section 41 of the NERC Act. The presence of potential habitats of conservation interest is presented in detail in **Appendix 19.1 Benthic Survey Report** of this PEIR and summarised below.

Table 19.18: Summary of sensitive benthic habitats and species within study area

Designated Feature	Legislation	Description	Designation Status
(H1110) Sandbanks which are slightly covered by seawater all of the time	The Habitats Regulations (see **Table 19.1** for more information)	Sandbanks	Annex I habitat
(H1170) Reefs - Sabellaria spinulosa, Mytilus edulis	Section 41 of the NERC Act (UK post 2010 biodiversity framework)	Biogenic Reefs	Habitat of Principal Importance
	The Habitats Regulations (see **Table 19.1** for more information)		Annex I habitat
Subtidal Sands and Gravel	Section 41 of the NERC Act (UK post 2010 biodiversity framework)	Broadscale Habitat	Habitat of Principal Importance
Arctica islandica	Section 41 of the NERC Act (UK post 2010 biodiversity framework)	Ocean quahog	Species of Principal Importance
	OSPAR list of threatened and/or declining Species and Habitats		Threatened and Declining Species

Sandbanks which are slightly covered by seawater all of the time

19.6.25 'Sandbanks which are slightly covered by sea water all of the time' (H1110) are an Annex I habitat listed under the Habitats Regulations (Ref 59). Sandbanks within the inshore region of the study area (i.e., within 12 NM) are considered as

supporting features of the Outer Thames Estuary SPA (UK9020309). This habitat is of importance for foraging red-throated diver which is a qualifying feature of the Outer Thames Estuary SPA.

19.6.26 This habitat is composed of sandy well-sorted substrates that form banks, which remain permanently covered by shallow sea water, typically occurring in water depths of <20m below Chart Datum. Sandbanks which are slightly covered by sea water all the time occur widely around the UK coast. The diversity and types of community associated with this habitat are determined particularly by sediment type together with a variety of other physical, chemical and hydrographic factors. Shallow sandy sediments are typically colonised by a burrowing fauna of worms, crustaceans, bivalve molluscs and echinoderms. Mobile epifauna at the surface of the sandbank may include shrimps, gastropod molluscs, crabs and fish. Sandeel (*Ammodytes spp)*, an important prey species for birds, live in sandy sediments. Where coarse stable material, such as shells, stones or maerl is present on the sediment surface, species of foliose seaweeds, hydroids, bryozoans and ascidians may form distinctive communities (Ref 59).

19.6.27 The Draft Order Limit has been carefully designed to avoid areas identified by the JNCC as Annex I Sandbank habitats. The closest Annex I sandbank feature to the Draft Order Limits is 10.3km and present within Haisborough, Hammond and Winterton SAC.

Annex I Sabellaria spinulosa reefs

19.6.28 Biogenic reefs, formed by *Sabellaria spinulos*a represent a form of biogenic reef (H1170) which is protected as Annex I habitat under the Habitats Regulations (Ref 57). Additionally, reef formed by *Sabellaria spinulosa* is listed as a Habitat of Principal Importance UK post-2010 Biodiversity Framework Priority Habitat under Section 41 of the NERC Act (2006)(Ref 13) (formerly UK BAP Priority Habitat).

19.6.29 *S. spinulosa*, is a small, tube-building worm (polychaete) found in the subtidal and lower intertidal/subtidal fringe and is widely occurring throughout UK waters. When conditions are favourable, dense aggregations of worms can develop, forming biogenic reefs up to about 60cm high and extending over several hectares. They provide a biogenic habitat that allows many other associated species to become established. The *S. spinulosa* reef habitats of greatest nature conservation significance are those which occur on sediment or mixed sediment areas. These enable a range of epibenthic species with their associated fauna and a specialised 'crevice' infauna, which would not otherwise be found in the area, to become established (Ref 59).

19.6.30 In naturally disturbed areas reefs may undergo annual cycles of erosion and recolonization (Ref 72). Surveys on the North Yorkshire and Northumberland coasts found that areas, where *Sabellaria spinulosa* had been lost due to winter storms, appeared to be recolonized up to the maximum observed 2.4 cm thickness during the following summer (Ref 72). Recovery of thin encrusting reefs may, therefore, be relatively rapid.

19.6.31 Predictive habitat data (Ref 36) (see **Figure 19.3** of this PEIR) showed the assemblage "*Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment*" (MC2211) is predicted to occur in highly localised area around 8km southeast of KP6 of the Proposed Offshore Scheme. The habitat subtype "sublittoral biogenic reefs" (MC21) were predicted to occur in isolated areas where physical and hydrographic characteristics were potentially suitable for reef settlement within the study area. These areas were predominantly distributed within the wider study area between KP16 and KP36. The biotope crossed into the Draft Order Limits at a single point at KP26. The biotope is also identified within 500m of the Draft Order Limits adjacent to KP18.5 and at KP54. Whilst the presence of this biotope is not an indication of the presence of Annex I reef at this location, it is an indication that conditions may be suitable for reef to establish. Predictive habitat mapping has been used to inform high level positioning of the Draft Order Limits during route development activities.

19.6.32 The benthic characterisation survey (**Appendix 19.1 Benthic Survey Report** of this PEIR.) provided evidence of ubiquitous presence of individuals or low-density aggregations of *S. spinulosa* within areas of the Draft Order Limits classified as offshore circalittoral sand (MD5), offshore circalittoral coarse sediment (MD3) and offshore circalittoral mixed sediment (MD4). Larger aggregations of *S. spinulosa* were identified at 59 of the 114 DDV transects selected to target features identified from geophysical survey results. A reefiness assessment was conducted to assess the likelihood of identified areas of the seabed with *S. spinulosa* presence representing an Annex I reef at points across the length of the Proposed Offshore Scheme. At KP9.5 there are four patches of *S. spinulosa* forming sediment crusts with some sections having a "low reef" resemblance and the majority being considered not a reef due to the low elevation and small area of coverage. The largest patches here are around 500m in length, however these patches do not provide continuous coverage and so are not classified as a reef as they don't meet the overall patchiness threshold. Overall patches within this section were classified as "not a reef".

19.6.33 Further along the Draft Order Limits, nine smaller patches from KP14 to KP25 were investigated, the largest of which being around 250m long. However, due to their elevation and composition all patches were classed as "not a reef". From KP31 to KP51 there are 15 more small patches, sparsely spread about the Draft Order Limits. Again, these patches were classified as "not a reef" The Route Development route section noted the presence of potential *S. spinulosa reef* with 2 small patches identified for ground-truthing investigation, both of which were classified as "not a reef". At KP60 a single patch measuring 5780m^2 was classified as "low reef". Between KP71 and KP74 patches measuring 25,270m^2, 17,770m^2 and 6,780m^2 were classified as "low reef" and noted to partially cover sections of the Draft Order Limits. presenting the location of the assessed aggregations are presented in **Figure 3.47** to **Figure 3.54** of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.6.34 From all the *S. spinulosa* structures investigated in the benthic characterisation survey no areas of medium or high reef resemblance were identified. Overall, there are patches of *S. spinulosa* aggregations across the Draft Order Limits, eight of the 41 patches investigated presented a resemblance to "low reef" and therefore may constitute Annex I biogenic reef features. The benthic characterisation survey showed the presence of *S. spinulosa* particularly in areas classified as offshore circalittoral sand and offshore mixed sediment, however on further investigation many of these aggregations did not constitute Annex I reef. This does highlight the potential for reef features to form and disappear within the Draft Order Limits. Holt et al. (Ref 99) noted some thin crusts of Sabellaria spinulosa Reef were relatively ephemeral and disappear following natural disturbances such as storms but recover the following year. Pearce et al (Ref 100) cast doubt on the theory that this was limited to thin crusts noting the disappearance of Saturn Reef, a seemingly stable and extensive reef in the southern North Sea which disappeared a year after its first discovery with no conclusive evidence for the cause of its decline.

Annex I - blue mussel (*Mytilus edulis*) beds

19.6.35 Blue mussel can form dense beds in intertidal and subtidal areas, typically on rocky substrates, boulders and mixed sediments. These beds provide important ecosystem services such as sediment stabilisation, enhancing biodiversity and improving water quality through filter feeding (Ref 73). These beds support a diverse range of associated species, including crustaceans, polychaetes and juvenile fish. Recruitment into blue mussel populations is highly variable, with settlement influenced by environmental factors such as water temperature, salinity, and predation pressures.

19.6.36 Blue mussel beds are a habitat of principal importance (Ref 13) and reefs formed by this species can constitute "Biogenic Reefs" listed under Annex 1 of the Habitats Regulations.

19.6.37 **Appendix 19.1 Benthic Survey Report** of this PEIR noted the presence of blue mussel aggregations within a patch of offshore circalittoral sand within the Draft Order Limits at KP8 (Transects LL_20_TR and LL_20_ADD). The aggregations spread laterally covering half of the width of the Draft Order Limits at this location, an area approximately 100m in length. An assessment of the identified blue mussel beds was conducted to evaluate their resemblance to Annex I biogenic reefs, using SACFOR density data in line with the reef grading criteria outlined in Roberts et al. (Ref 62). Further detail of the assessment is presented in **Appendix 19.1 Benthic Survey Report** of this PEIR, whilst a table equating SACFOR density with mussel bed grading is presented in **Table 19.18**:. A map presenting the location of the assessed aggregation is presented in Figure 3.69 of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.6.38 OSPAR defines a mussel bed as at least a 20% cover of subtidal sediments over an area of at least 25m² (Ref 63). Using this definition, patches can be estimated

and those with an area of greater than 25m² and considered Grade 1 could be potential mussel beds.

