Chapter 14: Benthic Ecology

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14.1 Introduction

This chapter presents the benthic ecology Ecological Impact Assessment for the proposed HVDC consenting corridor. Benthic habitats and species ecological receptors are considered in this chapter and are evaluated in the context of nature conservation legislation and relevant planning policy (see Chapter 5: Planning Policy). This EcIA presents baseline information, anticipated impacts upon benthic ecology receptors during installation and operation, as well as considering potential decommissioning impacts. Mitigation is proposed where appropriate, cumulative impacts are considered, and finally the residual impacts and their significance are assessed.

This chapter is supported by the following documents:

- NorthConnect – UK Nearshore and North Sea Survey Geophysical, Benthic and Geotechnical Route Survey (MMT, 2018).
- Habitat maps of the consenting corridor (MMT, 2018).
- Appendix E.1: Electromagnetic Field (EMF) and Sediment Heating literature review: Ecological Recommendations (NorthConnect, 2018).

14.2 Legislation, Policy and Guidance

This section outlines relevant legislation, policy and guidance applicable to the assessment of the potential effects on benthic ecology associated with installation, operation, and decommissioning phases of the project.

14.2.1 Legislative Framework

There are a number of different legislative instruments that are relevant to the assessment of potential impacts to benthic ecology receptors. These are detailed below:

14.2.1.1 International

- EC Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora known as the ‘Habitats Directive’, adopted in 1992. It was transposed into UK law via the Conservation (Natural Habitats, &c.) Regulations 1994 and Conservation of Habitats and Species Regulations 2010. In Scotland the Habitats Directive is transposed through a combination of the 1994 and 2010 Regulations. For offshore UK waters (12 nautical miles from the coast out to 200 nm or the limit of the UK Continental Shelf Designated Area) the Habitat Directive is transposed via The Conservation of Offshore Marine Habitats and Species Regulations 2017. Under the Habitats Regulations, benthic habitats listed in Annex I of the European Union (EU) Habitats Directive which are native to the UK should be conserved through the designation of Special Areas of Conservation (SACs). A number of Special Areas of Conservation (SACs) are designated for the conservation of benthic features off the North-east coast of Scotland.
- EC Directive 2000/60/EC known as the ‘Water Framework Directive’ (or WFD) which is the framework for an integrated approach to protection, improvement and sustainable use of water bodies in Europe, and necessitates member states to ensure that they meet 'good status’ for ecological and chemical quality elements. This includes coastal waters up to 1 nautical mile offshore, and river and transitional water bodies have an invertebrates quality element that is assessed to determine their status.

14.2.1.2 National

- Wildlife and Countryside Act 1981 as amended. Schedule 5 of the Wildlife and Countryside Act provides a list of threatened species for which killing, injuring or taking by any method is prohibited. The Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6 make amendments to the Wildlife and Countryside Act (1981 as amended), strengthening the legal protection for threatened species to include 'reckless' acts.
- Marine (Scotland) Act 2010 which provides a framework system for improved management and protection of marine and coastal environments in Scottish territorial waters. It included the establishment of Marine Scotland to act as the competent marine planning authority. It also included the designation of Scottish Marine Protected Areas (MPAs) to protect areas that are key in safeguarding the diversity of nationally rare or threatened and representative habitats and support functioning communities of species. The aim is to supplement existing marine protected areas such as SACs and SPAs. There are more than 180 MPAs in Scotland designated under the Marine (Scotland) Act 2010.
- Marine and Coastal Access Act (MCAA) 2009 which provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment, for offshore waters around Scotland (from 12 nm to the UK territory limit).
- The Nature Conservation (Scotland) Act 2004, which was passed by Scottish Parliament to develop an integrated approach to long term protection and management enforcement measures surrounding Scotland's natural heritage. The Act placed obligations on public bodies to conserve biodiversity, increased protection for SSSIs, amended legislation on Nature Conservation Orders, provided for Land Management Orders for SSSIs and associated land, strengthens wildlife enforcement legislation, and requires the preparation of a Scottish Fossil Code.
- Scottish Biodiversity Strategy, which comprises the 2020 Challenge for Scotland's Biodiversity (response to the Aichi Targets set by the United Nations Convention on Biological Diversity, and the European Union's Biodiversity Strategy for 2020) and supplements Scotland's Biodiversity: It's in Your Hands (2004).

14.2.2 Policy Framework

Further to legislative drivers, there is a policy framework in place to guide the assessment of the project:

- UK Marine Policy Statement which aims to contribute to attaining sustainable development in marine UK waters and is the main policy in determining marine licence applications.
- United Kingdom Biodiversity Action Plan (UKBAP) which creates actions plans for UK BAP priority species and habitats in the UK. It is succeeded by the UK Post-2010 Biodiversity Framework (2012), which runs from 2010-2011.
- Scottish Biodiversity List which is a list of species and habitats that are considered to be of principal importance for biodiversity conservation in Scotland.
- OSPAR convention, which guides international collaboration on the protection of the marine environment of the North-East Atlantic.
- Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC), in conjunction with Marine Scotland, have developed a priority list of marine habitats and species in Scotland's seas, known as Priority Marine Features (PMFs) (Howson *et al.*, 2012).

The list is intended to ensure that marine planning decisions are consistent, and in line with Marine Scotland's vision for marine nature conservation outlined in the Marine Nature Conservation Strategy. This list of PMFs included a number of benthic habitats and species which are present along the proposed consenting corridor.

14.2.3 Ecology Guidance

14.2.3.1 General Ecology Guidance

The following guidance will apply to this assessment:

- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland (2016) is the primary source guidance for the assessment. The aim of the guidance is to promote good practice in EcIA relating to marine, coastal and estuarine environments of the UK. It updates CIEEM's Terrestrial EcIA 2006 Guidelines and CIEEM's Marine EcIA Guidelines 2010.
- The International Union for Conservation of Nature (IUCN) has compiled a Red list of threatened species that are facing a high risk of global extinction. The list (IUCN, 2016) includes benthic species that are or may be present in the vicinity of the project.
- The Convention for the Protection of the Marine Environment of the North-East Atlantic produced the OSPAR List of Threatened and/or Declining Species and Habitats, considered to be of conservation concern within the north-east Atlantic (OSPAR, 2008). A number of habitats and species on the list were recorded during the project-specific survey.
- Assessment of the environmental impacts of cables (OSPAR, 2009), which assesses the environmental impacts of sea cables in terms of their relevance for the area covered by the Convention.

14.2.3.2 Guidance on Defining Reef

The definition of what constitutes a reef has not yet been precisely determined particularly for *Sabellaria spinulosa* reef and Stony Reef as the presence of *S. spinulosa* tubes or a stony environment does not necessarily make the area a potential Annex I habitat. For the purposes of this assessment the identification of *S. spinulosa* reef has been assessed based on its physical, biological and spatial characteristic reef features and scored to assess the degree of 'reefiness' based on a classification proposed by Gubbay (2007). The reefiness is weighted according to the perceived importance of each feature. Furthermore, the reefiness is increased with a score indicating the confidence in the feature score (Table 14.1).

