7. Intertidal and Subtidal Benthic Ecology

7.1. Study Area Definition

This chapter of the Scoping Report describes the potential impacts arising from the construction, operation and maintenance and decommissioning of Eastern Green Link 3 (EGL 3) hereafter referred to as 'the Project' on intertidal and subtidal benthic ecology receptors. Benthic receptors include the organisms living in (infauna) or on (epifauna) the seabed, excluding shellfish which are covered in Chapter 8 – Fish and Shellfish, as well as their supporting habitats.

The Scoping Boundary for the Project extends from MHWS in England to MHWS in Scotland. It is nominally 1 km wide, 500 m either side of the centreline, but however, it widens in areas where there is still optionality in the design e.g., to allow for micro-routeing around potential seabed features. It is anticipated that the Marine Licence application boundary will ultimately be 500 m following refinement and rationalisation as the MEA and design process evolves.

There are two proposed Landfalls in England being considered at this stage of the environmental assessment process; Anderby Creek and Theddlethorpe. These options will be subject to further technical feasibility work and stakeholder consultation and will be refined to one preferred option for inclusion in the subsequent Marine Licence application for the Project.

The Study Area for this receptor includes the Scoping Boundary plus an additional 15 km buffer to either side, representative of the maximum tidal excursion. This is consistent with the Marine Physical Processes chapter (Chapter 6) and incorporates the area within which there is the potential for indirect impacts associated with the deposition of suspended sediments. The Study Area will be reviewed and refined for the Marine Environmental Assessment (MEA) based on maximum tidal excursions and, if appropriate, sediment dispersion modelling. The zone of influence will be influenced by the conclusions of Chapter 6 – Marine Physical Processes, and this chapter should be read in conjunction with these findings.

Kilometre Points (KPs) are used throughout this Chapter to provide context as to where within the Study Area a feature lies. KP 0 is defined at the Anderby Creek Landfall. As there are still alternative Landfalls being considered, KPs have been created along the longest route from the proposed English Landfall at Anderby Creek, around the Holderness Offshore Marine Conservation Zone (MCZ) to the proposed Scottish Landfall at Sandford Bay. The KPs for this route are referenced as KP 0 – KP 575.3. Alternative options, which branch off this longest route, are routed from the proposed English Landfall at Theddlethorpe to the point where it converges with the longest route (referenced as T_KP 0 to T_KP18); and through Holderness Offshore MCZ, which is referenced as KP 0 to H_KP 40.

7.2. Data Sources

Data sources for the baseline characterisation will be presented in accordance with relevant guidance for the topic. The datasets that will be used to inform the description of the baseline environment for the MEA are described in the following sub-sections.

7.2.1. Site-specific Survey Data

Site-specific intertidal and subtidal benthic surveys will be carried out to supplement publicly available data sources to characterise the baseline environment and determine the presence of any features that may have conservation significance. A geophysical survey will be carried out first, over an approximate 500 m wide area, along the length of the proposed submarine cable corridor (including the landfall). In some areas this width will increase to 1 km if there are features of interest. Preliminary interpretation of the geophysical data will be undertaken onboard the survey vessel and environmental sampling stations will be selected based on this interpretation.

The survey methods will be based on consideration of best practice guidance including Davies et al. (2001), Wyn et al. (2006), Saunders et al. (2011), Nobel-James et al. (2018), and NRW (2019).

Positioning of environmental grab sampling stations will be based on flexible design - spacing interval will be informed by geophysical survey outputs as well as a review of publicly available data. However, it is expected that environmental sample stations will be located approximately every 1 km along the nearshore and coastal approaches section of the proposed submarine cable corridor. The sample stations within Marine Protected Areas with protected features sensitive to cable installation will be at 500m. However, where possible, video transects will be completed if sensitive species have been identified in the area. The offshore sections of the proposed submarine cable corridor will use an interval of 5-10 km.

At each sample location there will be two x Van Veen Grab drops totalling four samples from two drops (2 x Replicate A and B). Sediments from Replicate A only will be analysed from each drop for macrobenthic analysis and physio-chemical analysis, sediments from Replicate B will act as reserve samples. 0.1 m^2 samples will be collected with a Dual Van-Veen grab being used as the primary choice. Only grab samples comprising a minimum of 7 cm grab capacity with no evidence of wash-out will be accepted. Three attempts will be made at each station and if no sample is able to be collected this will be recorded.

The habitat mapping and biotope classifications shall be ground-truthed through a combination of photographic surveys (using both high resolution video and stills) and the benthic grab sampling at pre-determined sample locations, informed by the initial habitat maps.

Additional video transects will be undertaken to investigate potential sensitive features. The camera will be towed at a maximum of 1 knot above the seabed to ensure consistent footage. The footage will be the only source of ground-truthing in areas where a benthic grab has been unsuccessful.

The footage review will include observations such as substrate characterisation, evidence of benthic activity by organisms, identification of habitats and organisms, characterisation of aquatic vegetation and evidence of fishing activity.

Data will be used to produce intertidal and subtidal habitat maps. Faunal identification and quantification will be carried out on grab samples and still photographs to obtain species density data and percentage cover for colonial species.

Habitats will be identified to the lowest European Nature Information System (EUNIS) habitat classification possible. If a sensitive EC Habitats Directive Annex I listed habitat e.g., biogenic, stony or bedrock reef, etc., is identified the extent of the habitat within the survey area will be determined and consideration will be given to whether additional survey is required to avoid the habitat or further classify it.

Currently both open cut trenching and trenchless techniques are proposed methods of construction, a Phase 1 habitat walkover survey has been completed on the beach. Instead, characterisation will be based on the subtidal methodology proposed above.

Relevant stakeholders such as MMO, MD-LOT, Natural England, NatureScot, SEPA, Cefas and the JNCC will be consulted prior to the survey commencing. Some of this stakeholder engagement has already been undertaken.

7.2.2. Publicly Available Data

Desk based review of publicly available data sources (literature and GIS mapping files) will be used to supplement the site-specific ecology surveys and describe the wider baseline environment. Table 7-1 lists the key data sources which would be used in the assessment.

Table 7-1: Key publicly available data sources for intertidal and subtidal benthic ecology

Data Source	Description	Coverage	
		English Study Area	Scottish Study Area
EMODnet (2021)	EUNIS 2019 habitat types.	✓	✓
JNCC	Marine Habitat data product: Habitats Directive Annex I marine habitats. JNCC Conservation Advice for Marine Protected Areas.	✓	✓
Natural England	Natural England Conservation Advice for Marine Protected Areas.	✓	
Inshore Fishing and Conservation Authorities	Website with Information about fishing and the species in the different regional Eastern and Northeastern Inshore Fishing and Conservation Authorities.	✓	
British Geological Survey (BGS) Marine Sediment Particle Size dataset sourced from the BGS GeoIndex Offshore porta	This is a national dataset providing full coverage of the benthic, subtidal and intertidal aspects of the Study Area.	✓	✓
UKSeaMap 2018	Broad-scale overview of the coverage of different physical seabed habitats in the UK.	✓	✓
OneBenthic portal run by OpenScience Cefas	Compilation of 33,198 macrofaunal samples from 2014-2016, 83% of which contain associated data on sediment particle size composition. Dataset covers large areas of the UK continental shelf and was funded by the aggregates industry. (OpenScience.Cefas, 2023).	✓	✓
NatureScot	An executive non-departmental public body of the Scottish government responsible for the country's natural heritage. https://www.nature.scot/		✓

Data Source	Description	Coverage	
		English Study Area	Scottish Study Area
Offshore Wind Farm (OWF) and Interconnector Environmental Statements	Environmental Statements for OWF developments Outer Dowsing Offshore Windfarm Viking Link.	✓	✓
DEFRA (2020)	Intertidal substrate foreshore data.	✓	✓

7.2.3. Additional Studies

Beyond collection of site-specific survey data, no additional studies are proposed to inform this assessment. However, Chapter 6: Marine Physical Processes and Chapter 8: Fish and Shellfish will inform the environmental assessment.

7.3. Consultation

Consultation will be undertaken with stakeholders to supplement the desktop review and studies. The following bodies will be consulted as a minimum to ensure that the most up-to-date information is collated.