Table 19.19: Overview of mussel (*Mytilus edulis*) bed assessment categories

Coverage	Crust/Meadow SACFOR	Benthic Solutions Grading adapted from Roberts et. al. 2011
>80%	Superabundant	1
40-19%	Abundant	
20-39%	Common	
10-19%	Frequent	2
5-9%	Occasional	
1-5%	Rare	3
<1%	Less than Rare	
0%	Absent	4

19.6.39 Within the aggregation area, four patches were classed as Grade 2, seven classed as Grade 3 and 11 classed as Grade 4. No patches of blue mussel within the Draft Order Limits are classed as Annex I mussel beds, as per the methodology set out in Roberts et. al. (Ref 62). For further detail on the assessment see **Appendix 19.1 Benthic Survey Report** of this PEIR. An overview of these patches is summarised in **Table 19.19**:

Table 19.20: Blue mussel bed assessment of patches observed at KP8

Patches identified along Transect LL_20_TR and LL_20_ADD	Total	Grade 1	Grade 2	Grade 3	Grade 4	Not Visible
Patches	22	0	4	7	11	0

19.6.40 The blue mussel bed patches identified at KP8 from the benthic characterisation survey do not meet the criteria of an Annex 1 blue mussel bed. However, this does highlight the potential for blue mussel beds and reef features to form within the Draft Order Limits.

Subtidal sands and gravels

19.6.41 Subtidal sands and gravels are a listed UK post-2010 Biodiversity Framework Priority Habitat under Section 41 of the NERC Act (Ref 13) (formerly UK BAP Priority Habitat). Subtidal sands and gravel habitats can also correspond to Annex I Sandbanks which are slightly covered by seawater all of the time, where they form the relevant topographic features (Ref 78).

19.6.42 Subtidal sands and gravel habitats occur in a variety of environments, from sheltered to very exposed conditions. The sediment of these habitats ranges from mainly sand, through various combinations of sand and gravel, to mainly gravel. While very large areas of seabed are covered by sand and gravel in various mixes, much of this area is covered by very thin deposits over bedrock, glacial drift or mud. The strength of tidal currents and exposure to wave action are important determinants of the topography and stability of sand and gravel habitats. The diversity of flora and fauna living within the biotopes varies according to the level of environmental stress to which they are exposed. In nearshore areas, sand and gravel habitats are ecologically important as nursery grounds for juvenile commercial species such as flatfishes and bass, whereas offshore they support internationally important fish and shellfish fisheries (Ref 78).

19.6.43 Several habitats associated with subtidal sands and gravel, including offshore circalittoral sand and offshore circalittoral coarse sediment were present along the Proposed Offshore Scheme. Please see **Figure 19.3** of this PEIR.

Ocean quahog (*Arctica islandica*)

19.6.44 Ocean quahog is listed as a Species of Principal Importance UK post 2010 Biodiversity Framework Priority species under Section 41 of the NERC Act (Ref 13) (formerly UK BAP Priority species). It is also a species listed on the OSPAR list of declining and threatened species (Ref 27).

19.6.45 Ocean quahog is a marine bivalve that occurs in sandy and muddy sediments from the low intertidal zone to 400m 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 (Ref 79).

19.6.46 Review of publicly available data had shown that ocean quahog had been previously recorded in a small section of the Northern most point of the Proposed Offshore Scheme. However, no ocean quahog individuals were found on review of stills and video imagery or were noted as present from analysis of grab samples during the benthic characterisation survey. As no individuals have been found within the characterisation survey, impacts to this species have not been considered further in this assessment.

Marine Invasive and Non-Native Species (MINNS)

19.6.47 No MINNS were found to be present within the Draft Order Limits during the benthic characterisation survey.

Future baseline

19.6.48 The future baseline considers changes which may affect the future environment in the absence of the Proposed Offshore Scheme. It takes into account any developments that are likely to be present in the future baseline such as consented offshore wind farms.

19.6.49 The existing baseline conditions for intertidal and subtidal benthic ecology within the study area are relatively stable. Multiple datasets covering several years demonstrate similar patterns. This can be demonstrated from the findings in the site-specific surveys within the study area. The results from surveys conducted across the East Anglia ONE North windfarm site in 2010 and 2011 show similar finding to the North Vanguard site-specific surveys conducted in 2016 (Ref 40) and are analogous with the finding from the benthic characterisation survey conducted for the Proposed Offshore Scheme in 2024.

19.6.50 The existing environment within the study area has been largely influenced by a combination of physical processes which occur within the Southern North Sea (**Chapter 18 Marine Physical Environment** of this PEIR) and anthropogenic activities, such as fishing, in particular beam trawling (**Chapter 24 Commercial Fisheries** of this PEIR) and the development of offshore wind farms which has led to an increasing number of man-made structures in the marine environment (**Chapter 25 Other Marine Users** of this PEIR).

19.6.51 Patches of 'low reef' resemblance Annex I *S. spinulosa* reef were noted in areas of offshore circalittoral sand and offshore circalittoral mixed sediment within the Proposed Offshore Scheme. Similarly, aggregations of blue mussels were noted in a patch of offshore circalittoral sand at KP8. Whilst these features were not sufficiently developed to be considered reef, they may potentially form an Annex I reef feature in the future. The Applicant has made appropriate effort to identify the current extent of this feature within the Proposed Offshore Scheme in support of its ES. Due to the dynamic nature of the environment and both blue mussel and *S. spinulosa ecology*, it is not possible to predict if these areas would reduce, remain static or grow to form 'low' 'medium reef' or 'high reef' resemblance Annex I *Sabellaria spinulosa* reefs and blue mussel beds without the installation of the Proposed Offshore Scheme.

19.6.52 Anthropogenic induced climate change causing increases in sea temperatures may result in large spatial shifts to the marine benthic ecosystem. Northerly migration of benthic species is likely to occur and at a large scale this would result in changes to the abundance and species composition of benthic communities. A survey was conducted by Hiddink et al. (Ref 80) which focused on evaluating the changes in distribution of 65 common and widespread North Sea benthic invertebrate species between 1986 and 2000. The species geographic, bathymetric and thermal shifts were taken into account. The study supported the predicted northerly migration of species with many benthic invertebrates showing north-westerly range shifts and a movement towards

deeper and cooler waters. Shifts in distribution were found to correspond with increases in surface and seabed temperatures. Studies noted that if the examined species are unable to adjust to or endure an increase in temperature in the North Sea, there may be a decrease in benthic biodiversity.

19.7 Embedded design mitigation and control measures

Design and embedded mitigation measures

19.7.1 As described in **Chapter 2 Description of the Proposed Scheme** of this PEIR, a range of measures have been embedded into the Proposed Scheme design to avoid or reduce environmental effects. These mitigation measures form part of the design that has been assessed, which for intertidal and subtidal benthic ecology are listed in **Table 19.21**.

Table 19.21: Design and embedded mitigation measures of intertidal and subtidal benthic ecology

Commitment Reference Code	Measure	Compliance Mechanism
OD01	All cables will be installed in one trench.	CEMP secured by DML
OD02	HVDC Cables will be bundled together to minimise the EMF profile.	CEMP secured by DML
OD03	A trenchless cable installation method (such as horizontal directional drilling) will be used to avoid disturbance to surface sediments and habitats, with the exit point seaward of the 0m LAT water depth contour.	CEMP secured by DML
OD04	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.	CEMP secured by DML
OD05	External cable protection shall only be used where it can be demonstrated that adequate burial depth cannot be achieved (e.g., where ground conditions do not allow burial or at infrastructure crossings); the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability.	CEMP secured by DML
OD06	In sites designated for benthic features, cable protection materials will be selected to match the environment (e.g. rock of similar grade as the receiving environment) where feasible.	CEMP secured by DML
OD08	Micro-routeing within the Order Limits to avoid sensitive environmental constraints and minimise the risk of exposure by seabed mobility.	CEMP secured by DML
OD15	The risk of frac-out will be mitigated through design by undertaking ground investigation to determine the soil properties and understand if natural fissures could be present along the borehole alignment. This will include factoring in verified geology from ground investigation	Design secured by DML

Commitment Reference Code	Measure	Compliance Mechanism
	boreholes to provide a detailed hydrofracture analysis and calculation. This information will inform the design of trenchless methods at suitable depths to minimise the risk of frac-out.	

Control measures

19.7.2 Control measures are set out in **Appendix 2.2 Outline Offshore Construction Environmental Management Plan** of this PEIR which would manage the effects of construction. The measures of particular relevance to intertidal and subtidal benthic ecology are listed in **Table 19.22.**

19.7.3 Several management plans will be provided as Outline Management Plans with the application for development consent to support the DML. These would include an Outline Offshore Construction Environmental Management Plan (CEMP) (including biosecurity plan details), an Outline Marine Pollution Contingency Plan (MPCP), and Outline Cable Burial Risk Assessment (CBRA). An Outline Offshore CEMP can be found in **Appendix 2.2** of this PEIR. These documents would outline control 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 Proposed Offshore Scheme. Final management plans will be submitted in accordance with the DML to discharge the licence conditions.

19.7.4 The Applicant would ensure that all work that is undertaken during construction, operation and maintenance, and decommissioning complies with the requirements of relevant national and international legislation.

Table 19.22: Control measures

Commitment Reference Code	Measure	Compliance Mechanism
OC01	An offshore Construction Environmental Management Plan (CEMP) including an Emergency Spill Response Plan (ESRP), Waste Management Plan, Marine Pollution Contingency Plan (MPCP), Biosecurity Plan and Marine Mammal Mitigation Plan (MMMP) and a dropped objects procedure will be produced prior to installation.	DML secured through DCO
OC02	All project vessels must comply with the International Regulations for Preventing Collisions at Sea (1972) (IMO, 2019a), regulations relating to International Convention for the Prevention of Pollution from Ships (the MARPOL Convention 73/78) (IMO, 2019e) with the aim of preventing and minimising pollution from ships and the International Convention for the Safety of Life at Sea (SOLAS, 1974).	CEMP secured by DML

Commitment Reference Code	Measure	Compliance Mechanism
OC03	An installation machine failure contingency plan will be produced prior to installation	CEMP secured by DML
OC04	All oil, fuel and chemical spills will be reported to the MMO Marine Pollution response team	DML secured through DCO
OC05	Drilling fluids required for trenchless operations will 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 will 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. Chemicals will be chosen from the list of chemicals approved under the Offshore Chemical Notification Scheme. https://www.cefas.co.uk/data-and-publications/ocns/ and a chemical risk assessment will be provided as part of the CEMP.	CEMP secured by DML

19.8 Assessment of effects

19.8.1 This section presents the preliminary assessment of likely significant effects on intertidal and subtidal benthic ecology resulting from the construction, operation and maintenance, and decommissioning of the Proposed Offshore Scheme. The likely significant effects of the Proposed Offshore Scheme are identified taking into account the embedded design mitigation and control measures.