Table 14.1 Criteria for determining the 'reefiness' of *Sabellaria* reef (Gubbay, 2007).

Characteristic	**Not a reef**	**Reefiness**		
		Low	**Medium**	**High**
Elevation (cm) (average tube height)	<2	2-5	5-10	>10
Extent (m^2)	<25	25 - 10,000	10,000 – 1,000,000	>1,000,000
Patchiness (% cover)	<10	10-20	20-30	>30

Stony Reefs are defined by the EC Habitats Directive (European Commission, 2007) as areas where animal and plant communities develop on bedrock or stable boulders and cobbles. Because Irving's (2009) guideline for reefiness of stony areas is not applicable to bedrock, the parent category 'stony reef' as defined by the EC Habitats Directive has in this report been subdivided into Bedrock Reefs and

Stony Reefs, where Rtony Reefs refers to areas with cobbles or boulders with low, medium, or high reef characteristics (Table 14.2).

Table 14.2 Criteria to determine the 'reefiness' of Stony Reefs (Irving, 2009).

Characteristic	Not a reef	Reefiness		
		Low	Medium	High
Composition	<10 %	10-40 % Matrix supported	40-95 %	>95 % Clast supported
Elevation	Flat Seabed	<0.064 m	0.064 - 5 m	>5 m
Extent	<25 m^2	>25 m^2		
Biota	Dominated by infaunal species			>80 % of species present composed of epifaunal species.

This scoring system indicates that stony Reefs should be elevated by at least 0.064 m and with a composition of at least 10 % stones, covering an area of at least 25 m^2 and have an associated community of largely epifaunal species.

14.2.4 Consultation

Responses to comments made in the Marine Scotland Scoping Opinion (July, 2016) and Aberdeenshire Council Scoping Opinion (May, 2016) are presented in Chapter 4: Consultation, Table 4.1.

14.3 Assessment Methodology

14.3.1 Overview

The identification and assessment of the potential benthic ecological effects associated with the project was conducted in accordance with the CIEEM guidelines for EcIA (CIEEM, 2016). The method considers the importance (value / sensitivity) of the relevant ecological features and the magnitude of impacts, to determine an overall significance of effect upon these features. This method takes into account effect direction (beneficial or adverse), confidence, extent, duration, timing, frequency and reversibility.

The assessment approach was based on the conceptual 'source-pathway-receptor' model. This model was used to identify the likely impacts resulting from the installation, operation and decommissioning phases of the project. This model provided a transparent assessment route between impact sources and potentially sensitive receptors. The parameters of this model are defined as follows:

- **Source**: the origin of a potential impact (i.e. a project activity leading to an impact). Potential impact sources may have several pathways and receptors. For example, a potential impact source such as jetty foundation installation may result in several potential impacts such as resuspension of sediments, seabed abrasion and removal of substrata or underwater noise, which may each affect a number of receptors via different pathways.
- **Pathway**: the means by which the impact of the activity could influence a receptor. For the example above, resuspended sediment could settle across the seabed, or seabed disturbance could cause temporary or permanent habitat loss which could affect a receptor.
- **Receptor**: the element of the receiving environment which is affected by an impact. For the example above, benthic invertebrate species living on or in the seabed could be smothered by the deposited sediments which could affect their movement, feeding or respiration.

- The assessment was a combination of a quantitative approach where suitable data, evaluation and assessment methods were available and qualitative where required, based on a combination of empirical data, published literature and professional judgement.

Iterative steps involved in the assessment approach included:

- Determination of potential impact sources associated with the project (activities) and potential impacts.
- Definition of the benthic ecology receptors within the zone of influence of the project;
- Determination of potential interactions between impacts and benthic ecology receptors. At this point some impact / receptor combinations will be screened out, with consideration of interactions scoped out of assessment as reported in the Scoping Report (NorthConnect, 2016).
- Determination of the value and sensitivity of benthic ecology receptors;
- Assessment of the magnitude of impacts (considering embedded mitigation measures);
- Assessment of the significance of effects upon benthic ecology receptors (with embedded mitigation measures in place), including interacting or synergistic effects from the project;
- Proposal of additional mitigation measures to reduce, prevent or where possible offset any significant adverse effects of the project;
- Assessment of the residual effects (i.e. effects after any additional mitigation measures have been considered); and
- Assessment of cumulative effects upon benthic ecology receptors, considering other plans or projects in development. A full list of the other plans or projects considered is presented in Chapter 6: Cumulative Effects.

Further details for the assessment approach are provided in Section 14.3.4.

14.3.2 Desk Study

To determine benthic ecology receptors within the study area and inform an assessment of potential effects of the project on these receptors it was necessary to first establish the baseline (or existing) environment by conducting a desk-based review of grey and published literature.

Key data sources and information obtained from the desk-based review for benthic ecology are summarised in Section 14.4 below. It was concluded that insufficient up-to-date data were available for the benthic ecological habitats and species along the project's consenting corridor to conduct the assessment and consequently, project-specific benthic ecology field surveys were conducted along the consenting corridor as described in Section 14.3.3.

14.3.3 Field Surveys

14.3.3.1 Introduction

The following environmental surveys were conducted along a 500 m wide survey corridor covering the consenting corridor:

- Geophysical survey with multibeam echo sounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), and magnetometer;
- Geotechnical survey (vibrocores (VC) and cone penetration tests (CPT)); and
- Benthic survey (faunal, chemical, and particle size samples and seabed imagery).

The survey was divided into three sections: 'UK nearshore waters' from the landfall area south of Peterhead to about 4 km along the survey corridor; the 'UK EEZ' (European Economic Zone); and the 'Norwegian waters' of the North Sea. This chapter considers the findings of the first two sections only (Figure 14.1).