Table 7-2: List of stakeholders to be consulted

England	Scotland
JNCC	JNCC
Natural England (NE)	NatureScot
Centre for Environment, Fisheries and Aquaculture Science (Cefas)	Marine Scotland (MD-LOT)
Inshore Fisheries and Conservation Authority (IFCA) Eastern, North-Eastern and Northumberland.	
Environment Agency	Scottish Environmental Protection Agency (SEPA)
Centre for Environment, Fisheries and Aquaculture Science (Cefas	Centre for Environment, Fisheries and Aquaculture Science (Cefas

7.4. Baseline Characterisation

7.4.1. Introduction

This section has been split into the following sub-sections.

- General information
- English baseline characterisation
- Scottish baseline characterisation

This section provides a characterisation of the current baseline environment and describes the key intertidal and subtidal benthic ecology along the proposed submarine cable corridor. It also includes the designated sites and protected species within the English and Scottish Study Areas.

7.4.2. General Information

The proposed submarine cable corridor passes through various broadscale habitats between the proposed English and Scottish landfall sites. Table 7-3 lists these habitats along with a description of it.

Table 7-3: Broadscale habitat descriptions which the proposed submarine cable corridor passes through

Broadscale habitat type	EUNIS habitat description
A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Rocky habitats in the infralittoral zone subject to extremely exposed wave action or strong tidal streams. Typically, the rock supports a community of kelp *Laminaria hyperborea* with foliose seaweeds and animals, the latter tending to become more prominent in areas of strongest water movement. The depth to which the kelp extends varies according to water clarity, exceptionally (e.g. St Kilda) reaching 45 m. The sublittoral fringe is characterised by dabberlocks *Alaria esculenta.*
A3.2 - Atlantic and Mediterranean moderate energy infralittoral rock	Predominantly moderately wave-exposed bedrock and boulders, subject to moderately strong to weak tidal streams. On the bedrock and stable boulders there is typically a narrow band of kelp *Laminaria digitata* in the sublittoral fringe which lies above a *Laminaria hyperborea* forest. Associated with the kelp are communities of seaweeds, predominantly reds, including a greater variety of more delicate, filamentous types than are found on more exposed coasts (cf. A3.11).
A4.1 - Atlantic and Mediterranean high energy circalittoral rock	Occurs on extremely wave-exposed to exposed circalittoral bedrock and boulders subject to tidal streams ranging from strong to very strong. Typically found in tidal straits and narrows. The high-energy levels found within this habitat complex are reflected in the fauna recorded. Sponges such as *Pachymatisma johnstonia*, *Halichondria panicea*, *Esperiopsis fucorum* and *Myxilla incrustans* may all be recorded. Characteristic of this habitat complex is the dense 'carpet' of the hydroid *Tubularia indivisa.* The barnacle *Balanus crenatus* is recorded in high abundance on the rocky substrata. On rocky outcrops, *Alcyonium digitatum* is often present.
A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Mainly occurs on exposed to moderately wave-exposed circalittoral bedrock and boulders, subject to moderately strong and weak tidal streams. This habitat type contains a broad range of biological subtypes, from echinoderms and crustose communities (A4.21) to *Sabellaria* reefs (A4.22) and circalittoral mussel beds (A4.24).
A5.13 Infralittoral coarse sediment	Moderately exposed habitats with coarse sand, gravelly sand, shingle and gravel in the infralittoral zone, are subject to disturbance by tidal steams and wave action. Such habitats found on the open coast or in tide-swept marine inlets are characterised by a robust habitat of infaunal polychaetes such as *Chaetozone setosa* and *Lanice conchilega*, *cumacean crustacea* such as *Iphinoe trispinosa* and *Diastylis bradyi,* and venerid bivalves. Habitats with the lancelet *Branchiostoma lanceolatum* may also occur.
A5.14 Circalittoral coarse sediment	Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20 m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves. Certain species of sea cucumber (e.g. *Neopentadactyla)* may also be prevalent in these areas along with the lancelet *Branchiostoma lanceolatum*.
A5.15 Deep Circalittoral coarse sediment	Offshore (deep) circalittoral habitats with 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 quite diverse compared to shallower versions of this habitat and generally characterised by robust infaunal polychaete and bivalve species. Animal communities in this habitat are closely related to offshore mixed sediments, and in some areas, the settlement of *Modiolus modiolus* larvae may occur and consequently these habitats may occasionally have large numbers of juvenile *M. modiolus*. In areas where the mussels reach maturity their byssus threads bind the sediment together, increasing stability and allowing an increased deposition of silt leading to the development of the biotope A5.622.
A5.25 or A5.26 Circalittoral fine sand or Circalittoral muddy sand	Clean fine sands with less than 5% silt/clay in deeper water, either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20 m. The habitat may also extend offshore and is characterised by a wide range of echinoderms (in some areas including the pea urchin *Echinocyamus pusillus*), polychaetes and bivalves. This habitat is generally more stable than shallower, infralittoral sands and consequently supports a more diverse community. Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20%. This habitat is generally found in water depths of over 15-20 m and supports animal-dominated communities characterised by a wide variety of polychaetes, bivalves such as *Abra alba* and *Nucula nitidosa,* and echinoderms such as *Amphiura spp* and *Ophiura spp*., and *Astropecten irregularis*. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community.

Broadscale habitat type	EUNIS habitat description
A5.27 Deep Circalittoral sand	Offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. Very little data is available on these habitats however they are likely to be more stable than their shallower counterparts and characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.
A5.44 Circalittoral mixed sediment	Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20 m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms and burrowing anemones such as *Cerianthus lloydii* are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as *Nemertesia spp* and *Hydrallmania falcata*. The combination of epifauna and infauna can lead to species rich communities. Coarser mixed sediment communities may show a strong resemblance, in terms of infauna, to biotopes within the A5.1. However, infaunal data for this habitat type is limited to that described under the biotope A5.443, and so are not representative of the infaunal component of this habitat type.
A5.45 Deep circalittoral mixed sediments	Offshore (deep) circalittoral habitats with slightly muddy mixed gravelly sand and stones or shell. This habitat may cover large areas of the offshore continental shelf although there is relatively little data available. Such habitats are often highly diverse with a high number of infaunal polychaete and bivalve species. Animal communities in this habitat are closely related to offshore gravels and coarse sands and in some areas, populations of the horse mussel *Modiolus modiolus* may develop in these habitats (see A5.622).

Source: EUNIS (2019)

7.4.3. English Baseline Characterisation KP 0 to KP 431.4

7.4.3.1. Intertidal Zone, England

The definition of the intertidal zone is the area of seashore that is exposed at low tide and inundated at high tide (Marine Scotland, 2023). The Project will begin on the Lincolnshire coast; at the time of writing a preferred landfall site has not yet been determined; there are two proposed landfalls at Anderby Creek and Theddlethorpe.

At the proposed Anderby Creek landfall the foreshore sediments are largely composed of littoral sand and moderate to high energy infralittoral coarse sediment (EMODnet, 2021).

At the proposed Theddlethorpe landfall the foreshore sediments are also largely composed of sand. The available data indicates that the intertidal area is characterised by a moderate to high energy regime (EMODnet, 2021).

Table 7-3 describes the different habitats present within the Study Area.

7.4.3.2. Subtidal KP 0.45 – KP 431.4 within the English Study Area

The definition of subtidal zone is the area where the seabed is below the reach of the lowest spring tide.

As the Project moves away from the Lincolnshire coast, the sediment changes from the moderate energy infralittoral seabed to EUNIS code A5.13 Infralittoral coarse sediment for approximately 0.17 km before changing to A5.14 Circalittoral Coarse sediment which is the sediment the proposed submarine cable route goes through for 74 km. Coarse sediment which are a combination of coarse sands, gravel and shingle are widespread across the southern North Sea (OESEA4, 2022). The heterogeneous substrates and high energy conditions associated with A5.14 Circalittoral coarse sediment tend to be characterised by robust polychaete worms such as *Lanice conchilega* and the calcareous tube-building *Spirobranchus triqueter,* mobile crustaceans (particularly amphipods such as *Ampelisca spinipes*) and the sea cucumber *Neopentadactyla mixta*. The lancelet (*Branchiostoma lanceolatum)* may also occur in this habitat.