19.8.2 Two impacts, temperature increases in sediments and changes to electromagnetic frequency, are unique to construction and have been assessed within that phase alone. Further details of the scoping of impacts are presented in **Table 19.7.**

19.8.3 Following assessment further mitigation is proposed as required which is presented in **Section 19.9**.

Construction

19.8.4 It is anticipated that the construction programme for the Proposed Offshore Scheme would be split into multiple campaigns, comprising of route preparation and cable lay and burial campaigns. Pre-construction phase activities, such as surveys, route preparation, boulder clearance, pre-sweeping and infrastructure crossing preparation are expected to take up to one year to complete. As set out in **Chapter 2 Description of the Proposed Scheme** of this PEIR**,** installation

vessels would install the cables at an indicative speed of between 100m and 500m per hour, depending on seabed conditions and the vessels used.

19.8.5 The Offshore HVDC Submarine cables would be installed in one trench, with installation methodologies including simultaneous cable lay and trenching, and surface cable lay followed by post lay trenching. Cable burial tools which may be used include jet trenching machines, mechanical trenchers, control flow excavators and ploughs. Overall, displacement ploughs/boulder clearance ploughs would result in the greatest seabed disturbance, however this method may only be required within discrete sections **(Chapter 2 Description of the Proposed Scheme** of this PEIR).

19.8.6 Additional information on the construction, techniques is provided in **Chapter 2 Description of the Proposed Scheme** of this PEIR.

Temporary habitat loss/temporary seabed disturbance

19.8.7 Two of the pressures established by the Marine Pressures-Activities Database v1.5 (Ref 53; Ref 81) 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.

19.8.8 Aspects of the Proposed Offshore Scheme that physically disturb the seabed e.g., seabed preparation (including UXO identification and pre-sweeping of sand waves) and cable burial, have the potential to disturb subtidal habitats and species and cause temporary habitat loss. Typically, the extent of this disturbance would be 30m wide along the entire Proposed Offshore Scheme; 30m is representative of the clearance swathe of the PLGR which would take place along the entire 182km length and represents the worst-case scenario (WCS). The cable clearance and lay activity would take place within the width of this corridor. Beyond this footprint, low intensity physical disturbance may also occur from vessel anchoring or UXO identification.

19.8.9 Most activities that penetrate the seabed would present a temporary impact i.e., would only be undertaken once and the seabed will be able to recover after the activity. Some activities would occur in the same footprint and would be separated by several months e.g., PLGR 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.

19.8.10 The sensitivity to the effects of temporary habitat loss/seabed disturbance varies between receptors, with mobile, epibenthic species the more resilient to said effects (due to their ability to move away from a source of disturbance), whilst sessile epibenthos are the most susceptible to the effects of this impact. Habitats and species occurring within sediments which are regularly exposed to mobile

sediments are more likely to recover from the impacts of temporary habitat loss/seabed disturbance more quickly. Each habitat has been considered in the following sub-sections.

Subtidal Broadscale Habitats and Species

19.8.11 Three broadscale habitat complexes were identified within the Proposed Offshore Scheme including: Atlantic offshore circalittoral sand (MD521), Atlantic offshore circalittoral coarse sediment (MD321), Atlantic offshore circalittoral mixed sediment (MD421).

19.8.12 **Atlantic offshore circalittoral sand (MD521)** was the dominant habitat identified in the Draft Order Limits. The Level 5 biotopes identified within these broadscale habitats consisted of '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (MC5214), '*Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud' (MC6215), '*Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment*' (MC2211) and '*Mytilus edulis beds on Atlantic circalittoral sediment*' (MC2235). Biotopes MC2211 and MC2235 have been assessed separately under Annex I reefs, thus the sensitivities of the biotopes MC5214 and MC6215 have been used to inform the assessment of temporary habitat loss and seabed disturbance on Atlantic offshore circalittoral sand. This habitat presents low sensitivity to the impacts of penetration and abrasion according to MarESA sensitivity assessment. Due to the comparative increased presence of MC5214 compared to MC6215 and the similar sensitivities to impacts, the sensitivity of Atlantic circalittoral sand and Atlantic offshore circalittoral sand to temporary habitat loss and sea disturbance has been based on the habitat sensitivity of MC5214.

19.8.13 *MC5214 'Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' is a habitat of conservation interest and was formerly listed under the UK BAP. Within the boundaries of a Marine Conservation Zone (MCZ), it can be representative of the broadscale habitat subtidal sand. Outside of MCZs, it more generally corresponds to the former UK BAP habitat subtidal sands and gravels.is a habitat of conservation interest and formerly UK BAP habitat which can be representative of broadscale subtidal sand when located within the bounds of an MCZ and more generally is representative of the former UKBAP habitat subtidal sands and gravels habitat outside of these boundaries. This habitat demonstrates low sensitivity to both abrasion and penetration due to high levels of resilience. Trawling studies and the comparative study by Capasso et al. (Ref 66) suggest that the biological assemblage present in this biotope is characterised by species that are relatively tolerant of penetration and disturbance of the sediment. Mobile sands or habitats in shallow water, such as those present within nearshore sites along the Proposed 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 construction is completed within the area.

19.8.14 Therefore, the sensitivity of Atlantic offshore circalittoral sand to seabed disturbance and temporary habitat loss from abrasion and penetration is assessed to be low, as supported by MarESA (Ref 77). 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 and 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 offshore circalittoral sand and Atlantic circalittoral mud is **Negligible** and **Not Significant.**

19.8.15 **Atlantic offshore circalittoral coarse sediment (MD321)** occurred frequently throughout the southern areas of the Proposed Offshore Scheme interspersed in the troughs between mega-rippled sand waves and was associated with areas of 'gravelly muddy sand', 'gravelly sand' and 'muddy sandy gravel'. This habitat occurred in water depths of 42m to 29m below Lowest Astronomical Tide (LAT). Infauna samples acquired within areas of Atlantic offshore circalittoral coarse sediment did not present a sufficient amount of key species to appropriately assign any particular Level 5 biotope. Therefore, this assessment has been conducted at a high level on the JNCC biotope offshore circalittoral coarse sediment (SS.SCS.OCS).

19.8.16 Atlantic offshore circalittoral coarse sediment habitat is characterised by coarse sands and gravel or shell. This habitat may cover large areas of the offshore continental shelf although there is relatively little quantitative data available. Such habitats are generally characterised by robust infaunal polychaete and bivalve species (Ref 64). Evidence is limited but the biological assemblage present in this biotope is characterised by species that are likely to be relatively tolerant of penetration and disturbance of the sediments. Either species are robust or buried within sediments or are adapted to habitats with frequent disturbance (natural or anthropogenic) and recover quickly. Additionally, 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. Therefore, the sensitivity of Atlantic offshore circalittoral coarse sediment to seabed disturbance and temporary habitat loss from abrasion and penetration is assessed to be low, as supported by MarESA (Ref 64).

19.8.17 The magnitude of abrasion and penetration of the seabed has been assessed as low. The significance of this effect to Atlantic circalittoral coarse sediment is **Negligible** and **Not Significant.**

19.8.18 **Atlantic circalittoral mixed sediment** (**MD421**) is present within the southern area of the Proposed Offshore Scheme in areas delineated as flat seabed. Patches of mixed sediment were identified at KP23, KP31, KP66 and KP78 with a

larger patch around KP50. This habitat comprised a single Level 5 biotope of 'polychaete rich deep Venus community in offshore mixed sediment' (MD4211) which is considered representative of the subtidal sands and gravels habitat of principle importance.

19.8.19 This habitat is characterised by a rich population of infaunal polychaetes and a significant number of venerid bivalves. Abrasion is likely to damage epifauna and may damage a proportion of the characterising species. Additionally, species such as hydroids, have demonstrated entanglement as a result of abrasion. However, a comparative study by Capasso *et al.* (2010) (Ref 64) suggests that the biological assemblage present in this biotope is characterised by species that are relatively tolerant of penetration and disturbance of the sediments. Either species are robust or buried within sediments or are adapted to habitats with frequent disturbance (natural or anthropogenic) and recover quickly. Thus, the sensitivity of Atlantic circalittoral mixed sediment to abrasion and penetration has been assessed to be low. 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. The magnitude of the effect to Atlantic circalittoral mixed sediment has been assessed as low. Therefore, using the sensitivity and the magnitude, the significance of the effect on Atlantic circalittoral mixed sediment has been assessed as **Negligible** and **Not Significant**.

Annex 1 reef – *Sabellaria spinulosa* reef

19.8.20 The presence of individual or small aggregations of *S. spinulosa* was commonly found in areas defined as offshore circalittoral mixed sediment and offshore circalittoral coarse sediment, particularly along the southern part of the Proposed Offshore Scheme. This habitat was also found in areas defined as offshore circalittoral sand by **Appendix 19.1 Benthic Survey Report** of this PEIR. Despite variations in sediment preference, both the mixed and coarse sediment types supported potential *S. spinulosa* reef structures, with the species forming crusts on available hard substrates (e.g., occasional low-lying pebbles). *S. spinulosa* is a widely distributed species in the Southern North Sea, typically occurring as isolated individuals or in low-density aggregations. It can form distinct reef structures which are designated as a protected Annex I habitat under the Habitats Regulations and are also listed as a priority habitat under the NERC Act. The Draft Order Limits do not cross any designated sites which include this feature as part of the designation. Therefore, any impacts The Proposed Offshore Scheme may have on this feature will not occur as part of a designated site.