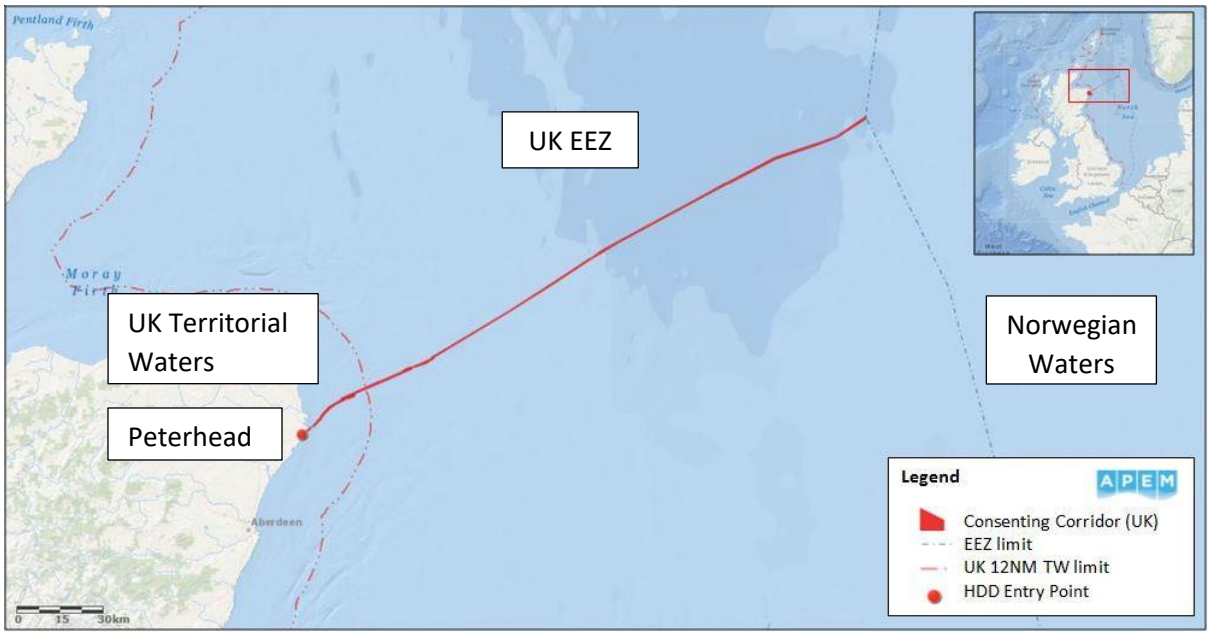

Figure 14.1 NorthConnect Consenting Corridor within UK waters

The UK nearshore section was surveyed between 8th and 12th December 2016. The North Sea section was surveyed between 6th and 29th July 2017 (UK and Norwegian waters). The benthic survey is described in detail below. Full details of the survey are provided in MMT (2018) with survey results summarised below in Section 14.4 Baseline Information.

The benthic survey was performed using a combination of grab samplers, as well as seabed photography and video systems. Sample locations were selected using the information provided from the geophysical survey data and in accordance with the requirements from NorthConnect and the Scottish Natural Heritage (SNH) report 'Guidance on survey and monitoring in relation to marine renewables deployments in Scotland' (Saunders et al., 2011).

A senior marine biologist on board during the geophysical survey determined the benthic ecology survey stations array based on the geophysical data and preliminary geological interpretations, ensuring that the different habitats interpreted from the SSS and MBES were ground-truthed.

Stations were sampled via a combination of video, still photography, and grab sampling (biota, Particle Size Analysis (PSA) and chemical analysis). However, where grab sampling was not possible due to the presence of hard seabed, coarse substrates, or sensitive habitat types, sampling was undertaken using video/still photo only.

The data from the benthic ecology survey, PSA and geophysical information were interpreted together to provide a GIS map of subtidal habitats with supporting quantitative sample data effectively characterising subtidal habitats/species within the survey area. Further details for each of the sampling methods are provided below.

14.3.3.2 Seabed Imagery

The UK Nearshore survey seabed imagery was obtained using a downward facing camera mounted on a Work Class Remotely Operated Vehicle (WROV). In contrast, the North Sea survey seabed imagery was obtained using the SeaSpyder Drop Down Video (DDV) system. Imagery was obtained at each grab sample station (see Section 14.3.3.3) and prior to grab sampling a minimum of four good quality, random still images were collected. In addition, approximately five minutes of video was recorded at each site, and used to provide further information for the habitats present and for the extent of any features identified.

In areas with hard bottom substrate or sensitive areas that could not be sampled with grab samplers, an extended video transect was performed in agreement with NorthConnect, to identify epifauna and habitat transitions and to aid the ground truthing of the predictive habitat model. The survey line was planned over the area of interest, with still images taken at appropriate predetermined intervals along the transect (usually every 25 or 50 m). The spacing between the still images was dependent on the length of the transect and characteristics of the features targeted.

The photos were analysed to identify species present and density of organisms. The video recordings were used to aid in the classification of habitats and to assess the extent of habitats. The different EUNIS habitat criteria were compared to the results of the still image analyses. Particular attention was paid to the elevation of habitats above seabed level, together with their spatial extent, percentage biogenic cover and patchiness, as these are key criteria for determining the presence of potential reef structures (Gubbay, 2007; Irving, 2009) and subsequently evaluating conservation importance of the habitats present.

A log was maintained of each still image and video collection at the grab sample locations, and during transects. As a minimum, this included the drop number, start and end location, duration, and a summary of the sediment type and the main species observed. A list of the still images, including the location of each, along with a clear indication of those taken at randomised pre-determined points for future analysis and those taken to show particular features of interest, was also maintained. Once the survey was complete, a detailed analysis of the stills data was conducted (see Section 14.3.3.6).

14.3.3.3 Grab Sampling and Analysis

In the UK nearshore waters a 0.1 m^2 Day grab and a 0.25 m^2 United States Naval Electronics Laboratory (USNEL) box corer were used. During the North Sea survey, only the USNEL box corer was used.

A total of 17 grab sampling locations were included in the survey in UK waters (both nearshore and EEZ). At each benthic grab sampling location, four grab samples were retrieved. Three of the replicate grabs were collected as samples for biotic analysis. One grab was used to obtain samples for particle size and chemical analysis.

A field log of sample positions was recorded including time of sampling, sediment type, and water depth. Photographs were taken of all samples *in situ*. Samples were carefully sieved using seawater and a sieving table consisting of a 5 mm mesh sieve over a 1 mm mesh sieve (using gentle hose pressure). The biological material retained in the 1 mm mesh was sorted from the remaining sediment and shell fragments using stereo microscopes. For identification of benthic biota both stereo-zoom microscope and compound microscope were used. Samples from each of the sampling sites were identified separately, and 10 % of the samples were later randomly quality controlled. The samples were preserved in 80% ethanol.

The macrobiota were counted and identified to the lowest practicable taxonomic level using standardised nomenclature and appropriate keys and references.

14.3.3.4 Particle Size Analysis

At each benthic grab sample location sediment was sampled for PSA. Up to one litre of sediment from each sample location was collected for analysis to determine the proportion of different particle size fractions. In line with the British standard Methods of test for soils for civil engineering purposes (British Standard 2010), wet sieving was applied in essentially cohesive sediments while dry sieving was only used for sediments that did not contain significant amounts of silt and clay, i.e. almost entirely granular sand and/or gravel.

To analyse the finer fractions such as silt and clay (<0.063 mm), the sedimentation by the hydrometer method was applied. This analysis is carried out when a certain percentage of material passing through the 0.0063 mm wet/dry sieve is reached. The percentage is usually 10 or 15% due to the fact that, at this level, the ratio of silt and/or clay can have a substantial effect on the physical properties of a soil.