Dependant on the final route design the proposed submarine cable corridor may also go through areas of A5.25 or A5.26 Circalittoral fine sand or Circalittoral muddy sand. This seabed composition is between 5% to 20% silt to sand and is characterised with a diverse variety of polychaetes, bivalves such as white furrow shell (*Abra alba*) and shiny nut clam (*Nucula nitidosa*), and echinoderms such as brittlestars (*Amphiura spp*) and serpent star (*Ophiura spp*)., and sand star (*Astropecten irregularis*).

The proposed submarine cable corridor goes through an area of A5.44 Circalittoral mixed sediment between KP 56 and KP 61.5. Due to the variable nature of this type of seabed a diverse and wide range of species can be found including infaunal polychaetes, bivalves, echinoderms and burrowing anemones such as *Cerianthus lloydii*. Where there is harder substrate such as stones and shells epifaunal hydroid species such as Sea beard (*Nemertesia spp*) and *Hydrallmania falcata*. The proposed submarine cable corridor goes also through an area of A5.45 Deep circalittoral mixed sediments between KP 64.2 and KP 66.7 and again at KP 96.1and KP 98.1 this habitat included a diverse range of infaunal polychaete and bivalve species.

Though the proposed submarine cable corridor does not directly go through any areas of Annex I reef it does go within 0.4 km of areas of Bedrock/stony reef. This type of EUNIS habitat A4.3 Atlantic and Mediterranean low energy circalittoral rock and A4.33 Faunal communities on deep low energy circalittoral rock which occurs on wave-sheltered circalittoral bedrock and boulders subject to mainly weak/very weak tidal streams. Species identified within this habitat type are often dominated by encrusting red algae, brachiopods (*Neocrania anomala*) and ascidians sea vase (*Ciona intestinalis*) and sea squirt (*Ascidia mentula*).

The proposed submarine cable corridor goes through several areas of A5.15 Deep Circalittoral coarse sediment. These habitats of coarse sands and gravel or shell cover a wide area of the offshore continental shelf. Their species types can be characterised by robust infaunal polychaete and bivalve species. This habitat it suitable for settlement of horse mussel (Modiolus modiolus). This is something that would be noted during the benthic survey.

The majority of the proposed submarine cable corridor route, beginning at KP 107, goes through A5.27 Deep Circalittoral sand with approximately 482 km of the route going through this habitat type in both the English and Scottish waters. Due to depth of this type of habitat little data is available on it, however, it is believed to be a more stable habitat than its shallower counterparts and therefore should be characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

Below is the list of sediment habitat types the proposed submarine cable corridor goes through. Firstly, Anderby Creek landfall options and then the landfall option at Theddlethorpe.

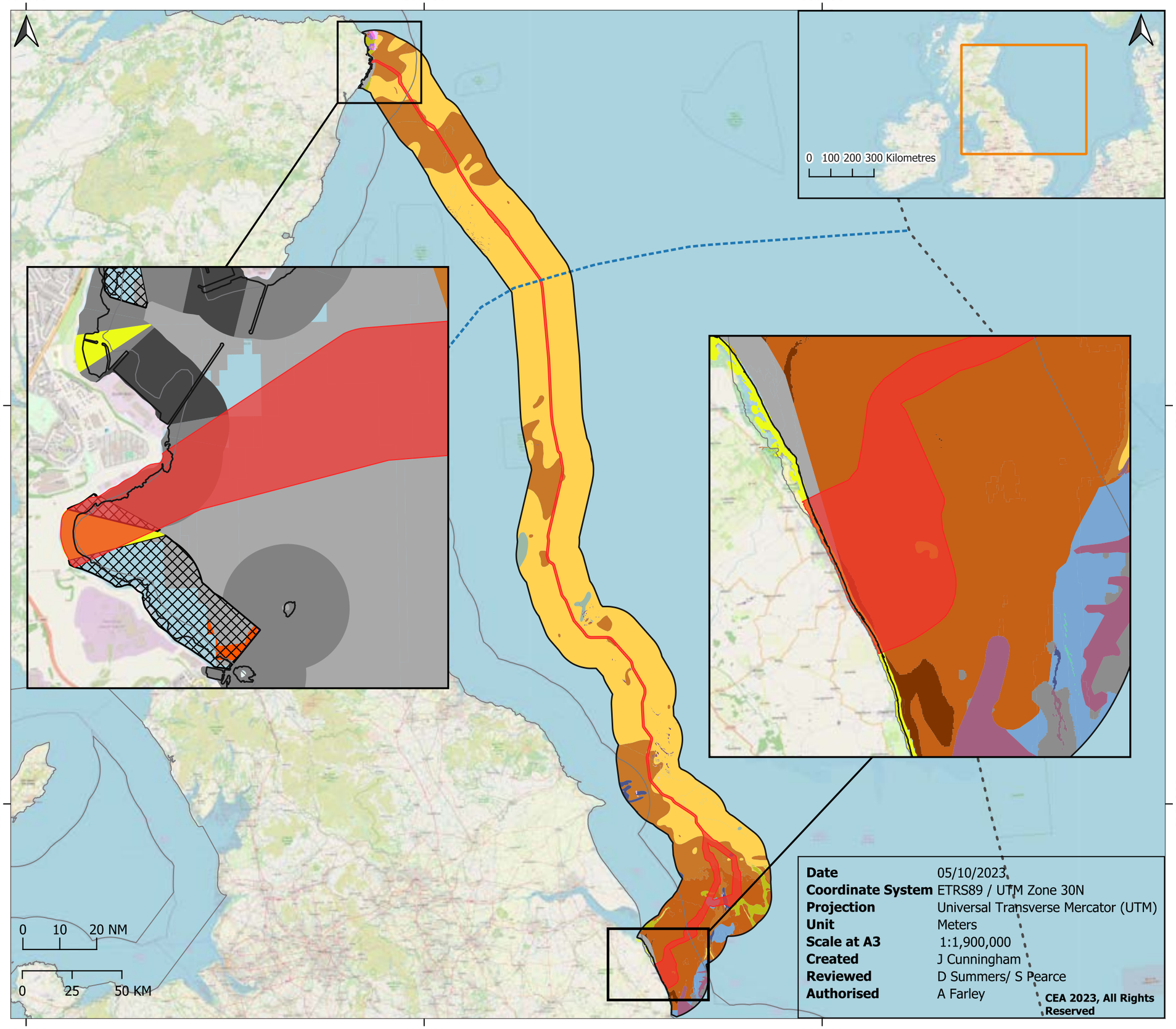
Anderby Creek – KP 0.4 to KP 431.4 (south to north)

- Moderate energy infralittoral seabed
- A.5.13 Infralittoral coarse sediment
- A5.14 Circalittoral coarse sediment
- A5.25 or A5.26 Circalittoral fine sand or Circalittoral muddy sand
- A5.44 Circalittoral mixed sediment
- A5.45 Deep circalittoral mixed sediments
- A5.15 Deep Circalittoral coarse sediment
- A5.27 Deep Circalittoral sand

Theddlethorpe T_KP 0.4 to TP_KP 14 (south to north)

- Littoral sand (intertidal)
- High energy infralittoral seabed
- High energy circalittoral seabed
- A5.14 Circalittoral coarse sediment

Figure 7-1, Drawing C01494-EGL3-PROT-009, illustrates the Intertidal and subtidal benthic ecology study areas and predicted habitat types within the Study Area.