19.8.21 Where aggregations of *S. spinulosa* were identified, seabed imagery were analysed for the potential for this feature to be constitute an Annex I reef using the methodology defined by (Ref 48). From this analysis, the presence of low resemblance Annex I reefs formed by *S. spinulosa* were identified from discrete patches located at KP60, KP73, KP74, KP75. The presence at each of these

locations was represented by a single discrete patch of low resemblance Annex I reef. The presence of discrete patches within sections of the Draft Order Limits suggests that environmental conditions are suitable to form reef patches particularly in areas of broadscale habitat Atlantic offshore circalittoral mixed sediment MD421 and Atlantic offshore circalittoral coarse sediment MD321. The presence of reef in these areas was limited to discrete patches and at no point did these features span the entire width of the Draft Order Limits. Figures detailing the assessment process and the presence of patches assessed for reefiness are shown in Figure 3.47 to Figure 3.54 of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.8.22 *S. spinulosa* reefs comprise of dense subtidal aggregations of this small, tube building polychaete worm. *S. spinulosa* can act to stabilise cobble, pebble and gravel habitats, providing a consolidated habitat for epibenthic species. *S. spinulosa* are "r" strategists and are adapted to live in frequently disturbed environment subject to regular covering and exposure by sediment and natural disruption from storm events. These reefs are especially susceptible to the impacts of dredging and trawling, particularly in areas subject to intensive or prolonged disturbance (Ref 68). However, it is likely that reefs of *S. spinulosa* can recover quite quickly from short-term or intermediate levels of disturbance, as found by Vorberg (Ref 69). Therefore, the sensitivity of *Sabellaria spinulosa* reef on stable circalittoral mixed sediment to seabed disturbance and temporary habitat loss from abrasion and penetration has been assessed to be medium, as supported by MarESA (Ref 68).

19.8.23 The magnitude of the impact has been appraised as low due to the localised and temporary nature of the seabed disturbance associated with the cable installation process and to reflect that the impact is likely to also occur under natural conditions.

19.8.24 With reference to the high ecological value of the habitat, the Applicant would seek to mitigate impacts on any features wherever possible through embedded mitigation. Construction activities would be planned and implemented in a manner that should avoid interference with the Annex I *Sabellaria spinulosa* reefs. Please see Commitment Reference OD08 (**Table 19.22**). With the incorporation of this embedded mitigation, the effect of temporary habitat loss and seabed disturbance on Annex 1 *Sabellaria spinulosa* reef is assessed as **Minor** and **Not Significant**.

Annex 1 reef – Blue mussels *Mytilus edulis*

19.8.25 Patches of aggregated blue mussel were identified in an area of offshore circalittoral sand MD521 within the Draft Order Limits at KP8, and the Level 5 biotope '*Mytilus edulis* beds on sublittoral sediment' (MC2235) was found to be present within areas of Atlantic circalittoral (MD521). Blue mussel are a very common species around the coast of the UK with large commercial beds in the Wash, Morecambe Bay, Conway Bay and the estuaries of south-west England

(Ref 68). In certain conditions, aggregations can form distinct reef structures proud of the seabed which are designated as a protected Annex I habitat under the Habitats Regulations, which are of significant ecological importance. Blue mussel beds are also recognised as a Habitat of Principal importance under the NERC Act (Ref 13).

19.8.26 No grab sampling at these locations were conducted due to the sensitive nature of the feature which meant it was not possible to fully quantify the identified features to biotope level. However, for the purposes of this assessment, the sensitivity of the biotope *MC2235 Mytilus edulis* beds on Atlantic circalittoral sediment has been used as a proxy to assess the sensitivity of the habitat, as this biotope is considered representative of the feature.

19.8.27 The aggregations of blue mussel identified at KP8 were assessed for their resemblance to Annex I reef feature using criteria adapted from Roberts et al (Ref 71). The assessment suggested that the identified aggregations present at KP8 were not sufficiently dense enough and did not cover a large enough area to be considered to represent an Annex I biogenic reef feature as defined by OSPAR (Ref 27). However, whilst they were not considered to represent an Annex I habitat at present within the Draft Order Limits given the rarity of the feature and the potential for this feature to grow prior to construction an impact assessment has been considered further within this section. Figures presenting the location of the assessed aggregations are presented in Figure 3.47 to Figure 3.54 of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.8.28 The occurrence of the biotope requires the presence of dense *Mytilus edulis* beds. *Mytilus* spp. populations are considered to have a strong ability to recover from environmental disturbance (Ref 72; Ref 76). Larval supply and settlement could potentially occur annually; however, settlement is sporadic with unpredictable pulses of recruitment (Ref 75; Ref 74). The sensitivity of this feature is conducted on the basis of the rates adopted by Manwaring et al. 2014 (Ref 75) which suggested that resilience is based on larval supply and wave exposure. Resilience of this feature to the impacts of abrasion and penetration is suggested as medium and therefore may take between two to ten years to recover. Overall, the MarESA assessment suggests that this feature has a medium sensitivity when resilience and recovery are taken into account.

19.8.29 The magnitude of the impact of temporary disturbance has been appraised as low. This assessment reflects the temporary (<1 year) and localised nature of the seabed disturbance associated with the HVDC Submarine Cable installation process with impacts limited to the Draft Order Limits. Combined with a medium sensitivity of blue mussel beds to physical disturbance, the overall effect is determined to be **Minor** and **Not Significant** given that the identified aggregated mussels were not present in sufficient density to constitute an Annex I reef.

19.8.30 Pre-construction surveys would be conducted prior to development, should these surveys reveal that the aggregations have developed sufficiently to constitute an

Annex I reef, the sensitivity would be raised to high on the basis of the feature protection. In this instance the overall effect would be considered moderate and significant. Please see Commitment Reference OD08 (**Table 19.21**). With the incorporation of this embedded mitigation, the effect of temporary habitat loss and seabed disturbance on Annex 1 *blue mussel beds* is assessed as **Minor** and **Not Significant**.

19.8.31 The benthic characterisation survey has informed the exact location of blue mussel beds Figure 3.47 to Figure 3.54 of **Appendix 19.1 Benthic Survey Report** of this PEIR ensuring that accurate micro-routing can be undertaken. With this embedded mitigation, no direct interaction with this type of habitat is expected.

Subtidal sands and gravel

19.8.32 Due to the highly dynamic nature of these habitats, especially in shallower waters, they have a high resilience to any physical disturbance from penetration or abrasion. The subtidal sands and gravels located within the Draft Order Limits have a low sensitivity to physical disturbance.

19.8.33 The subtidal sands and gravels, which dominate much of the Draft Order Limits, are found extensively across the wider North Sea. Temporary disturbance would therefore have negligible effects on the wider distribution and extent of these benthic habitats. Considering this, the magnitude of any temporary disturbance is appraised to be negligible.

19.8.34 Due to the highly dynamic nature of these habitats, especially in shallower waters, they have a high resilience to any physical disturbance from penetration or abrasion. The subtidal sands and gravels located within the Draft Order Limits have a low sensitivity to physical disturbance. The effect on subtidal sands and gravel has been assessed to be **Negligible** and **Not Significant.**

Permanent habitat loss

19.8.35 There would be a requirement to use cable protection within the Draft Order Limits to protect the Proposed Offshore Scheme at infrastructure crossings or for burial remediation where the minimum depth for lowering the cable cannot be achieved. The placement of cable protection would result in the irreversible conversion of sediment habitats to hard substrate, permanently altering the ecological composition and function of the affected area unless they could be removed during decommissioning (see **paragraph 19.8.119**). Such changes can lead to shifts in benthic community, favouring species adapted for hard substrates while displacing those reliant on softer sediments.

19.8.36 A preliminary review of the acquired geophysical and geotechnical data has identified potential areas within the Draft Order Limits where external cable protection may be required. These areas are categorised into two groups: the maximum design envelope for external cable protection excluding infrastructure crossings, and external cable protection required specifically for infrastructure crossings. The locations of cable crossings along the route are known, providing

a high level of certainty regarding the expected volume and footprint of protection in those areas. In total, the Proposed Offshore Scheme, buried within a single trench, would cross 18 other cables which would require the deployment of cable protection. In contrast, the extent of cable protection required where target burial depths cannot be achieved remains uncertain and would be informed by the cable burial risk assessment which would be provided in the ES.

19.8.37 Several cable protection types have been considered within **Chapter 2 Description of the Proposed Scheme** of this PEIR. This assessment has been conducted on the assumption that cable protection would be conducted via rock placement as this is the cable protection type which has the largest seabed footprint. The Applicant has committed burying cables except in areas where trenching isn't possible (ODO4) and ensuring external cable protection shall only be used where it can be demonstrated that adequate burial depth cannot be achieved (e.g., where ground conditions do not allow burial or at infrastructure crossings); the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability (ODO5). Please see for further details on the design and embedded mitigation proposed.

19.8.38 The permanent habitat loss is expected to be limited to discrete areas where these interventions are unavoidable. Pre-construction surveys would inform the routeing of the HVDC Submarine Cable within the Order Limits to minimise the need for such measures and to ensure that sensitive features are avoided as far as possible.

19.8.39 Further details on the WCS installation footprint for permanent habitat loss is presented in **Chapter 2 Description of the Proposed Scheme** of this PEIR. A summary table illustrating the WCS for the basis of this assessment is presented in **Table 19.23**.

Table 19.23: Maximum design envelope for cable protection

Parameter	Value
Estimated external cable protection (excluding infrastructure crossings)	
Length of HVDC Submarine Cable requiring cable protection (excluding infrastructure crossings)	Identification of areas within the Draft Order Limits requiring cable protection was not established prior to PEIR submission. The maximum area of route requiring remedial cable protection will be outlined in the ES.
Total area of seabed covered by cable protection (m^2)	
Total volume of cable protection (m^3)	
Cable Protection for Infrastructure Crossings	
Total number of crossings required	18
Total length of cable crossings (m)	2700 m

Parameter	Value
Total area of seabed covered by cable crossings (m^2)	37,800 m^2

19.8.40 The sensitivity and magnitude of the effects of permanent habitat loss varies between receptors. 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.