14.3.3.5 Multivariate Statistical Analysis

Multivariate analysis was undertaken using the Plymouth Routines in Multivariate Ecological Research (PRIMER) v6.0 statistical package (Clarke & Gorley, 2006). Site related differences in community structure were examined using the Bray-Curtis similarity coefficient. Truncation of the macrobiota data was undertaken before calculation of multivariate statistics. Juvenile (JUV) individuals and colony forming species, e.g. the bryozoan *Flustra foliacea*, were excluded from the dataset.

Square root transformation was applied to the data before calculating the Bray-Curtis similarity measures. This transformation was applied to reduce the influence of dominant species in the assemblage characterisation (Clarke & Warwick, 2001).

CLUSTER analysis was utilised to provide a visual representation of sample similarity in the form of a dendrogram. CLUSTER analysis was conducted in conjunction with a SIMPROF (similarity profile) test to determine whether groups of samples were statistically indistinguishable at the 5% significance level, or whether any trends in groupings were apparent.

Non-numeric multi-dimensional scaling (MDS) was performed on the transformed dataset to further explore the data. The MDS plot visualises the relative similarities between samples.

14.3.3.6 Habitat Classification

Habitats/biotopes were classified based on the EUNIS classification system (European Environment Agency, 2017) to the lowest level possible. The classification involves consideration of semi-quantitative biological data (e.g. estimation of abundance of species) and environmental data (e.g. substrate type, wave exposure, tidal currents, salinity).

Quantitative methods were used for the identification of biota in grab samples, with all the data presented as individuals per square metre and percentage cover of colonial species. The semi quantitative SACFOR abundance scale was used for photo analyses.

14.3.4 Impact Assessment Methodology

The general approach to the Environmental Impact Assessment (EIA) is described in Chapter 3: Methodology including the approach to assessing the significance of effects based on the magnitude

of impact and value/sensitivity of receptor. The following section should therefore be read in conjunction with Chapter 3: Methodology.

The value and sensitivity of each benthic ecological receptor was determined based on consideration of the factors outlined in Table 14.4 and Table 14.5. The assigned value and sensitivity for each receptor are not necessarily linked within a particular impact. For example, a receptor could be of very high value (e.g. a designated feature of a Special Area of Conservation (SAC)) but have a low or negligible physical/ecological sensitivity to an impact and vice versa. The sensitivity of a receptor (to the specific impact) has therefore been used where relevant as a modifier for the value assigned to the receptor, with the logic applied for the assessment clearly indicated in the assessment narrative.

Table 14.4 Receptor Value Criteria for Benthic Ecology

Value	Definition
Very High	• An internationally designated site or potential/candidate site for designation (SAC, cSAC, pSAC or Ramsar site) or an area which the Statutory Nature Conservation Body (SNCB) has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified. • Internationally significant and viable areas of a habitat type listed in Annex I of the Habitats Directive. • Globally threatened species (Critically endangered or endangered on IUCN Red list) or species listed on Annex I or II of the Bern Convention. • Regularly occurring populations of internationally important species that are rare or threatened in the UK or of uncertain conservation status. • A regularly occurring, nationally significant population/number of any internationally important species including species listed in Annex II of the Habitats Directive. • Habitats or species that are highly regarded for their important biodiversity, social, community and / or economic value.
High	• A nationally designated site (such as a Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Marine Protected Area (MPA) and potential MPA (pMPA), Marine Nature Reserve (MNR) or Marine Conservation Zone (MCZ)) or a discrete area which the SNCB has determined meets the published selection criteria for national designation (such as SSSI selection guidelines) irrespective of whether or not it has yet been notified. • Regularly occurring, globally threatened species (Vulnerable or lower on IUCN Red list) or species listed on Annex 3 of the Bern Convention. • UKBAP habitats and species; Priority Marine Features; Scottish Biodiversity List • Habitats or species that possess important biodiversity, social, community and / or economic value.

Value	Definition
Medium	• Viable areas of key habitat identified in the Regional/County BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole. • Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile. • Water Framework Directive biological quality element. • Any regularly occurring significant population that is listed in a Local Red Data Book. • Significant populations of a regionally/county important species. • Habitats or species that possess moderate biodiversity, social, community and / or economic value.
Low	• Areas of habitat identified in a sub-County (District/Borough) BAP or in the relevant Natural Area profile. • District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on District/Borough ecological criteria (District sites, where they exist, will often have been identified in local plans). • Sites/features that are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource. • Habitats or species that are abundant, common or widely distributed. • Habitats or species that possess low biodiversity, social, community and / or economic value.
Negligible	• No site designation for areas of habitat. • Species present are common and widespread. • Habitats or species that are not considered important for their biodiversity, social, community and / or economic value.

Table 14.5 Receptor Sensitivity Criteria for Benthic Ecology

Sensitivity	Definition
Very High	• Species are under significant pressure and/or are highly sensitive to changing environments. • Species are intolerant of the impact with little or only slow recovery.
High	• Species may be under significant pressure and/or highly sensitive to changing environments. • Species may have a very low capacity to tolerate the impact with little or only slow recovery.
Medium	• Species may be currently under pressure or are slow to adapt to changing environments. • Species may have a low capacity to tolerate or recover from the impact.
Low	• Species are generally adaptable to changing environments. • Species may show some tolerance of the impact or recover quickly from impacts.
Negligible	• Species are highly tolerant of the impact.

The magnitude of impacts were assessed based on consideration of the criteria in Table 14.6 and taking into account the application of any embedded mitigation design measures to be incorporated

at the installation, operation or decommissioning phases. Where embedded mitigation design has been considered this has been clearly indicated in within the impact assessment.

Table 14.6 Impact Magnitude criteria for Benthic Ecology

Magnitude	Definition
Major	• **Habitat:** Impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect). • **Species:** Impact causes changes to a large proportion of the receptor species population, resulting in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect).
Moderate	• **Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). • **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes a change to a large proportion of the receptor species population resulting in a decline in the abundance of the overall population, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Minor	• **Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). • **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Negligible	• **Habitat:** Impact causes an effect on the receptor habitat that is not likely to change the extent or community composition of the wider habitat. • **Species:** Impact causes an effect on the receptor species population that is undetectable or within the range of natural variation.
No Change	• Impact has no effect or has no interaction with the receptor.

Based on the value/sensitivity of the receptor and the magnitude of the potential impact, the significance of effect was then determined based on consideration of the matrix in Table 14.7.

Table 14.7 Categorising significance of effects for Benthic Ecology

Magnitude of Impact	Sensitivity/Value of Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Major	Major	Major	Moderate	Minor	Minor
Moderate	Major	Moderate	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible
No Change	No Change	No Change	No Change	No Change	No Change

Key:

	Significant Effect
	Non-Significant Effect

For the purposes of this EIAR, an impact which has the potential to result in a significant effect on the environment has been defined as a moderate or major significance of effect (see Table 14.7), and mitigation is proposed where possible to prevent, reduce or offset the effect. Residual effects on benthic ecology receptors (i.e. effects following implementation of specific mitigation measures) were then identified and their significance determined.