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Intertidal and Subtidal Predicted Benthic Habitat Types

C01494-EGL3-PROT-009-C

- Exclusive Economic Zone Limit (EEZ)
- 12NM Limit
- Scottish Adjacent Waters
- Benthic Study Area
- EGL 3 Scoping Boundary

Intertidal Zone Foreshore

- Boulders/ Loose Rock
- Gravel
- Made Ground
- Mud
- Rock Platform
- Rock Platform with Boulders/ Loose Rock
- Sand
- Sand & Gravel
- Unspecified
- Not Present

EUSeaMap (2021) Habitat Types (EUNIS 2007/ Full-Detail Classification)

- A3: Infralittoral rock and other hard substrata
- A3.1: Atlantic and Mediterranean high energy infralittoral rock
- A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
- A3.3: Atlantic and Mediterranean low energy infralittoral rock
- A4: Circalittoral rock and other hard substrata
- A4.1: Atlantic and Mediterranean high energy circalittoral rock
- A4.2: Atlantic and Mediterranean moderate energy circalittoral rock
- A4.27: Faunal communities on deep moderate energy circalittoral rock
- A4.33: Faunal communities on deep low energy circalittoral rock
- A5.13: Infralittoral coarse sediment
- A5.14: Circalittoral coarse sediment
- A5.15: Deep circalittoral coarse sediment
- A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand
- A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand
- A5.27: Deep circalittoral sand
- A5.35: Circalittoral sandy mud
- A5.37: Deep circalittoral mud
- A5.43: Infralittoral mixed sediments
- A5.44: Circalittoral mixed sediments
- A5.45: Deep circalittoral mixed sediments
- A5.6: Sublittoral biogenic reefs
- A5.61: Sublittoral polychaete worm reefs on sediment
- A5.611: [Sabellaria spinulosa] on stable circalittoral mixed sediment
- Na

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7.4.3.3. Designated Sites within the English Study Area

Table 7-4 presents the designated sites designated for benthic habitats and or species within the English Study Area, along with their protected features and conservation objectives. Designated sites within the area of the Project are also illustrated in Chapter 5 – Designated Sites in Figure 5-1, Drawing C01494-EGL3-PROT-007.

Table 7-4: Designated sites in England designated for benthic habitats and species within the Study Area

Site Name and Code	Distance to Scoping Boundary (km)	Relevant Annex I Protected Features	Conservation Objectives
Holderness Offshore MCZ (JNCC, 2021)	Within Scoping Boundary. 0.4 km of the route passes through the MCZ on the longest route. Alternative route crosses (for approximately 21 km)	▪ Overarching objective	The Conservation Objective for the Holderness Offshore Marine Conservation Zone is that the protected features: ▪ so far as already in favourable condition, remain in such condition; and ▪ so far as not already in favourable condition, be brought into such condition, and remain in such condition.
		▪ Subtidal coarse sediment ▪ Subtidal mixed sediments ▪ Subtidal sand	With respect to Subtidal coarse sediment, Subtidal sand and Subtidal mixed sediments within the Zone, this means that: i. its extent is stable or increasing; and ii. its structures and functions, its quality, and the composition of its characteristic biological communities (which includes a reference to the diversity and abundance of species forming part of or inhabiting that habitat) are such as to ensure that it remains in a condition which is healthy and not deteriorating. Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.
		▪ North Sea glacial tunnel valleys (Silver Pit)	With respect to the North Sea glacial tunnel valleys within the Zone, this means that: i. its extent, component elements and integrity are maintained; ii. its structure and functioning are unimpaired; and iii. its surface remains sufficiently unobscured for the purposes of determining whether the conditions in paragraphs (i) and (ii) are satisfied. Any obscurement of that feature brought about entirely by natural processes is to be disregarded. Any alteration to that feature brought about entirely by natural processes is to be disregarded.
		▪ Ocean quahog (*Arctica islandica*) ***Species of Conservation Importance**	With respect to the Ocean quahog (*Arctica islandica*) within the Zone, this means that the quality and quantity of its habitat and the composition of its population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive. Any temporary reduction of numbers is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.
North East of Farnes Deep HPMPA (JNCC, 2023)	4.9 km	▪ Overarching Objective	The Conservation Objective for the North East of Farnes Deep HPMA is that the protected features: ▪ so far as already in favourable condition, remain in such condition; and ▪ so far as not already in favourable condition, be brought into such condition, and remain in such condition.

Site Name and Code	Distance to Scoping Boundary (km)	Relevant Annex I Protected Features	Conservation Objectives
		▪ Subtidal coarse sediment ▪ Subtidal sand ▪ Subtidal mixed sediments ▪ Subtidal mud	With respect to Subtidal coarse sediment, Subtidal sand, Subtidal mixed sediments and Subtidal mud within the Zone, this means that: ▪ Extent is stable or increasing; and ▪ Structures and functions, quality, and the composition of characteristic biological communities (which includes a reference to the diversity and abundance of species forming part of or inhabiting each habitat) are such as to ensure that they remain in a condition which is healthy and not deteriorating. Any temporary deterioration in condition is to be disregarded if the habitats are sufficiently healthy and resilient to enable recovery. Any alteration to the features brought about entirely by natural processes is to be disregarded.
		▪ **Ocean quahog (*Arctica islandica*) *Species of Conservation Importance**	With respect to the Ocean quahog (*Arctica islandica*) within the site, this means that the quality and quantity of its habitat and the composition of its population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive. Any temporary reduction of numbers is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.
Humber Estuary SAC (UK0030170) (JNCC, 2023a)	4.26 km	▪ 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae)* ▪ 1150 Coastal lagoons Priority Feature ▪ 2160 Dunes with *Hippophae rhamnoides* ▪ 2110 Embryonic shifting dunes ▪ 1130 Estuaries ▪ 1140 Mudflats and sandflats not covered by seawater at low tide ▪ **2130 Fixed dunes with herbaceous vegetation (`grey dunes`) *Priority Feature** ▪ 1310 *Salicornia* and other annuals colonising mud and sand ▪ 1110 Sandbanks which are slightly covered by sea water all the time ▪ 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes')	With regard to the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change, ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; ▪ The extent and distribution of qualifying natural habitats and habitats of qualifying species ▪ The structure and function (including typical species) of qualifying natural habitats ▪ The structure and function of the habitats of qualifying species ▪ The supporting processes on which qualifying natural habitats and habitats of qualifying species rely ▪ The populations of qualifying species, and, ▪ The distribution of qualifying species within the site
Saltfleetby – Theddlethorpe Dunes and Gibraltar SAC (UK0030270) (JNCC, 2023b)	Within Scoping Boundary	▪ 2110. Embryonic shifting dunes ▪ 2120. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Shifting dunes with marram ▪ **2130. Fixed dunes with herbaceous vegetation ("grey dunes"); Dune grassland *Priority Species** ▪ 2160. Dunes with *Hippophae rhamnoides;* Dunes with sea-buckthorn ▪ 2190. Humid dune slacks	With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change, ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; ▪ The extent and distribution of the qualifying natural habitats ▪ The structure and function (including typical species) of the qualifying natural habitats, and, ▪ The supporting processes on which the qualifying natural habitats rely

Site Name and Code	Distance to Scoping Boundary (km)	Relevant Annex I Protected Features	Conservation Objectives
Inner Dowsing, Race Bank and North Ridge SAC (UK0030370) (JNCC, 2023c)	6.77 km	▪ 1170 Reefs ▪ 1110 Sandbanks which are slightly covered by sea water all the time	To ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate and that it makes the best possible contribution to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: ▪ the extent and distribution of qualifying natural habitats and habitats of the qualifying species ▪ the structure and function (including typical species) of qualifying natural habitats ▪ the structure and function of the habitats of the qualifying species ▪ the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely ▪ the populations of each of the qualifying species ▪ the distribution of qualifying species within the site

7.4.3.4. Protected Species and Priority Features within the English Study Area

Ocean quahog (*Arctica islandica*)

The ocean quahog is found around all British and Irish coasts, as well as offshore. 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 (MarLIN, 2023).

The ocean quahog is a burrowing species which has been found in a range of sediments, from coarse clean sand to muddy sand, in a range of depths typically from 4 m to 482 m deep. Ocean quahogs are thought to have a high sensitivity to physical loss of habitat, it is therefore important to conserve the extent and distribution of supporting habitats to provide the best chance of any potential settlement for new recruits and to retain existing individuals (JNCC, 2018b).

The ocean quahog is a protected feature in the following designated sites within the English Study Area.