Subtidal broadscale habitats and species

19.8.41 There are four broadscale habitat complexes within the Proposed Offshore Scheme including: Atlantic offshore circalittoral sand (MD521), Atlantic circalittoral mud (MC621), Atlantic offshore circalittoral coarse sediment (MD321), Atlantic offshore circalittoral mixed sediment (MD421).

19.8.42 The placement of cable protection within subtidal sands and gravels and habitats Atlantic offshore circalittoral sand (MD521), Atlantic circalittoral mud (MC621), Atlantic offshore circalittoral coarse sediment (MD321) and Atlantic offshore circalittoral mixed sediment (MD421) 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 MD521, MC621, MD321 and MD421 to permanent habitat loss through rock protection is high. Cable protection would be a permanent addition to these habitats, and it is assumed that it would not be removed following decommissioning of the Proposed Offshore Scheme. Cable protection would be installed only where considered necessary for the safe operation of the Proposed 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 as the receiving environment will be used as an alternative to terrestrially sourced granite where feasible)(Commitment Reference OD06). 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 MC321, MC421, MD521 and MC621 has been assessed as negligible. The significance of this effect has been assessed as **Minor** and **Not Significant**.

19.8.43 The Applicant has committed to burying the HVDC Submarine Cables except in areas where trenching isn't possible (Commitment Reference ODO4) and ensuring that external cable protection shall only be used where trenching is not

possible (Commitment Reference ODO5). Please see for further details on the design and embedded mitigation.

Annex 1 reef – *Sabellaria spinulosa*

19.8.44 The presence of low resemblance Annex I *Sabellaria spinulosa* reef were noted within discrete sections of the Draft Order Limits at KP80, KP85, KP90, KP92 and KP93. Further detail on the presence of Annex I *Sabellaria spinulosa* reef is provided in **paragraph 19.8.24** and **Figure 19.4** of this PEIR.

19.8.45 As found within the benthic characterisation survey, identified patches were recorded as *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment (MC2211) in areas of Atlantic offshore circalittoral sand (MD521). Given the potential change of substrate type from sand to artificial concrete/rock, this biotope is assessed as having no resistance and very low resilience to this impact pressure under the MarESA assessment. Given that this is also a highly protected habitat, the sensitivity for this biotope to permanent habitat loss is assessed as high.

19.8.46 Pre-installation habitat mapping would be essential to identify areas of ecological significance, such as established *S. spinulosa* reefs. Avoidance strategies like micro-routing will be applied to avoid these ecologically sensitive areas (Commitment Reference OD08). **Appendix 19.1 Benthic Survey Report** of this PEIR has shown that whilst the presence of low-level patchy Annex I reef was identified within the Draft Order Limits, sufficient space remains available to allow the Applicant to micro-site the final HVDC Submarine Cable position to avoid impacting this habitat. This would limit the level of permanent habitat loss for this feature 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.**

19.8.47 The Applicant has committed to pre-construction surveys to update on the state of sensitive features identified during the characterisation survey. Further details on this commitment are presented in **Section 19.9**. The Applicant has also committed to micro-routeing within the Order Limits to avoid sensitive environmental constraints and minimise the risk of exposure by seabed mobility (Commitment Reference OD08).

Annex I reef - Blue mussel beds

19.8.48 Aggregations of blue mussel were identified within a section of offshore circalittoral sand at KP8 within the Draft Order Limits. These aggregations were assessed for a resemblance to Annex I biogenic reef but were determined not to be considered representative of an Annex I reef feature. Further detail is provided in **paragraph 19.8.28** and a map presenting the location of the assessed aggregation is presented in Figure 3.69 of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.8.49 For the purposes of the assessment a WCS has been considered that this feature would develop prior to construction to form an Annex I reef feature. The Level 5 biotope '*Mytilus edulis beds on Atlantic offshore circalittoral sediment* (MC2235)' was identified in areas of Atlantic circalittoral sand (MC521) within the Draft Order Limits and has been used to assess the sensitivity of this feature.

19.8.50 Blue mussel can be found on a wide range of substrata including artificial substratum (e.g. metal, wood, concrete), bedrock, biogenic reef, caves, crevices/fissures, large to very large boulders, mixed, muddy gravel, muddy sand, rock pools, sandy mud, small boulders, under boulders (Ref 77). An increase in the availability of hard substratum may be beneficial in areas where sedimentary habitats were previously unsuitable for colonisation e.g. coarse, mobile sediments. It should be noted that differences in diversity and other structural characteristics of assemblages between natural and artificial substratum have been observed suggesting that there is not a direct, compensatory effect (Ref 82).

19.8.51 Although individual blue mussels can colonise hard substrates, a change in substrate type may not directly reduce individual productivity. The MarESA assessment is based on the biotope, which includes both the species and the substratum. The sensitivity of blue mussel beds on subtidal sediment to physical change (to another seabed type) is considered high, as such a change can alter the biotope and affect community structure and diversity. Nonetheless, recovery may be possible if suitable sediment remains nearby to support relocation.

19.8.52 Pre-installation habitat mapping would be essential to identify areas of ecological significance, such as established blue mussel reefs. Avoidance strategies like micro-routing will be applied to avoid this ecologically sensitive area (Commitment Reference OD08). **Appendix 19.1 Benthic Survey Report** of this PEIR has shown that whilst the presence of aggregations of blue mussel were present at KP8 within the Draft Order Limits, these did not constitute Annex I reef. Despite this, sufficient space remains available to allow the Applicant to micro-site the final HDVC Submarine Cable position to avoid impacting the existing aggregations. This would limit the level of permanent habitat loss for this feature 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**.

19.8.53 The Applicant has committed to pre-construction surveys to update on the state of sensitive features identified during the characterisation survey. Further details on this commitment are presented in **Section 19.9**. Applicant has also committed to micro-routeing within the Order Limits to avoid sensitive environmental constraints and minimise the risk of exposure by seabed mobility (Commitment Reference OD08).

Subtidal sands and gravel

19.8.54 These habitats are classified by sand and coarse sediment; they have a no resistance to a physical change (to another seabed type). The subtidal sands and gravels located within the Draft Order Limits have a high sensitivity to physical disturbance.

19.8.55 The subtidal sands and gravels, which dominate much of the Draft Order Limits, are found extensively across the wider North Sea. Permanent habitat loss will have negligible effects on the wider distribution and extent of these benthic habitats. Considering this, the magnitude of any temporary disturbance has been assessed to be negligible.

19.8.56 These habitats are classified by sand and coarse sediment; they have a no resistance to a physical change (to another seabed type). The subtidal sands and gravels located within the Draft Order Limits have a high sensitivity to physical disturbance. The effect on subtidal sands and gravel has been assessed to be **Minor** and **Not Significant.**

Temporary increase and deposition of suspended sediments

19.8.57 The construction of the Proposed 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 Proposed Offshore Scheme before the sediment is deposited on the seabed. Additionally, once deposited, these plumes can cause smothering of habitats and their features.

19.8.58 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 Proposed Offshore Scheme.

19.8.59 Once deposited on the seabed, fine particulate sediments can cause light smothering (<5cm) of habitats and species whereas heavier sediments can cause heavy smothering (≥30cm). Gooding et al (Ref 83) reported that fine sediment plumes created by ploughing would rapidly dilute and disperse within the water column, settling in 1mm 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:

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

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

19.8.60 Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR, estimates coarse sediment, created from seabed preparation and cable trenching (excluding sandwave clearance) activities, will settle from the water column within close proximity to the disturbance site. Sedimentation from fine sediment would cause light smothering of less than 1mm along the Proposed Offshore Scheme except for a localised area between KP8 and KP11 where increased fines content would lead to a higher level of sedimentation not exceeding 12mm. Fine sediment will not exceed 0.1mm outside of the study area from pre-lay and cable trenching activities.

19.8.61 For trailing suction hopper dredger (TSHD) activities associated with sand wave clearance coarse sediment would settle within the immediate vicinity of the dredging activity. Fine sediment would not exceed 0.1mm outside of the Draft Order Limits. Within the study area sedimentation would not exceed 1mm except for localised areas within proximity of disposal sites associated with sandwave clearance where light smothering would occur. Sedimentation at the selected disposal sites would be the most significant level of smothering associated with the Proposed Offshore Scheme. Sedimentation at these sites would not exceed 30mm and is likely to remain within 20mm at most sites (**Appendix 18.1 Sediment Modelling Report** of this PEIR). Therefore, there would be no heavy smothering (up to 30cm of fine material added to a habitat in a single discrete event - Ref 60) as a result of the Proposed Offshore Scheme and heavy smothering will not be considered in this assessment.

19.8.62 The maximum distance from trenching activities where suspended sediment concentrations exceed 20mg/l is 10km south west and 5km north east of KP8 aligned with the predominant current where areas of fine sediment contribute to the increase in suspended sediment concentration (SSC). SSCs of around 50mg/l occur along the dredge track from TSHD sand wave clearance activities but these concentrations are short lived generally occurring for less than an hour before reducing to SSCs of <10mg/l. SSC concentrations at selected disposal sites were noted to be the highest modelled (up to 1000mg/l in some instances) but again impacts were determined to be short lived over a period of a few hours. The MarESA threshold for changes in suspended solids is “A change in one rank on the WFD scale (e.g., from clear to intermediate) for one year” (Ref 95). Background values of SSC inshore are high at with an annual average of 47mg/l and sometimes as high as 170mg/l during discrete high energy events. The annual average background concentration offshore was recorded at 5 mg/l. The increases by the Proposed Offshore Scheme are generally within the levels of natural variability noted in the wider area and do not exceed the MarESA threshold for a significant effect.

19.8.63 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.

Intertidal habitats and species

19.8.64 The Proposed Scheme installation would use HDD (Trenchless cabling technique) at the proposed 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.

19.8.65 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 it is also considered a PLONOR ("Pose little or No Risk) on the OSPAR commission's list of substances used and discharged offshore (Ref 96). Due to its clay-like nature, bentonite consists of very fine particulates that would remain within the water column. Thus, limited smothering can occur between tidal cycles. The habitats present within the Walberswick nearshore (proposed Landfall) are comprised of littoral fine sand and muddy sand. They are subject to naturally higher levels of SSCs from fine particulate sediment than subtidal habitats with background concentrations reaching 47mg/l within the nearshore area as set out in **Chapter 18 Marine Physical Environment** of this PEIR. The sensitivity of the habitats present within the intertidal zone to increased suspended sediment from a bentonite plume is negligible.