Consequently, a significance of effect determined to be minor or lower is considered not to be significant in terms of the EIA Regulations. For these effects, mitigation measures have not been proposed to reduce the significance of the effect. For each significance of effect determined for each receptor/impact combination the assessment has indicated whether the effect is beneficial or adverse, and an assessment of the confidence in the assessment has been provided. The definitions for classifying the confidence in the assessment are provided in Table 14.8.

Table 14.8 Confidence in assessment of significance of effects

Confidence	Guideline	Evidence base to evaluate likelihood of effects
High	Probability estimated at 95% chance or greater	Scientific evidence and project information is detailed, consistent and extensive. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK).
Medium	Probability estimated above 50% but below 95%	Scientific evidence and project information is available but variable in detail, consistency and volume. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK).
Low	Probability estimated at below 50%	Scientific evidence and project information is limited in availability, and variable in detail, consistency and volume. Studies are not based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK), but are based on more distant habitats, species or populations being affected by other pressures.

14.3.5 Limitations of Assessment

Conditions at or near to the project will be subject to change over time with species movement and habitat change both into and out of the area. Therefore, this assessment reflects the conditions recorded at the time of the project-specific surveys and most recent desk study data available, as well as consideration of existing knowledge on the potential trends in the baseline in the future. As habitat mapping is based on the geophysical survey, and limited ground truthing was conducted, it is assumed that habitat mapping is a true reflection of the habitats within the consenting corridor. However, there is the potential for the actual boundaries of the predicted habitat types to vary from those predicted by the model.

14.4 Baseline Information

The understanding of the benthic ecology environment within the consenting corridor of the Project was largely informed by a Project specific benthic ecology survey conducted by MMT (2017). This understanding was further informed by a desk-based review of protected species and habitats within the vicinity.

The Project is located within the central North Sea. Biodiversity is generally lower in central and southern areas of the North Sea than in the northern areas (Künitzer *et al.*, 1992; Kröncke, 2011). The benthic species present within the area are largely correlated with the substrate type and associated hydrodynamic conditions and the following section provides information on the benthic species and habitats within the vicinity of the Project.

14.4.1 Designated Sites (for benthic ecology species)

This section relates to sites designated in full, or in part, due to the presence of benthic habitats or species. No existing designated sites are currently located within the consenting corridor, however, the proposed Southern Trench MPA is located within the consenting corridor. The designated sites within the vicinity of the consenting corridor are shown in Figure 14.2.

Table 14.9 Designated Sites with Benthic Ecology Features

Designated Site Receptor	Distance to HVDC Corridor	Qualifying Features	Importance of Features
Southern Trench proposed MPA	0 km: Crossed by Consenting Corridor.	Burrowed mud habitat, shelf deeps minke whales, and oceanic fronts as well as geodiversity features	Burrowed mud is a Priority Marine Feature
Scanner Pockmark SAC	0.45 km South	Submarine structures made by leaking gases	Annex I habitat
Norwegian Boundary Sediment Plain MPA	27 km South East	Ocean quahog (*Arctica islandica*)	OSPAR Annex V species and Priority Marine Feature
Turbot Bank MPA	26 km South	Sandeels	Keystone species & prey item for many fish species

14.4.1.1 Southern Trench proposed MPA

The Southern Trench proposed MPA has also been proposed for burrowed mud habitat, minke whales, shelf deeps and oceanic fronts and its geodiversity features. The consenting corridor passes through the southern end of this MPA. The areas of burrowed mud have been recorded in the northern and north-western portions of this proposed MPA.

14.4.1.2 Scanner Pockmark SAC

Scanner Pockmark is a Special Area of Conservation (SAC) approximately 450 m south of the consenting corridor. The boundary of this site is currently under consideration for amendment. If this amendment is enforced, the boundary of the site may be less than 100 m south of the consenting corridor. Scanner pockmark is a large seabed depression in the northern North Sea which contains large blocks of the Annex I habitat 'Submarine structures made by leaking gases'. The blocks lie in the base of the pockmark and support fauna more typically associated with rocky reef. These carbonate structures are notably colonised by large numbers of anemones (*Urticina felina* and *Metridium senile*) and squat lobsters (*Galathea squamifera)* (Dando, 2001).

14.4.1.3 Norwegian Boundary Sediment Plain MPA

The Norwegian Boundary Sediment Plain Marine Protected Area (MPA) is approximately 27 km south of the consenting corridor and is on the border of the UK EEZ. The Norwegian Boundary Sediment Plain MPA is home to a range of animals that live both in and on the sand and gravel habitats such as starfish, crabs, and the long-lived ocean quahog (*Arctica islandica*). This site has been designated for the ocean quahog which is an OSPAR Annex V species and Priority Marine Feature. Further information on this site is provided in Chapter 15: Fish and Shellfish.

14.4.1.4 Turbot Bank MPA

Turbot Bank MPA is approximately 26 km south of the consenting corridor and is an area of sandy sediment, including part of the shelf bank and mound feature known as 'Turbot Bank'. It is important for sandeels which are closely associated with sand habitats, living buried in the sand for months at a time. Further information on this site is provided in Chapter 15: Fish and Shellfish.

Figure 14.2 Protected sites designated for benthic ecology features within the vicinity of the consenting corridor

14.4.2 Intertidal Habitats, Species and Biotopes

The landfall site is at Longhaven Cliffs. Given the nature of the site, the benthic survey conducted along the consenting corridor was not able to survey close to the cliffs and the intertidal zone was not surveyed. However, observation of the site from the survey vessel and from the top of the cliff face indicates an exposed, barren habitat. Based on observations it is considered likely that limited populations of barnacles, limpets, chitons, and other encrusting species are present. There may also be some areas of fucoid algae particularly in sheltered crevices.

14.4.3 Subtidal Sediments

Sediment along the proposed consenting corridor varied between bedrock, sand, mud and mixed sediments with gravel and boulders. The sediment at the UK landfall end of the consenting corridor was bedrock that was overlaid with small areas of rippled gravel which also characterised the first 100 m of the survey corridor moving seaward away from the landfall. Beyond this point, the sediment became predominantly sand. PSA at Site S01 (Figure 14.3) confirmed the area was predominantly sandy (Table 14.10, Figure 14.4). Site S02 had a large proportion of gravel and some cobbles/boulders. From Site S03 to Site S09 sediment was predominantly sandy with a small gravel component, and the proportion of silt and clay gradually increased moving from Site S10 to Site S17 and was the dominant component from Site S12 to Site S17.