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

2130 – Fixed dunes with herbaceous vegetation (`grey dunes`) Priority Feature

This habitat is characterised by fixed dune vegetation occurring mainly on the largest dune systems, being those that have the width to allow it to develop. It typically occurs inland of the zone dominated by European marram grass (*Ammophila arenaria*) on coastal dunes, and represents the vegetation that replaces marram as the dune stabilises and the organic content of the sand increases. In the UK the vegetation corresponds to the following National Vegetation Classification (NVC) types:

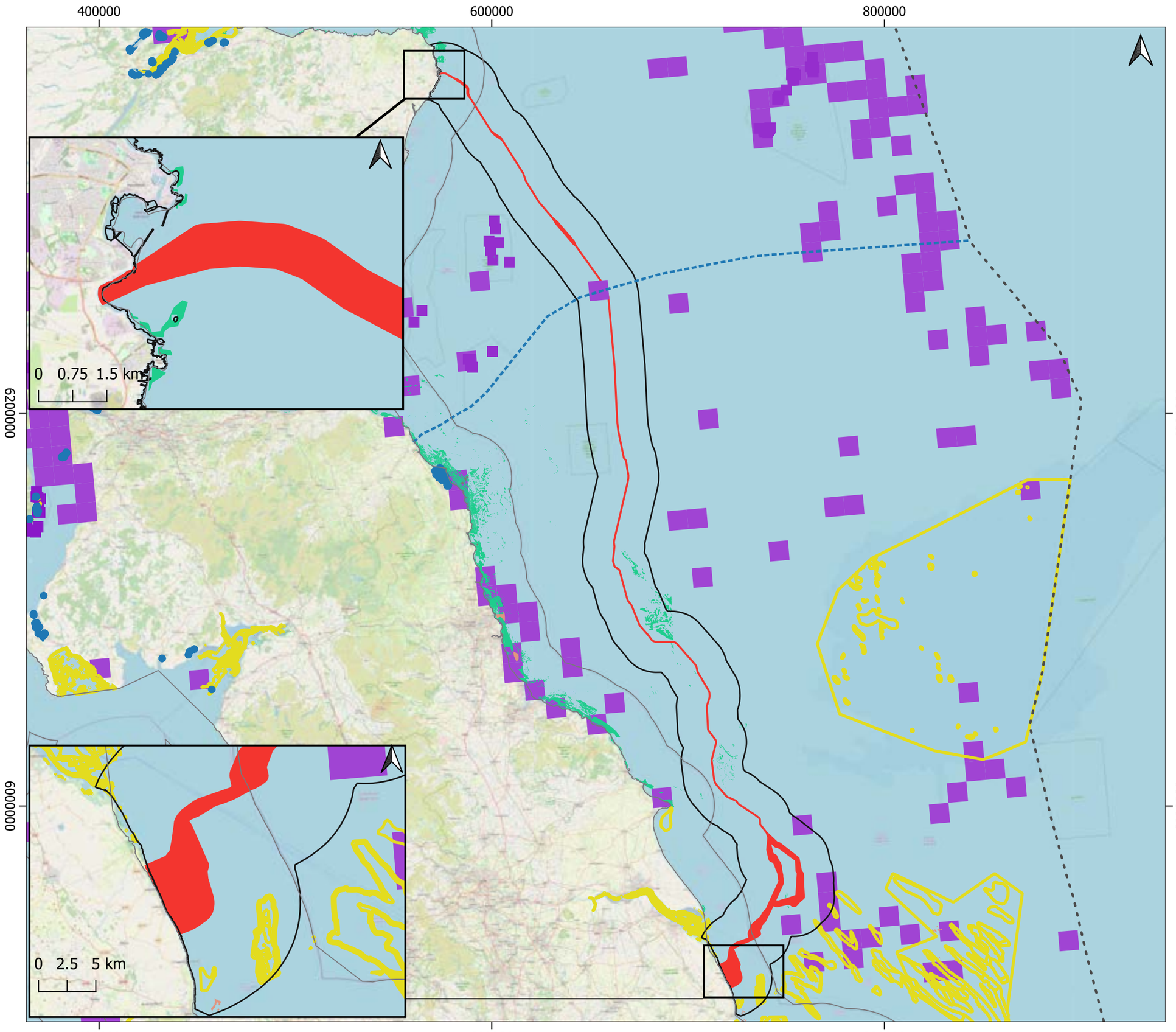
- SD7 European marram grass (*Ammophila arenaria*) – Festuca rubra semi-fixed dune community
- SD8 Red Fescue (*Festuca rubra)* – Lady's bedstraw (*Galium verum*) fixed dune grassland
- SD9b European marram grass– Tall oat grass (*Arrhenatherum elatius*) dune grassland, bloody cranes-bill (*Geranium sanguineum)* sub-community
- SD11 Sand Sedge (*Carex arenaria*) – Siny Iceland lichen (*Cornicularia aculeata*) dune community
- SD12 Sand Sedge – Sheep's fescue (*Festuca ovina)* – Common bent (*Agrostis capillaris*) dune grassland.

The herbaceous vegetation of fixed dunes in the UK exhibits considerable variation. The most widespread type is Atlantic dune grassland, consisting of a short sward characterised by red fescue and lady's bedstraw and is typically rich in species of calcareous substrates. The vegetation shows considerable variation both from north to south and from east to west. In the south, several orchid species are found, including pyramidal orchid (*Anacamptis pyramidalis),* and a rich variety of other species. A taller type of dune grassland vegetation, in which bloody crane's-bill is prominent, is particularly characteristic of north-east England. In areas with a drier and more continental climate, such as Norfolk, and where the substrate is at the acidic end of the spectrum, the fixed dune vegetation is rich in lichens (JNCC, 2023d).

2130 – Fixed dunes with herbaceous vegetation (`grey dunes`) Priority Feature is a protected feature for the following designated sites within the English Study Area:

- Humber Estuary SAC
- Saltfleetby – Theddlethorpe Dunes and Gibraltar SAC

Figure 7-2 illustrates the sensitive sites and features with the intertidal and subtidal benthic ecology Study Area.



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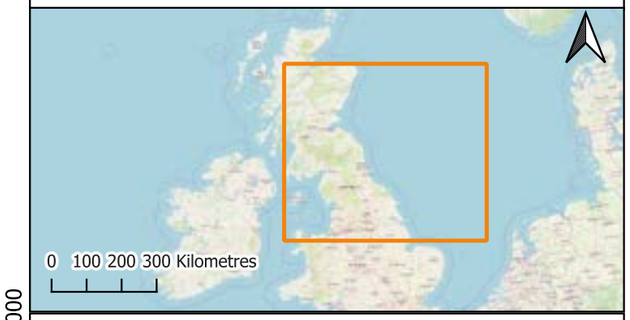
Relevant Sensitive Sites And Features Within The Benthic Ecology Study Area

C01494-EGL3-PROT-010-D



- Exclusive Economic Zone Limit (EEZ)
- 12NM Limit
- Scottish Adjacent Waters
- EGL 3 Scoping Boundary
- Benthic Study Area
- Annex I Sandbank
- Ocean Quahog
- Seagrass Cover

Annex I Reef

- Bedrock
- Bedrock and/or Stony
- Biogenic

0 10 20 NM

0 25 50 KM

Date	09/10/2023
Coordinate System	ETRS89 / UTM Zone 30N
Projection	Universal Transverse Mercator (UTM)
Unit	Meters
Scale at A3	1:1,900,000
Created	EP
Reviewed	D Summers/ S Pearce
Authorised	A Farley

Document Path: Z:\GIS\GIS_PROJECTS\C01494_EGL3&4\Project\QGS\EGL3\06_PROT\C01494_EGL3_PROT-010.qgz

Export Date: 09/10/2023

7.4.4. Scotland Baseline Characterisation KP 431.4 to KP 575.3

7.4.4.1. Intertidal Scotland

The Scottish proposed landfall site is at Sandford Bay on the Aberdeenshire coast where the foreshore sediments are composed of sand, boulders, loose rock and rock platforms. The available data indicates that the intertidal area will be characterised by high energy infralittoral seabed and high energy circalittoral seabed (EMODnet, 2021).