19.8.66 If a frac-out occurs, a bentonite plume would be visible within the marine environment for the length of the tidal cycle i.e. 24hours over which the release occurred and would be completely diluted in seawater after two tidal cycles. An Outline Offshore Construction Environmental Management Plan (CEMP) and Outline Marine Pollution Contingency Plan would be provided with the ES, which will outline the measures to be implemented to comply with legislation if a pollution event were to occur (see Commitment References OCO1 and OCO5 in **Table 19.22**). 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

19.8.67 There are three broadscale habitat complexes within the Proposed Offshore Scheme including: Atlantic offshore circalittoral sand (MD521), Atlantic offshore circalittoral coarse sediment (MD321), Atlantic offshore circalittoral mixed sediment (MD421). Indicative disposal areas have been identified for the

preliminary assessment as the width of the Draft Order Limits between specific KP points. These may be refined following feedback for the ES and would be fully defined in the DML. **Table 19.24** presents details of the indicative disposal areas and the corresponding broadscale habitats which were identified during the benthic characterisation survey.

Table 19.24: List of indicative sandwave clearance disposal areas and identified subtidal broadscale habitats

Indicative Zone	Identified BSH or Biotopes
KP14 to KP25.5	Predominantly MD521 Atlantic offshore circalittoral sand with patches of MD321 Atlantic offshore circalittoral coarse sediment and MD421 Atlantic offshore circalittoral mixed sediment.
KP33.5 to KP35.5	MD521 Atlantic offshore circalittoral sand
KP42.5 to KP44.5	MD521 Atlantic offshore circalittoral sand
KP54.5 to KP67	Predominantly MC5214 *Abra alba and Nucula nitidosa in Circalittoral Muddy Sand or Slightly Mixed Sediment* and patches of MD421 Atlantic offshore circalittoral mixed sediment
KP97.5 to KP108.5	MC5214 *Abra alba and Nucula nitidosa in Circalittoral Muddy Sand or Slightly Mixed Sediment*
KP116.5 to KP 121.5	MC5214 *Abra alba and Nucula nitidosa in Circalittoral Muddy Sand or Slightly Mixed Sediment*

19.8.68 **Atlantic circalittoral offshore sand (MC521**) 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. Filter/suspension feeders would 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.

19.8.69 The Level 5 biotopes identified within Atlantic circalittoral offshore sand habitats consisted of '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (MC5214), '*Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud' (MC6215), '*Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment*' (MC2211) and '*Mytilus edulis beds on Atlantic circalittoral sediment*' (MC2235). Biotopes MC2211 and MC2235 have been assessed separately under Annex I reefs (see below), thus the sensitivities of the biotopes MC5214 and MC6215 have been used to inform the assessment of increased suspended

sediment and deposition on Atlantic offshore circalittoral sand. Biotope MC5214 demonstrates low sensitivity to temporary increase and deposition (light smothering) of suspended sediment whilst MC6215 is not sensitive to this pressure. Therefore, to represent the WCS, the sensitivity of biotope MC5214 will be used to inform this assessment.

19.8.70 Of the characterising species of MC5214 the catworm (*Nephyts hombergii),* can migrate through up to 90cm of sand of a rate of 20cm/day and *Abra alba* can migrate upwardly through sediment to reach the seabed surface when subject to light smothering. Both species were identified in sediment samples in areas classified as MC6215. *Fabulina fabula* is also characterising species of this habitat and can migrate up to 50cm in sand. Sand habitats have a low sensitivity to increased suspended sediment and light smothering (Ref 84).

19.8.71 Atlantic circalittoral offshore sand is predominantly surrounded by coarse sediment within the Proposed Offshore Scheme, with 86.5% (±15.3 Standard Deviation (SD)) sand present at the offshore stations. Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts that sedimentation levels would not exceed 1mm outside of the Draft Order Limits, except for discrete areas associated with the deposition of material from sandwave clearance where sedimentation levels would not exceed 30mm.

19.8.72 Particle Size Distribution (PSD) data from the marine characterisation survey (**Appendix 19.1 Benthic Survey Report** of this PEIR) demonstrated a dominance of fine sediment (52.7% ±26.0 SD) at nearshore stations. Therefore, any fine particles that were to settle on the sand habitats within the Proposed Offshore Scheme and study area would be insufficient to change the character of the sand habitats.

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

19.8.74 **Subtidal offshore circalittoral coarse sediment** habitats are characterised by mobile infauna and sessile epifauna. Whilst mobile fauna can temporarily relocate to avoid temporary increase and deposition of suspended sediments, the epifauna within this habitat is vulnerable. ‘Common’ and ‘Frequent’ occurring (as per SACFOR scale) species present within subtidal coarse sediments and found within the Draft Order Limits include the pea urchin (*Echinocyamus pusillus*), *A. alba,* and the polychaetes *Spiophanes bombyx* and *Glycera lapidum.* These species can migrate upwardly through the seabed during periods of increased smothering, with *A. alba* and *S. bombyx* demonstrating no sensitivity to light smothering (Ref 86 and Ref 87). Atlantic subtidal offshore circalittoral coarse sediment has a low sensitivity to temporary increases and deposition of suspended sediment.

19.8.75 Subtidal coarse sediments include coarse sand, gravel, pebbles, shingle and cobbles.

19.8.76 Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts that sedimentation levels would not exceed 1mm outside of the Draft Order Limits, except for discrete areas associated with the deposition of material from sandwave clearance where sedimentation levels would not exceed 30mm. Therefore, any fine particles that were to settle on the sand habitats within the Proposed Offshore Scheme would be insufficient to change the character of the sand habitats within the background of natural sediment process.

19.8.77 The magnitude of this effect is negligible. The significance of the effect has been assessed as **Negligible** and **Not Significant.**

19.8.78 **Atlantic offshore circalittoral 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. 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, which is likely to remove any light smothering from sediment deposition. **Chapter 18 Marine Physical Environmental** of this PEIR states peak spring flows varying between 0.5m/s and 1.35m/s within the study area which is broadly typical of the currents within the wider southern North Sea. Mixed sediment habitats are considered to have negligible sensitivity to temporary increases and light deposition of suspended sediment.

19.8.79 The average PSD across the Proposed Offshore Scheme varied between nearshore and offshore sites. The nearshore region (stations LL_01_EBS to LL_17_EBS) comprised mainly of fine sediment (52.7% ±26.0SD), with smaller proportions of sands (33.3% ± 15.8SD) and gravel (14.2% ±23.6SD). The offshore regions (stations LL_21_EBS to LL_138_EBS) comprised of mainly sand (86.5% ±15.3 SD), with smaller proportions of fine sediment (7.79% ±10.5 SD) and gravel (5.69% ± 10.1 SD) (Ref 85).

19.8.80 Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts that sedimentation levels would not exceed 1mm outside of the Draft Order Limits, except for discrete areas associated with the deposition of material from sandwave clearance where sedimentation levels would not exceed 30mm. Therefore, any fine particles that were to settle on the sand habitats within the Proposed Offshore Scheme would be insufficient to change the character of the mixed habitats.

19.8.81 All instances of increased suspended sediment concentrations and deposition would be temporary.

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

Annex I reef – *Sabellaria spinulosa*

19.8.83 *Sabellaria spinulosa* is a tube building polychaete that thrives in areas of increased suspended sediment which it uses for feeding and tube formation activities. Additionally, this polychaete can tolerate 5cm of smothering for several weeks, suggesting a high adaptability to light sediment deposition. Annex I *Sabellaria spinulosa* reefs demonstrate a negligible sensitivity to increased suspended sediment and light smothering (Ref 87).

19.8.84 Low resemblance Annex I *Sabellaria spinulosa* reefs were present in mixed and coarse sediment habitats within the Draft Order Limits, particularly along the southern section of the Proposed Offshore Scheme.

19.8.85 Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts that sedimentation levels of more than 0.1mm only predicted to occur within the study area while sedimentation of more than 1mm was only predicted to occur within the Draft Order Limits, except for discrete areas at KP8 associated with the deposition of material from sandwave clearance where sedimentation levels would not exceed 30mm. Therefore, any fine particles that were to settle on the reef habitats within the Proposed Offshore Scheme would be insufficient to change the character of the reef habitats. All instances of increased suspended sediment concentrations and deposition would be temporary.

19.8.86 Smothering in the Draft Order Limits would not exceed 1mm within the vast majority of the Draft Order Limits. Very isolated patches, i.e. sandwave clearance disposal areas may reach high sedimentation rates of around 30mm. However, the MarESA benchmark states smothering of less than 5cm is considered 'Light' and that *Sabellaria spinulosa on stable Atlantic circalittoral mixed sediment* is 'Not Sensitive' to this pressure at this benchmark due to its high resilience.

19.8.87 The Draft Order Limits do not cross any sites designated for benthic habitats therefore any impacts the Proposed Offshore Scheme may have on Annex I *Sabellaria spinulosa* reefs would not occur on habitat designated as part of a site.

19.8.88 The magnitude of temporary increase and deposition of suspended sediment on Annex I *Sabellaria spinulosa* reefs has therefore been considered as low. The significance of the effect has been assessed as **Negligible** and **Not Significant.**

Annex I reef - blue mussel beds

19.8.89 Patches of aggregated blue mussel were identified in an area of Atlantic offshore circalittoral sand within the Draft Order Limits at KP8. No grab sampling at these locations were conducted due to the sensitive nature of the feature, which meant it was not possible to quantify the identified features to biotope level. The Level 5 biotope '*Mytilus edulis beds on Atlantic circalittoral sediment* (MC2235)' was

identified to be present within areas of Atlantic circalittoral mud within the Draft Order limits and has been used to assess the sensitivity of this feature.