Table 14.10: PSA Results for Sediment Samples taken during the Benthic Survey

Sampling location	Sediment classification
S01	very silty fine SAND
S02	slightly silty sandy GRAVEL with COBBLES
S03	gravelly medium to coarse SAND
S04	slightly silty gravelly SAND
S05	slightly silty very gravelly SAND
S06	silty gravelly SAND
S07	slightly silty gravelly SAND
S08	slightly gravelly SAND
S09	slightly silty SAND.
S10	slightly gravelly very silty SAND
S11	slightly gravelly very silty SAND
S12	slightly gravelly sandy SILT
S13	slightly gravelly slightly sandy SILT
S14	slightly gravelly slightly sandy SILT
S15	slightly gravelly slightly sandy SILT
S16	slightly gravelly slightly sandy SILT
S17	slightly gravelly slightly sandy SILT

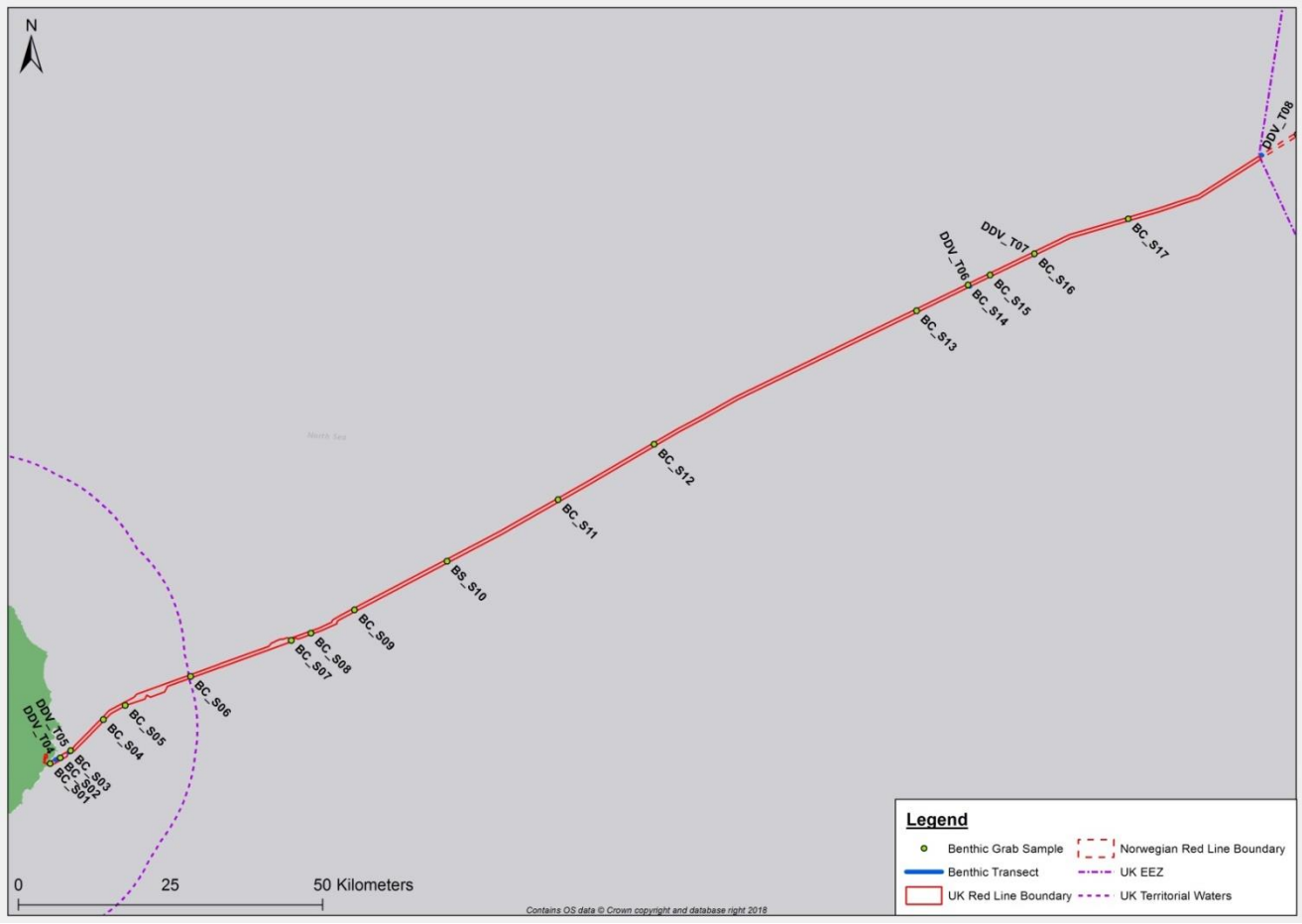

Figure 14.3 Grab Sample Locations within UK Waters

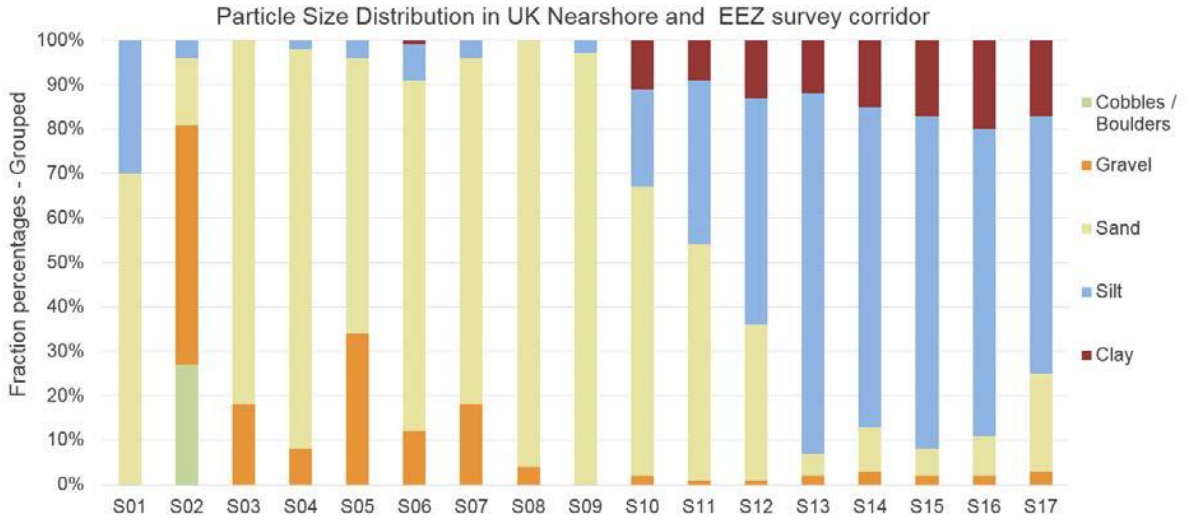

Figure 14.4 Particle size distribution chart for the sediment within the UK waters survey corridor (MMT, 2018).

14.4.4 Subtidal Species and Biotopes

During the environmental surveys conducted in 2017, within the survey corridor, a total of 17 habitats were recorded from the landfall area south of Peterhead to the limit of the UK EEZ, of which 12 habitats are within the proposed consenting corridor (Table 14.11). Habitat maps for the consenting corridor are provided in MMT (2018). The most abundant habitat identified within the survey corridor was 'Sea pens and burrowing megafauna in circalittoral fine mud (A5.361)' which was recorded along the last 95 km of the survey corridor up to the edge of the UK EEZ. This habitat is characterised by fine muds often heavily bioturbated by megafauna typically with the sea pens *Virgularia mirabilis* and *Pennatula phosphorea*.