7.4.4.2. Subtidal KP 431.4 – KP 574 within the Scottish Study Area

As previously mentioned, the majority of the proposed submarine cable corridor route goes through A5.27 Deep Circalittoral sand which, within the Scottish Study Area, starts at KP 431.4 to KP 502.5 and then again from KP 523.6 to KP 529.7 and KP 544.1 to KP 557.3. Due to the depth of this type of habitat little data is available, however, it is believed to be a more stable habitat than its shallower counterparts and therefore should be characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

When the route approaches the proposed Scottish Landfall at Sandford Bay in Aberdeenshire the proposed submarine cable corridor goes through A5.15 Deep Circalittoral coarse sediment before reaching the intertidal areas as described in section 7.4.4.1.

Below is the list of sediment habitat types the proposed submarine cable corridor goes through within the Scottish subtidal Study Area.

From KP 431.4 to KP 575.4

- A5.27 Deep Circalittoral sand
- A5.15 Deep Circalittoral coarse sediment
- Moderate energy deep circalittoral seabed
- Moderate energy circalittoral seabed
- High energy circalittoral seabed
- High energy infralittoral seabed

7.4.4.3. Designated Sites within the Scottish Study Area

Table 7-5 presents the designated sites designated for benthic habitats and or species within the Scottish Study Area, along with their protected features and conservation objectives. Designated sites within the area of the Project are also illustrated in Chapter 5 – Designated Sites in Figure 5-2. Drawing C01494-EGL3-PROT-008.

Table 7-5: Designated sites in Scotland designated for benthic habitats and species within the Study Area

Site Name and Code	Distance to Scoping Boundary (km)	Relevant Annex I Protected Features	Conservation Objectives
Southern Trench MPA (JNCC, 2023f)	Within Scoping Boundary for 8 km	▪ Burrowed mud	The Conservation Objectives of the Southern Trench MPA, are that the protected features: ▪ so far as already in favourable condition, remain in such condition. ▪ so far as not already in favourable condition, be brought into such condition, and remain in such condition. "Favourable condition", with respect to a marine habitat, means that: a) its extent is stable or increasing; and b) its structures and functions, its quality, and the composition of its characteristic biological communities are such as to ensure that it is in a condition which is healthy and not deteriorating.
		▪ Fronts ▪ Shelf deeps	The Conservation Objectives of the Southern Trench MPA, are that the protected features: ▪ so far as already in favourable condition, remain in such condition. ▪ so far as not already in favourable condition, be brought into such condition, and remain in such condition. "Favourable condition", with respect to a large-scale feature, means that:

Site Name and Code	Distance to Scoping Boundary (km)	Relevant Annex I Protected Features	Conservation Objectives
			a) the extent, distribution and structure of that feature is maintained; b) the function of the feature is maintained so as to ensure that it continues to support its characteristic biological communities and their use of the site including, but not restricted to, feeding, spawning, courtship or use as nursery grounds; and c) the processes supporting the feature are maintained. For the purpose of determining whether a protected feature is in favourable condition any alteration to that feature brought about entirely by natural processes is to be disregarded.
		▪ Quaternary of Scotland ▪ Submarine Mass movement	The Conservation Objectives of the Southern Trench MPA, are that the protected features: ▪ so far as already in favourable condition, remain in such condition. ▪ so far as not already in favourable condition, be brought into such condition, and remain in such condition. "Favourable condition", with respect to a feature of geomorphological interest, means that: a) its extent, component elements and integrity are maintained; b) its structure and functioning are unimpaired; and c) its surface remains sufficiently unobscured for the purposes of determining whether the criteria in paragraphs (a) and (b) are satisfied. For the purpose of determining whether a feature of geomorphological interest is sufficiently unobscured under paragraph (3) I, any obscuring of that feature entirely by natural processes is to be disregarded.
Buchan Ness to Collieston SAC [UK0030101] (JNCC, 2023g)	2.5 km	▪ 1230 Vegetated Sea cliffs	Conservation Objectives for vegetated sea cliffs 1. To ensure that the qualifying feature of Buchan Ness to Collieston SAC is in favourable condition and makes an appropriate contribution to achieving favourable conservation status 2. To ensure that the integrity of Buchan Ness to Collieston SAC is maintained by meeting objectives 2a, 2b and 2c 2a. Maintain the extent and distribution of the habitat within the site 2b. Maintain the structure, function and supporting processes of the habitat 2c. Maintain the distribution and viability of typical species of the habitat

7.4.4.4. Protected Features and Species within the Scottish Study Area

Burrowed mud

Burrowed mud habitats are highly sensitive to physical disturbance caused by a range of activities. Activities that cause physical disturbance including penetration, abrasion or removal of the seabed can be highly damaging to both mobile and sessile epifaunal and infaunal species that characterise the habitat type. Physical disturbances leading to water flow, wave exposure and pronounced siltation alterations are also detrimental as burrowing species experience feeding rate disruption and greater energy expenditure that impacts reproduction and recruitment. Burrowed mud habitats are also particularly vulnerable to pollution. High fluxes of nutrients or organic material can cause hypoxia and physical burial leading to defaunation, alteration of species composition and changes to ecosystem functioning. Burrowing species do have the capacity to recover from such impacts (albeit this may be slowly) provided that the habitat has not been permanently changed, pressures that they are sensitive to are removed/avoided, suitable environmental

conditions are maintained and that there are undisturbed neighbouring burrowed mud communities which can recolonise the area (NatureScot 2020a).

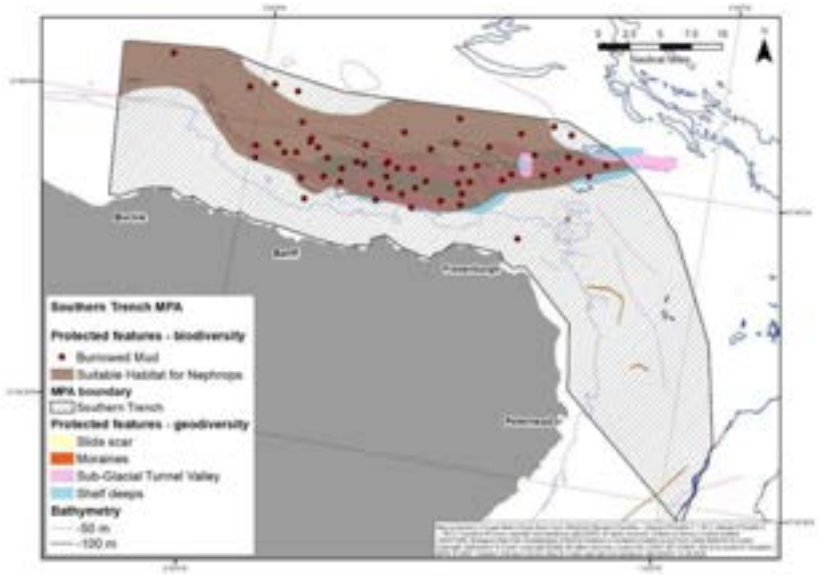


Figure 7-3: Location of burrowed mud habitats within the Southern Trench MPA. (Source: NatureScot, 2020)

Burrowed mud is a protected feature for the following designated site within the Scottish Study Area:

- Southern Trench MPA

Ocean quahog aggregations

Ocean quahog aggregations are found in various types of sand and gravels and as previously mentioned are long-lived species. As such, ocean quahog is highly protected and is registered on the OSPAR Commission List of Threatened and/or Declining Species & Habitats (OSPAR, 2023). Although there are no designated sites within the Scottish Study Area where ocean quahog aggregations are listed as a protected feature, it is important to note there are several designated sites in close proximity to the study area including the Firth of Forth Banks Complex MPA where ocean quahog are a feature.

7.5. Proposed Assessment Methodology

The intertidal and subtidal benthic ecology MEA will follow the assessment approach set out in Chapter 4 of this Scoping Report, using the project-wide assessment matrix. The assessment of potential effects will be established using the standard Source-Pathway-Receptor approach.

Data derived from the site-specific survey will provide a more detailed site characterisation and fill key data gaps such as habitat biotope maps; presence, extent and condition of sensitive habitats; and presence of protected species. The results from assessment undertaken to inform the marine physical processes chapter will be used to establish the potential impacts on intertidal and subtidal benthic receptors.