19.8.90 The aggregations of blue mussel identified at KP8 were assessed for their resemblance to Annex I reef feature using criteria adapted from Roberts et. al. (Ref 62). The assessment suggested that the identified aggregations present at KP8 were not sufficiently dense enough and did not cover a large enough area to be considered to represent an Annex I biogenic reef feature as defined by OSPAR. However, whilst they were not considered to represent an Annex I habitat at present within the Draft Order Limits, given the rarity of the feature and the potential for this feature to grow prior to construction an impact assessment has been considered further within this section. Figures presenting the location of the assessed aggregations are presented in Figure 3.47 to Figure 3.54 of **Appendix 19.1 Benthic Survey Report** of this PEIR.

19.8.91 Individual blue mussels are not sensitive to increased suspended sediment concentrations; blue mussels are suspension feeders, occurring in areas of high suspended particulate matter (Ref 68). Additionally, blue mussels possess efficient shell cleaning and pseudofaeces expulsion mechanisms to remove silt cover (Ref 88).

19.8.92 The biotope *Mytilus edulis beds on Atlantic circalittoral sediment* (MC2235) demonstrates a medium sensitivity to smothering from increased deposition of suspended sediments (Ref 68). However, this MarESA sensitivity score presents the worst-case scenario and states 'mortality is likely to be more significant in wave sheltered areas, devoid of tidal streams, where the smothering sediment remains for prolonged periods.' The aggregate of blue mussel is present at an offshore site within the Draft Order Limits, where they will be exposed to tidal energy, and all instances of increase and deposition of suspended sediment would be temporary, lasting a short period of time. Thus, this increased mortality is unlikely to occur. Additionally, (Ref 68) notes blue mussels have a demonstrated ability to remerge from 6cm of smothering within one day and demonstrated blue mussels were able to survive smothering depths of 2cm, 5cm and 7cm for 32 days. However, it is important to also note that recorded blue mussel mortality after sediment smothering of 1–2cm. For this reason, a precautionary medium sensitivity value has been used in the assessment.

19.8.93 Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts Sedimentation of more than 0.1mm was only predicted to occur within the study area, except for discrete areas associated with the deposition of material from sandwave clearance where sedimentation levels which would not exceed 30mm. Sedimentation of more than 1mm was only predicted to occur within the Draft Order Limits. All instances of increased suspended sediment concentrations and deposition would be temporary.

19.8.94 Therefore, the magnitude of this effect is assessed to be low and the significance of effect has been assessed as **Minor** and **Not Significant**.

19.8.95 Pre-construction surveys will be conducted prior to development; should these surveys reveal that the blue mussel aggregations have developed sufficiently to constitute an Annex I reef, the sensitivity would be raised to high on the basis of feature protection.

Subtidal sands and gravel

19.8.96 Subtidal sands and gravels, which are commonly found in the North Sea and present within the Proposed Offshore Scheme, are highly mobile (Ref 45) and are subject to natural increased turbidity from high energy wave action, a similar level to that expected to be caused by cable construction activities. This moderate high tidal energy is likely to remove all light smothering (<5cm) from sediment deposition. Subtidal sands and gravels habitats have a low sensitivity to temporary increase and deposition of suspended sediment.

19.8.97 The subtidal sands and gravels, which dominate much of the Draft Order Limits, are found extensively across the wider North Sea. Temporary increases and deposition of suspended sediments within the Draft Order Limits will therefore have negligible effects on the wider distribution and extent of these benthic habitats. The magnitude of this effect is assessed to be negligible. The significance of this effect has been assessed as **Negligible** and **Not Significant**.

Changes in underwater noise

19.8.98 All works undertaken during the construction phase of the Proposed Offshore Scheme will generate underwater sound. Sound is readily transmitted into the underwater environment. Sound 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. 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. This category includes sound sources such as continuous running machinery, sonar, and vessels.

19.8.99 Primary sources of underwater sound from the Proposed Offshore Scheme include vessel movements, geophysical surveys, the use of equipment on the seabed (e.g. boulder grabs, pre-sweeping and trenching equipment) and UXO clearance (noting that UXO clearance will not be a licensable activity under the DML). Most of the source types generate continuous (non-impulsive) sound; the exception is UXO clearance. Activities associated with the lift and shift of any confirmed UXO are to be included in the application for development consent.

19.8.100 At present there are no published sensitivity thresholds for benthic species. A review of MarESA sensitivity assessments for habitats and marine invertebrates

identified within the Proposed Offshore Schemes recognised 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. MarESA consider the benchmark level to be the regular passing of a 30m trawler at 100m or a working cutter-suction transfer dredge at 100m for one month during important feeding or breeding periods. As the benchmark is analogous to the activities that would take place during construction, i.e., vessel movements, seabed disturbance, the sensitivity of subtidal species to underwater noise is assessed as negligible and the magnitude of effect has been assessed to be negligible. The overall significance of effect of underwater noise on subtidal species has been assessed as **Negligible** and **Not Significant.**

Transboundary temporary increase and deposition of suspended sediments

19.8.101 With regards to the potential for sediment plumes to be transported into neighbouring state waters, the study area only intersects with the Netherlands EEZ. Therefore, the only potential for transboundary effects is due to cable installation at the offshore end of the Draft Order Limits where the Proposed Offshore Scheme transits into the Netherlands. In this region the flows are aligned almost parallel with the UK-Dutch EEZ boundary (with ebbing northward flows driving any plume slightly inshore into the UK EEZ while flooding southward flows would drive any plume slightly offshore into the Dutch EEZ). Peak flows in this area are relatively slow (around 0.5m/s on spring tides, with an equivalent spring tide excursion of approximately 6.5km). Given the flow speeds and directions, any plume generated by cable installation activities occurring between approximately KP173 to the end of the Proposed Offshore Scheme could be transported into the Dutch EEZ on the flood tide. Any increases in SSC would be shorted lived occurring intermittently for two days or less depending on installation speeds. Further, the increases would only occur close to the seabed and would have a low magnitude. A similar impact in the UK EEZ would be expected to occur on the ebb tide from cable installation within the Dutch EEZ in the area close to the UK-Dutch EEZ border. Project specific data presented in **Chapter 18 Marine Physical Environment** of this PEIR and discussed in **paragraph 19.8.60** to **paragraph 19.8.62** predicts that sedimentation levels of more than 0.1mm only predicted to occur within the study area wile sedimentation of more than 1mm was only predicted to occur within the Draft Order Limits. On this basis, the magnitude of the impact has been assessed as negligible.

19.8.102 The broadscale habitats present at the Dutch EEZ include circalittoral sand and circalittoral mud habitats.

19.8.103 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. 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. Therefore, sand habitats demonstrate a low sensitivity to temporary increase and deposition of suspended sediment.

19.8.104 The transboundary effects of temporary increases and deposition of suspended sediment on sand habitats is assessed as **Negligible** and **Not Significant**.

19.8.105 The characterising polychaetes of mud habitats are either predators or deposit feeders and are unaffected by increased suspended sediment in the water column. Characterising bivalves of mud habitats include *Kurtiella bidentata, Abra* spp. and *Thyasira* spp. which can migrate through up to 20cm of sediment deposition to reach the seabed surface. Other characterising species include the brittlestar *Ophiura ophiura* which can survive up to 32 days buried in up to 7cm of coarse and fine sediment (Ref 89) and the polychaetes *Nephtys spp*. and *Nereis spp.* which can migrate through up to 50cm of deposited mud. The sensitivity of mud habitats to increased suspended sediment and light smothering is therefore negligible. The transboundary effects of temporary increase and deposition of suspended sediment on mud habitats is assessed as **Negligible** and **Not Significant**.

Operation and maintenance

19.8.106 The Proposed Offshore Scheme would be designed to minimise any maintenance requirements. Following installation, routine operation and maintenance activities will be required. These are expected to include:

a. inspection surveys;
b. cable repair (if required); and
c. reburial, remedial protection, or maintenance and reinstatement of external cable protection features.

19.8.107 The associated impacts of operation and maintenance would be less than those experienced during the construction phase of the Proposed Offshore Scheme. Consequently, as a WCS, operational impacts would be equal to or less than the magnitude to construction. Therefore, the following conclusions reached for construction are applicable:

a. Temporary habitat loss/seabed disturbance to subtidal habitats and species;
   i. Subtidal Broadscale Habitats and Species- **Negligible** and **Not Significant**;
   ii. Annex 1 reef – Sabellaria spinulosa reef– **Minor** and **Not Significant**;

iii. Annex 1 reef – Blue mussels Mytilus edulis– **Minor** and **Not Significant**;
iv. Subtidal sands and gravel - **Negligible** and **Not Significant**;

b. Permanent Habitat Loss;
i. Subtidal Broadscale Habitats and Species – **Minor** and **Not Significant**;
ii. Annex 1 reef – *Sabellaria spinulosa* – **Minor** and **Not Significant**;
iii. Annex I reef - Blue mussel beds *Mytilus edulis* – **Minor** and **Not Significant**;
iv. Subtidal sands and gravel– **Minor** and **Not Significant**;

c. Temporary Increase and deposition of suspended sediments;
i. Intertidal Habitats and Species - **Negligible** and **Not Significant**;
ii. Subtidal Broadscale Habitats and Species- **Negligible** and **Not Significant**;
iii. Annex I reef – *Sabellaria spinulosa* - **Negligible** and **Not Significant**;
iv. Annex I reef - blue mussel beds– **Minor** and **Not Significant**;
v. Subtidal sands and gravel- **Negligible** and **Not Significant**;

d. Changes in underwater noise- **Negligible** and **Not Significant**;

e. Transboundary Effects of Temporary increase and deposition of suspended sediments - **Negligible** and **Not Significant**;

19.8.108 Please refer to **paragraph 19.8.4** for detailed impact assessment for construction.

19.8.109 Additional information on the Proposed Offshore Scheme operation and maintenance is provided in **Chapter 2 Description of the Proposed Scheme** of this PEIR.

Temperature changes

19.8.110 During the operation of the HVDC Submarine Cable, heat losses will occur due to the resistance of the HVDC Submarine Cable/conductor. This would cause isolated heating of the surrounding environment, such as the sediment around a buried cable 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 0.2m depth is used as a guideline in Germany (Ref 93). The benchmark for sensitivity used by MarESA is a 5°C increase in temperature for one month, or 2°C for one year.