A further 2.33 km^2 (233 ha) of the consenting corridor was designated as 'Pockmarks' and not assigned a EUNIS biotope code. The pockmark areas appear to belong to the same broad habitat classification as the surrounding areas (i.e. the biotopes A5.26, A5.35, and A5.361). They may later prove to represent a different or new biotope, following updates to the EUNIS classification (EEA, 2018).

The following habitats were recorded during the benthic survey, however, the boundary of the consenting corridor has been designed to exclude them due to their conservation value:

- A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock;
- A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock;
- A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock;
- A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand; and
- A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud.

For further detail on the findings of the survey see MMT (2018).

Table 14.11: Habitats recorded during the Environmental Survey in 2017 indicating EUNIS Habitat Classification and extent within consenting corridor.

Habitat Code	Habitat Classification	Site ID	Area within Consenting Corridor (km^2)	Area within Consenting Corridor (hectares)
A3.1	Atlantic and Mediterranean high energy infralittoral rock	none	0.02	2
A4.2	Atlantic and Mediterranean moderate energy circalittoral rock	none	0*	0*
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	T05	0*	0*
A4.2211	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	T04, T05	0*	0*
A5.13	Infralittoral coarse sediment	none	0.02	2
A5.14	Circalittoral coarse sediment	T04, T05, S03	0.13	13
A5.15	Deep circalittoral coarse sediment	S05	4.87	487
A5.25	Circalittoral fine sand	T04, S01, S08	5.74	574
A5.251	*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	S09	0*	0*
A5.26	Circalittoral muddy sand	S10	12.00	1,200
A5.27	Deep circalittoral sand		19.35	1,935
A5.35	Circalittoral sandy mud	S11	28.15	2,815
A5.36/ A5.361	Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	S13, S14, S15, S16, S17, S18, T06, T07, T08	52.47	5,247
A5.376	*Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	S12	0*	0*
A5.44	Circalittoral mixed sediment	T04, S02	1.25	125
A5.45	Deep circalittoral mixed sediments	S04	2.28	228
A5.611	*Sabellaria spinulosa* on stable circalittoral mixed sediment†	T04, S02, S06, S07	0.14	14

* These habitats were recorded within the survey corridor but are located outside of the consenting corridor.

† This habitat was not classed as a reef.

14.4.5 Habitats and Species of Conservation Importance

14.4.5.1 Habitats of Conservation Importance

14.4.5.1.1 Bedrock and Stony Reef

Bedrock Reef is listed in Annex I of the EC Habitat Directive under the 'Reefs' feature (Section 14.2.1). There are areas of potential bedrock and Stony Reef close to the consenting corridor, however, the consenting corridor has been designed to avoid these areas by at least 50m. Much of the first 4 km of

the survey corridor was Bedrock Reef. At the start of the survey corridor, near the UK landfall, the bedrock is possible Bedrock Reef.

Transect T05 covered predominantly an area of outcropping bedrock between around KP 3.920 and KP 4.146. The epifauna was dominant and was characterised by *Sabellaria spinulosa* tubes. Hard surfaces where no tubes were present were covered by different species of bryozoans, hydrozoans and sea anemones. The extent of the bedrock area recorded along transect T05 was estimated to be approximately 22,000 m^2 based on SSS interpretation.

There are several smaller bedrock outcrops located between KP 3.768 and KP 4.566 but they were not sampled during the survey and these are all considered to be potential Bedrock Reefs.

14.4.5.1.2 Stony Reef

Stony Reef is listed in Annex I of the EC Habitat Directive under the 'Reefs' feature (Section 14.2.1). There are areas of potential bedrock and Stony Reef close to the consenting corridor, however the consenting corridor has been designed to avoid these areas by at least 50m. At transect T04 (KP 1.339 to KP 1.589) the habitat, classified as *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock (A4.2211), was assessed to meet the qualifying criteria of a potential Stony Reef (MMT, 2018) under the Annex I of the EC Habitats Directive. The clast-supported reef was graded as 'medium' based on:

- the composition having a coverage of 40 to 95 %;
- the elevation was assessed to vary between 0.05 m and 1 m, with a distinct separation from the seabed; and
- the extent was assessed to be approximately 70,000 m^2 based on the results of the geophysical survey.

The biota associated with the hard surfaces consisted mainly of *Sabellaria spinulosa*, the bryozoan *Flustra foliacea* and sea stars.

A similar area, composed of till, was interpreted in the northern part of the corridor at approximately KP 2.178. Due to its proximity to transect T04, the physical conditions can be assumed to be comparable and the assessment has been made that this area is a potential Stony Reef.

14.4.5.1.3 Pockmarks

Whilst pockmarks are not conservation features alone, they can support 'submarine structures made by leaking gases' which are list in Annex I of the EC Habitat Directive. Scanner Pockmark Marine Protected Area (MPA) is a Special Area of Conservation (SAC) approximately 450 m south of the consenting corridor. Pockmarks were present between KP 66.760 to KP 125.214. Interpretation of geophysical data suggested that the sediments within the majority of the pockmarks were composed of sediments different to the surrounding seabed, with occasional pockets of coarse sediments (A5.45). The frequency of pockmarks increased towards the east. Dense fields of pockmarks were identified between KP 125.214 and KP 199.042, with pockmarks becoming rarer to the east, but still present from KP 199.042 to KP 206.620. A 100 m transect, T06, was surveyed to the southeast of Site S14 over a pockmark. The transect started at KP 171.591 and ran eastwards until KP 171.693. None of these pockmarks appeared to have carbonate structures and so do not qualify as 'submarine structures made by leaking gases'.

14.4.5.1.4 Sabellaria spinulosa Reefs

Sabellaria spinulosa reefs are biogenic reefs that are listed in Annex I of the EC Habitats Directive. Aggregations of *S. spinulosa* tubes that have the potential to qualify as Annex I reef were located close to the consenting corridor, however, the consenting corridor has been designed to avoid these areas by at least 50m.

At the outcropping bedrock located around KP 4, surveyed at video transect T05, the *S. spinulosa* tube aggregations had a different structure and elevation. On the slopes and on bedrock elevated from the surrounding sand and gravel, large reef structures were elevated >10 cm from the underlying bedrock. No sampling was performed at the hard surfaces, but the structures were clearly visible in the video data, and example captures are seen in Figure 14.5. The area was very patchy, shifting between reef structures, bedrock lacking tubes, and strings of gravel. The location of the *S. spinulosa* reef made it difficult to take still images as it is mainly steep sloping bedrock and is the reason behind the lack of tube aggregations in the still images. Using the definition written described by Gubbay (2007) for grading the reefiness, it is considered to fulfil the criteria of a high graded *S. spinulosa* reef (MMT, 2018).