The following UK guidance is available and will be used to inform the assessment:

- Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK Offshore waters – Appendix 1 Benthic Characterisation (JNCC and Natural England, 2022).
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Parker et al., 2022).
- Sensitivity of features based upon the Marine Evidence-based Sensitivity Assessment (MarESA) framework where possible (MarLIN, 2021).
- The MarESA approach used by the Marine Life Information Network (Tyler-Walters et al. 2018) which provides sensitivity reviews of species and habitats.

Where potentially significant impacts are identified, consultation will be undertaken with statutory nature conservation bodies (SNCBs) to agree proportionate and effective mitigation, and residual effects will be presented.

7.6. Scope of Assessment

A range of potential impacts on intertidal and subtidal benthic ecology have been identified which may occur during the construction, operation and maintenance, and decommissioning phases of the Project. Table 7-5 describes the potential impacts identified and provides justification as to whether they will be scoped in or out of the MEA. A precautionary approach has been taken and where there is no strong evidence base, or the significance is uncertain at this stage the impact has been scoped 'in' to the MEA. Where there is a clear evidence base that the effect from the impact will not be significant, either alone or in combination with other plans and projects, the impact has been scoped 'out' of the MEA.

Table 7-6: Scoping assessment of impacts on intertidal and subtidal benthic ecology

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
Temporary habitat loss / seabed disturbance *(Abrasion / disturbance of the substrate on the surface of the seabed* *Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion)*	Trenchless solution and duct installation and open cut trenching at landfall Cable burial and trenching.	Intertidal habitats	**IN –** At this stage of scoping no decision has been made on the installation technique to be used. As noted in the project description this may be either a trenchless technique or an open cut technique used. If an open cut technique is used it will cause temporary habitat loss and disturbance to the intertidal area and adjacent terrestrial habitats. Due to the potential disturbance this could cause it has been scoped in at this stage.	**OUT –** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. If the cable were to fail within the trenchless solution, there is no means of repairing it and a new duct would need to be drilled. This would be the subject of a separate Marine Licence. Therefore, impacts during operation and maintenance have been scoped out for the intertidal area.	**OUT** – It is likely that the cables duct would be left in place with no further impacts on the environment.
	Boulder clearance, PLGR, pre-sweeping of sand waves. Trenchless Solution and duct excavation. Cable burial and trenching. Anchoring/jack-up foundations. Deposit of external cable protection.	Subtidal – Broadscale habitats	**OUT –** The significance of the effect will vary according to the techniques used during cable burial (e.g., jet or plough trenching) and the sensitivity of the habitat. The Study Area contains commonly occurring infralittoral and circalittoral habitats (e.g., A5.15, A5.27 and A5.45) that are widely distributed within the North Sea region. MarLIN sensitivity assessments for these habitats indicate that due to the burrowing life habitat of the dominant species the habitat has a low sensitivity to abrasion and penetration. Whilst species within the immediate footprint of the construction activities will be affected, the medium to high resilience of the habitat indicates that recovery will occur in the short-term. Effects will not be significant for broadscale habitats and have therefore been scoped out of the assessment.	**OUT -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised repair works or remedial external cable protection may be required. If these circumstances arise the significance of the effect will be of lower magnitude that during construction. Effects will not be significant for broadscale habitats and have therefore been scoped out of the assessment.	**OUT -** The significance of the effect during decommissioning is similar or of lower magnitude than construction and have therefore been scoped out of the assessment for broadscale habitats.
		Subtidal – Annex I habitats	**IN –** The results of the benthic and environmental surveys will determine if any Annex I habitats are present within the area of the Project. Annex I habitats such as biogenic/geogenic reef, have the potential to be significantly affected by the installation of the cable as they typically have a higher sensitivity to abrasion and penetration and a lower resilience. The assessment will therefore focus on these habitats if they are found to be present.	**IN -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised repair works may be required. In these circumstances the significance of the effect will be of lower magnitude that during construction. However, the effect could still potentially be significant if within an Annex I habitat.	**IN -** The significance of the effect during decommissioning is similar or of lower magnitude than construction. However, effects could potentially be significant if within an Annex I habitat.
Permanent habitat loss *(Physical change (to another seabed type or sediment type)*	Deposit of external cable protection.	Subtidal – Annex I habitats	**IN –** The extent of Annex I habitat within the North Sea is limited in relation to the wider broadscale habitats. Annex I habitats will have a high sensitivity to the impact pathway due to the potential for reclassification of the habitat type. Given the limited extent of such habitats the change in seabed type can have significant effects with regards the function of a designated site, or the extent of habitat within UK waters. The results of the benthic and	**IN -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised remedial external cable protection may be required. In these circumstances the significance of the effect will be of lower magnitude that during	**OUT –** During decommissioning no new seabed deposits will be made. There will therefore be no further permanent changes to the seabed.

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
Water flow (tidal current) changes including sediment transport considerations)			environmental surveys will determine if any Annex I habitats are present within the area of the Project and the assessment will focus on these habitats if they are found to be present.	construction. However, the effect could still potentially be significant if within an Annex I habitat.	
		Subtidal – Broadscale habitats	**OUT –** The presence of the deposit of external cable protection has the potential to change the seabed type. They also have the potential to very locally alter sediment transport, creating scour pits or causing accretion. This may alter the benthic habitats either directly through a change in the substrate (e.g., sand to rock) or indirectly because of changes to local hydrodynamic conditions (e.g., increased risk of scour). The significance of the effect will vary according to the sensitivity of the habitat and the spatial extent of the deposits. The Study Area contains commonly occurring infralittoral and circalittoral habitats (e.g., A5.15, A5.27 and A5.45) that are widely distributed within the North Sea region. Although MarLIN sensitivity assessments identify that the habitats have high sensitivity to this pressure, the deposits will be extremely localised in relation to the wide extent of the habitat. Using the benthic and environmental survey data and engineering studies, the environmental assessment will identify the habitats that will be affected by deposits. However, where the habitats are not protected and are not within a designated site, no significant effects are predicted, and the pressure will be scoped out of the assessment.	**OUT –** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that remedial external cable protection may be required. Although MarLIN sensitivity assessments identify that the habitats have high sensitivity to this pressure, the deposits will be extremely localised in relation to the wide extent of the habitat. Where the habitats are not protected and are not within a designated site, no significant effects are predicted, and the pressure will be scoped out of the assessment.	**OUT –** During decommissioning no new seabed deposits will be made. There will therefore be no further permanent changes to the seabed.
Temporary increase and deposition of suspended sediments *(Changes in suspended solids (water clarity)* *Smothering and siltation rate changes* *Hydrocarbon & PAH contamination)*	Boulder clearance, PLGR. Trenchless solution and duct excavation. Cable burial and trenching. Anchoring / jack-up foundations. Deposit of external cable protection.	Broadscale habitats Annex I *Sabellaria spinuolsa* reefs	**OUT –** Sediment suspended by interactions with the seabed will temporarily increase turbidity before being rapidly dispersed through natural hydrodynamic processes. Other projects near the Project reported sediments contaminated with heavy metals, PCBs and PAHs (GEOxyz, 2022), but analysis against OSPAR guidelines concluded that they were considered to be of no concern (OSPAR, 2014). Indirect effects from the mobilisation of contaminants entering the food chain are not predicted to be significant. The broadscale habitats identified in the Study Area are dominated by burrowing infauna which would not be affected by a change in water clarity. The benchmark used by Natural England for the pressure is a change in one rank e.g., from clear to intermediate, on the Water Framework Directive scale for one year.	**OUT -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised repair works or remedial external cable protection may be required. In these circumstances the significance of the effect will be of lower magnitude that during construction and has therefore been scoped out of the assessment for the same reasons.	**OUT -** The significance of the effect during decommissioning is similar or of lower magnitude than construction and has therefore been scoped out of the assessment for the same reasons.