19.8.111 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.

19.8.112 A review of the sensitivity of some of the most common infaunal species identified within the Draft Order Limits (*Abra alba*, *Spiophanes bombyx*, *Fabula fabulina*, *Nuclua nitidosa* and *Owenia spp.*) concluded that their resistance and resilience to temperature increases lead to an overall low or no sensitivity categorisation by MarESA. Therefore, the sensitivity of subtidal species to increases in temperature has been assessed as low.

19.8.113 The heat loss from the cable is related to the physical and thermal properties of the cables. To inform the assessment, a desk-top literature review was conducted to evaluate the thermal performance of submarine cables of analogous projects, including recorded temperature changes surrounding the cables at differing depths (**Appendix 2.4 Offshore Thermal Emissions Technical Note** of this PEIR). The technical note concludes that for cables operating at full power, the temperature is raised in the immediate vicinity of the cable but reduces with distance.

19.8.114 The average ambient temperature 0.5m below seabed in the North Sea is 15°C. Assuming a cable burial depth of 1m below the seabed, modelling from analogous projects outlined in **Appendix 2.4 Offshore Thermal Emissions Technical Note** of this PEIR demonstrated seabed temperatures increases can be expected to be at or around current accepted limits of 2°C over a year, over localised areas. This is on the assumption that the HVDC Submarine Cables are operating at maximum operating temperatures during this time. To reach these temperatures the system would have to operate at full load continuously for an extended period of time (months/years). In reality, the system will not be at full load for this long and therefore the temperature would fluctuate and be unlikely to reach these maximums for extended periods. Although thermal effects would be long-term and occurring continuously for the operational lifetime of the Proposed Offshore Scheme, the temperature increase is low level and likely to be only 1 – 2°C higher than ambient at the shallow sediment depths (<0.2m) at which infaunal species are typically found. Therefore, the magnitude of the effect has been assessed to be low.

19.8.115 The significance of the effect on subtidal species has been assessed as **Negligible** and **Not Significant.**

Electromagnetic Field (EMF) Changes

19.8.116 During the operation of an HVDC Submarine Cable, EMF emissions are generated. To inform the assessment, a single scenario was modelled to calculate the EMF emissions. The calculations are presented in **Appendix 2.3 Electromagnetic Field Assessment** of this PEIR. They show that for bundled HVDC poles the magnetic field dissipates to background geomagnetic levels approximately 10m above the seabed when cables are buried at 1m below the seabed. The magnetic field directly above the cables at the seabed is 99.3μT.

19.8.117 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 Ref 123 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. The sensitivity of subtidal species to electromagnetic changes is negligible.

19.8.118 Where possible, the HVDC Submarine Cables used within the Proposed Offshore Scheme would be buried. Finalised target burial depth would be defined post-consent in a pre-construction CBRA. Given the background geomagnetic field of around 49μT, the background induced electric field could range between 4.9 and 62μV/m in tidal velocities between 0.5m/s and 1.3m/s (as stated in **Appendix 2.3 Electromagnetic Field Assessment** of this PEIR). Although effects from electromagnetic changes would be long-term and occurring continuously for the operational lifetime of the Proposed Offshore Scheme, the highest intensity emission strength for the Proposed Offshore Scheme is significantly lower than that used in the laboratory experiments reviewed by Ref 94. Thus, the magnitude of the effect is negligible.

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

Decommissioning

19.8.120 The Proposed Scheme is expected to have a life span of 40 years. If decommissioning requires cessation of operation and removal of visible infrastructure at this point, then activities and effects associated with the decommissioning phase are expected to be no worse than during construction; and with the removal of visible infrastructure, effects would reduce over the course of that period. The Proposed 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. The following conclusions reached for construction are therefore applicable:

f. Temporary habitat loss/seabed disturbance to subtidal habitats and species;
   i. Subtidal Broadscale Habitats and Species- **Negligible** and **Not Significant**;
   ii. Annex 1 reef – Sabellaria spinulosa reef– **Minor** and **Not Significant**;
   iii. Annex 1 reef – Blue mussels Mytilus edulis– **Minor** and **Not Significant**;
   iv. Subtidal sands and gravel – **Negligible** and **Not Significant**;

g. Permanent Habitat Loss;
   i. Subtidal Broadscale Habitats and Species – **Minor** and **Not Significant**;
   ii. Annex 1 reef – *Sabellaria spinulosa* – **Minor** and **Not Significant**;
   iii. Annex I reef - Blue mussel beds *Mytilus edulis* – **Minor** and **Not Significant**;

iv. Subtidal sands and gravel– **Minor** and **Not Significant**;

h. Temporary Increase and deposition of suspended sediments;
   i. Intertidal Habitats and Species – **Negligible** and **Not Significant**;
   ii. Subtidal Broadscale Habitats and Species- **Negligible** and **Not Significant**;
   iii. Annex I reef – *Sabellaria spinulosa* - **Negligible** and **Not Significant**;
   iv. Annex I reef - blue mussel beds– **Minor** and **Not Significant**;
   v. Subtidal sands and gravel- **Negligible** and **Not Significant**;

i. Changes in underwater noise- **Negligible** and **Not Significant**;

j. Transboundary effects of temporary increase and deposition of suspended sediments – **Negligible** and **Not Significant**

19.8.121 Please refer to **paragraph 19.8.4** for detailed impact assessment for construction.

19.9 Mitigation, monitoring and enhancement

19.9.1 Mitigation measures are defined in **Chapter 5 EIA Approach and Methodology** of this PEIR, with embedded control measures for intertidal and subtidal benthic ecology being presented in **Section 19.6** of this chapter.

Additional mitigation and enhancement

19.9.2 The preliminary environmental assessment has concluded that the Proposed Offshore Scheme alone would not have any significant effects that would require additional mitigation. However, it is acknowledged that the presence of discrete patches of low resemblance Annex I *Sabellaria spinulosa* reef and single patch of aggregated blue mussel were identified within the Draft Order Limits. These habitats can be highly ephemeral with features breaking up during winter storms and re-establishing or growing in the next season.

19.9.3 Whilst the PEIR assessment has determined that the Proposed Offshore Scheme would not have an adverse effect on either of the habitats this is partly due Commitment Reference OD08 whereby micro-routeing would be undertaken within the Draft Order Limits to avoid sensitive features. Based on the current extent and quality of these features, the Applicant is confident that sufficient space remains within the width of the Draft Order Limits for effective micro-routeing, to ensure that impacts on these features are Not Significant. Biogenic reef features are ephemeral in nature, and their extent may change from the pre-consent baseline prior to construction. Pre-construction surveys will inform the final routing decisions. If routeing cannot avoid Annex I reef features, the Applicant commits to minimising the footprint within sensitive habitats by selecting a route that affects the smallest possible area and targets the lowest quality reef. Consultation with the relevant SNCBs will be undertaken once the results of the pre-construction surveys are available and a final route has been identified.

Table 19.25: List of indicative pre-construction survey areas and identified subtidal broadscale habitats

Indicative Zone	Identified BSH or Biotopes
KP 8	Blue mussel beds *Mytilus edulis*
KP 60	*Sabellaria spinulosa*
KP 73	*Sabellaria spinulosa*
KP 74	*Sabellaria spinulosa*
KP 75	*Sabellaria spinulosa*

19.9.4 Given the ephemeral nature of these features, the Applicant proposes to undertake a pre-construction survey to confirm the location and extent of any biogenic reef habitat (*Sabellaria spinulosa* and blue mussel) within the Draft Order Limits. The survey specification would be agreed with the MMO prior to the commencement of survey works. The 2024 marine characterisation survey would be used to focus the scope of the pre-construction survey. The pre-construction survey would be used for micro-routeing to avoid or minimise the impact on sensitive features (Project Offshore Commitment 01, **Appendix 29.1 Outline Schedule of Environmental Commitments and Measures** of this PEIR).

Monitoring

19.9.5 There are no likely significant adverse effects related to the intertidal and subtidal benthic ecology assessment identified either during construction, operation and maintenance or decommissioning stages of the Proposed Scheme that require monitoring.

19.10 Summary of residual effects

19.10.1 The preliminary assessment has concluded that no significant effects on intertidal and subtidal ecology are expected from the Proposed Offshore Scheme alone during construction, operation and maintenance, and decommissioning, provided design and control measures are implemented. No additional mitigation has been proposed at this stage.

Topic Glossary and Abbreviations

Term	Definition
CBRA	Cable Burial Risk Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute for Ecology and Environmental Management
DCO	Development Consent Order
DDV	Drop-Down Video
DML	Deemed Marine Licence
DVV	Dual van Veen
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMODnet	European Marine Observation Data Network
ES	Environmental Statement
EUNIS	European Union Nature Information System
FOCI	Feature of Conservation Importance
HDD	Horizontal Directional Drilling
HOCI	Habitat of Conservation Importance
HRA	Habitats Regulations Assessment
HVDC	High Voltage Direct Current
LAT	Lowest Astronomical Tide
MarLIN	The Marine Life Information Network
MarESA	Marine Evidence based Sensitivity Assessment
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MHWS	Mean High Water Springs
MINNS	Marine Invasive Non-native Species
MMO	Marine Management Organisation
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
NBN	National Biodiversity Network

Term	Definition
NERC	Natural Environment and Rural Communities
NGLL	National Grid Lion Link Limited
NM	Nautical Miles
NPPF	National Planning Policy Framework
OSPAR	Convention for the Protection of the Marine Environment of the North East Atlantic
PEIR	Preliminary Environmental Information Report
PINS	The Planning Inspectorate
PLGR	Pre-Lay Grapnel Run
PSD	Particle Size Distribution
SAC	Special Area of Conservation
SD	Standard Deviation
SoS	Secretary of State
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
SWT	Suffolk Wildlife Trust
TSHD	Trailing Suction Hopper Dredger
UK	United Kingdom
UXO	Unexploded Ordnance
WCS	Worst-case Scenario
ZoI	Zone of Influence

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