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
			While trenching is undertaken a sediment plume will be generated continuously, but it will move with the location of the cable spread. Sands and gravels do not form part of the sediment load and will settle out of suspension quickly. MarLIN categorise light smothering as the deposition of up to 5cm of sediment in a discrete event. Light smothering will occur from several of the project activities. The most significant contributor (relatively) will be from the sediment plume generated by cable trenching. Modelling undertaken for other cable projects (e.g., Viking Link reported in Intertek 2017 GridLink 2020, BERR 2008) indicates that approximately 90% of the suspended sediment is re-deposited within close proximity (<100 m) and would be classed as heavy smothering. The remaining 10% is transported over a wide area, which depending on the strength of the prevailing currents could be as far as 10-15 km, but will be deposited in thicknesses of less than 2 mm. This is within the range of natural variability associated with sediment transport in the region. The modelling also concludes that regardless of the position along a cable route, the sediment plume generated is aligned with the dominant tidal axis. Material is deposited primarily along the dominant tidal axis but with some lateral extension. Over most of the plume the increase in suspended sediment concentrations is generally lower than 30 mg/l with natural conditions returning within a single tidal cycle following the cessation of activities, although if very fine chalk particles are present this could be extended to 4-5 days. Overall, the change in water clarity is not significant and generally in line with changes experience during storm conditions when background concentrations can reach 1000 mg/l. Benthic communities most sensitive to light smothering will be Annex I reef habitat (e.g., *Sabellaria spinulosa* reef, horse and blue mussel beds). *Sabellaria spinulosa* are not sensitive to the impact pathway (Tillin et al. 2022), requiring some degree of sediment transport for tube-building and feeding. Mussel beds are discussed separately below. No significant effects are predicted from light smothering on most benthic habitat types and the impact pathway has been scoped out of the assessment.		

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
Temporary increase and deposition of suspended sediments *(Changes in suspended solids (water clarity)* *Smothering and siltation rate changes* *Hydrocarbon & PAH contamination)*	Boulder clearance, PLGR. Trenchless Solution and duct excavation. Cable burial and trenching. Anchoring / jack-up foundations. Deposit of external cable protection.	Annex I *Modiolus modiolus* and *Mytils edulis* beds	**IN -** *Modiolus modiolus* (horse mussel) are unable to actively emerge from sediments if buried. If the deposition of fine sediment is not removed by currents/tidal flow, then mortality can occur. Experiments have shown that light smothering for longer than 8 days can lead to significant mortality (Tillin 2016). *Mytilus edulis* (blue mussel) are more resistant to high levels of suspended material and are able to move up through deposited sediments. However, mortality will depend on the duration of smothering. This impact pathway pressure cannot be scoped out of the assessment for this habitat type until the benthic and environmental surveys have confirmed the absence of blue/horse mussel beds within or in proximity to the Project.	**IN -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised repair works may be required. This impact pathway cannot be scoped out of the assessment for this habitat type until the ecological surveys have confirmed the absence of blue/horse mussel beds in or within proximity of the Project.	**IN -** The significance of the effect during decommissioning is similar or of lower magnitude than construction. This pressure cannot be scoped out of the assessment for this habitat type until the ecological surveys have confirmed the absence of blue/horse mussel beds in or within proximity of the Project.
Temporary increase and deposition of suspended sediments *(Changes in suspended solids (water clarity)* *Smothering and siltation rate changes* *Hydrocarbon & PAH contamination)*	Pre-sweeping	Subtidal habitats	**IN –** Pre-sweeping of sand waves involves the re-positioning of large quantities of sediment from the cable route to either immediately alongside the cable route, or to a separate disposal location. Depending on the technique used and the size of sand waves requiring pre-sweeping, the redeposition of sediment can cause smothering >10 cm deep over relatively wide areas of seabed (in the order of tens of thousands square metres). Effects could also potentially be significant if the disposal site contains sensitive habitats. The impact pathway cannot be scoped out until further information is available on the habitats present and the areas that will require pre-sweeping.	**OUT –** Pre-sweeping is used during construction to ensure that the cables are buried below the base of mobile sediments. Generally during operation, remedial works are focused on protecting sections of cable that have become exposed due to sediment mobility, or to repair cables that have been damaged by a third party (e.g., fishing damage). Pre-sweeping would not be required during a cable repair for third-party damage as the cable would already be exposed on the seabed. Therefore, the only scenario pre-sweeping might be required is where the cable has been damaged during construction and develops a fault in an area where pre-sweeping was used during construction. In this scenario the significance of the effect will be of lower magnitude than during construction and has therefore been scoped out of the assessment.	**IN –** Controlled flow excavation could be used during decommissioning to expose the buried cable. The significance of the effect during decommissioning is similar or of lower magnitude than construction. However, effects could potentially be significant if within a sensitive habitat.
Underwater noise changes	Geophysical survey. Presence of project vessels and equipment.	Subtidal species	**OUT –** Most research into the effects of underwater sound has focused on mortality, acute physiological effects or species interactions in species such as fish and marine mammals. There is relatively little evidence on the effects on sediment-dwelling invertebrates although it is thought that chronic exposure could lead to changes in the way in which a species contributes to ecosystem processes such as carbon storage or nutrient cycling (Solan *et al* 2016).	**OUT -** If the cable is installed correctly the likelihood of it requiring maintenance and repair is significantly reduced. However, there remains the potential that localised repair works or remedial external cable protection may be required. In these circumstances the significance of the effect will be of lower magnitude that during	**OUT -** The significance of the effect during decommissioning is similar or of lower magnitude than construction and has therefore been scoped out of the assessment for the same reasons.

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
			The Project will be a one-off event set against a background of existing anthropogenic noise. Any effects will be localised and short-term and are not predicted to be significant.	construction and has therefore been scoped out of the assessment for the same reasons.	
Introduction or spread of marine invasive non-native species (MINNS)	Presence of project vessels and equipment. Deposit of external cable protection.	Subtidal species	**OUT –** Although the introduction of project vessels, equipment, and external cable protection have the potential to bring in and spread MINNS all relevant guidelines will be followed (GB Non-native Species Secretariat, 2015) including vessel cleaning facilities and the use of anti-fouling paint. Project vessels and contractors will comply with the International Convention for the Control and Management of Ships' Ballast water and Sediments. All seabed deposits will be inert with no biologically active material. Project vessels will complete a biosecurity risk assessment prior to arriving on site which will include factors such as origins of the vessels and ensuring that relevant equipment is cleaned before use. Compliance with Regulations will be sufficient to minimise the risk to the environment.		
Electromagnetic changes /Barrier to species movement	Presence of cables	Subtidal species	N/A	**OUT –** Benthic communities are typified by sessile or low mobility species, which are unlikely to navigate using magnetic fields or have electroreceptors. At present there is very little research data available on this subject, however a recent study of polychaete *Hediste diversicolor* and EMF concluded that the species probably was unable to gather any directional information from the factor and therefore did not perceive it as a stressor (Jakubowska *et al*, 2019). Although some species of mollusc and crustacean are believed to be magnetically sensitive these are discussed within the shellfish and fish topic chapter. This pressure has therefore been scoped out of the assessment for benthic ecology.	N/A
Temperature increase	Presence of cables	Subtidal habitats and species	N/A	**OUT –** During the operation of an HVDC cable heat losses occur because of the resistance in the cable/conductor. This can cause localised heating of the surrounding environment (i.e., sediment for buried cables, or water in the interstitial spaces of external cable protection). There are no specific regulatory limits applied to temperature changes in the seabed, although a 2°C change between seabed surface and 0.2 m depth is used as a guideline in Germany. Conservative calculations undertaken for Viking Link (which crosses German waters) concluded that heating in excess of 2°C at 20 cm sediment depth will only occur if cables are bundled and buried to less than 0.75 m (National Grid and Energinet 2017).	N/A

Potential Impacts	Project Activities	Sensitive Receptors	Scoping Justification		
			Construction	Operation (including repair and maintenance)	Decommissioning
				Any temperature changes will be localised to the immediate environment surrounding the cable and undetectable against natural temperature fluctuations in the surrounding sediments and water column. No significant effects are predicted. This pressure has therefore been scoped out of the assessment.	
Accidental spills *(Hydrocarbon & PAH contamination)*	Presence of project vessels and equipment	Intertidal and Subtidal habitats	**OUT -** Project vessels and contractors will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 which relate to pollution from oil from equipment, fuel tanks etc and release of sewage (black and grey water). It is a legal requirement that all vessels have a Shipboard Oil Pollution Emergency Plan (SOPEP). Compliance with Regulations will be sufficient to minimise the risk to the environment.		

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