Figure 14.5 Elevated aggregations of *Sabellaria spinulosa* tubes along transect T05, in habitat A4.2211.

The assessment made from the video was in relatively poor visibility, and therefore should be considered an estimation. The extent of the area is hard to assess due to the mix of two different kinds of hard surfaces, one with and one without *S. spinulosa* present. These two habitats cannot be distinguished using available SSS and backscatter and is merged into a classification complex, A4.213/A4.2211, in the habitat charts.

During the UK North Sea survey camera calibration of the SeaSpyder DDV, a high density of *S. spinulosa* area was sampled. The stills from the camera calibration site, together with the video, show distinct tube formations densely aggregated accounting for a *S. spinulosa* coverage of 70-100 %. The epifauna on the reef was rich. The geophysical data indicates that the area covers approximately 12,200 m^2. This area is interpreted to potentially fulfil the criteria of a medium graded *Sabellaria*

spinulosa reef ((MMT, 2018)) and to be classified as an Annex I – 1170 Biogenic Reef. The elevation was approximately ≥5 cm, with some of the aggregations abraded but still distinguishable as *S. spinulosa*. This area has been classified to a more detailed level, from 'Circalittoral mixed sediments (A5.44)', to '*Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611)'.

Grab sample location S07, located in the area of coarse sediment at KP 45.601, was characterised by sand and cobbles/boulders encrusted with *S. spinulosa* in a poorly sorted matrix. The grab sample was dominated by the echinoderm *Echinocyamus pusillus*, cnidarian Edwardsiidae and polychaetes. No *S. spinulosa* was identified in the grab sample replicates from this site. The *S. spinulosa* only appears to occur on the seabed in discrete larger aggregations, possibly encrusting boulders. The still images S07_03 and S07_04 have a 46 % and 23 % coverage of *S. spinulosa* respectively (MMT, 2018 #333). With consideration of the elevation and coverage together with the frequency of occurrence, a section from KP 45.338 to 45.723 south of SCL is considered to fulfil the criteria of a medium graded *Sabellaria spinulos*a reef and falls under the Annex I –1170 Biogenic Reef.

14.4.5.2 Species of Conservation Importance

14.4.5.2.1 Sea Pen and Burrowing Megafauna Communities

Sea pens and burrowing megafauna communities are on the OSPAR list of species considered under threat and/or decline in the Greater North Sea (region II) (OSPAR, 2008). This habitat consists of plains of mud at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. It is found in sheltered basins of fjords, sea lochs, voes (small bays) and in deeper offshore waters including the North Sea.

An area of the consenting corridor of approximately 52.47 km^2 was assessed to be the OSPAR Sea pen and burrowing megafauna communities habitat. These communities are described within the biotope A5.361 – 'Sea pens and burrowing megafauna in circalittoral fine mud'.

14.4.5.2.1 Arctica islandica

The ocean quahog *Arctica islandica* is on the OSPAR list of species considered under threat and/or decline in the Greater North Sea (region II) (OSPAR, 2008) and it is a Priority Marine Feature under The Marine (Scotland) Act and the UK Marine and Coastal Access Act. It is a bivalve shell up to 13 cm in length found around all British and Irish coasts and offshore including the North Sea. Further information on ocean quahogs is provided in Chapter 15: Fish and Shellfish.

14.4.5.2.2 Sandeel

Turbot Bank NCMPA is approximately 26 km south of the consenting corridor and is an area of sandy sediment, including part of the shelf bank and mound feature known as 'Turbot Bank'. It is important for sandeels which are closely associated with sand habitats, living buried in the sand for months at a time. Further information on sandeels is provided in Chapter 15: Fish and Shellfish.

14.4.6 Sediment Quality and Contamination

Sediment quality and contamination are assessed in Chapter 7: Seabed Quality. Of the 17 sites samples for sediment contamination, no organic contaminants (including Polycyclic Aromatic Hydro Carbons, and Total Petroleum Hydrocarbons) were present at concentrations exceeding the Canadian Threshold Effect Levels (TEL). As such no site had organic contamination levels which have the potential to result in environmental effects.

With regard to inorganic contaminants, TELs were exceeded at 10 of 17 sites, however, there were no exceedances of the Probable Effect Levels (PEL). As such, at these sites, heavy metals were at levels where environmental effects are possible, but unlikely to occur.

It can therefore be said that sediment quality is generally good to very good and no levels of contamination were identified that are likely to result in adverse environmental effects.

14.4.7 Valuation of Key Receptors

A summary of the benthic ecology receptors relevant to the project, along with their assigned value/sensitivity is presented in Table 14.12.

Table 14.12: Valuation of Benthic Ecology Receptors

Receptor Group	Receptor	Receptor Value	Justification
Designated Sites	Scanner Pockmark SAC	Very High	Protected site under the EC Habitat Directive supporting the Annex I habitat - Submarine structures made by leaking gases.
Designated Sites	Southern Trench proposed MPA	High	Proposed site under the Marine (Scotland) Act 2010 which supports a burrowed mud habitat.
Designated Sites	Norwegian Boundary Sediment Plain NCMPA	High	Protected site under the Marine and Coastal Access Act (MCAA) 2009 which supports the ocean quahog (*Arctica islandica*).
Designated Sites	Turbot Bank NCMPA	High	Protected site under the Marine and Coastal Access Act (MCAA) 2009 which supports sandeels.
Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	Submarine structures made by leaking gases	Very High	Annex I feature of the Habitats Directive found at Scanner Pockmark MPA and may be associated with other pockmarks in the area. All pockmarks are included in this category as a precautionary approach.
Very High Value Biotopes	Pockmarks	Very High	Annex I feature of the Habitats Directive found at Scanner Pockmark MPA and may be associated with other pockmarks in the area. All pockmarks are included in this category as a precautionary approach.
Very High Value Biotopes	A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – *Sabellaria spinulosa* reef.

Receptor Group	Receptor	Receptor Value	Justification
Very High Value Biotopes	A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Potential to support EC Habitat Directive Annex I feature – *Sabellaria spinulosa* reef.
High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Common habitat type supporting common species but has the potential to support Priority Marine Features.
High Value Biotopes	A5.14 - Circalittoral coarse sediment	High	Common habitat type but has the potential to support Priority Marine Features such as the sea cucumber *Neopentadactyla mixta*.
High Value Biotopes	A5.15 - Deep circalittoral coarse sediment	High	Common habitat type but has the potential to support Priority Marine Features such as the horse mussel *Modiolus modiolus*.
High Value Biotopes	A5.25 - Circalittoral fine sand	High	Common habitat type but has the potential to support Priority Marine Features.
High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	This is a Priority Marine Feature.
High Value Biotopes	A5.27 - Deep circalittoral sand	High	Common habitat type supporting common species but has the potential to support Priority Marine Features.
High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	This is a Priority Marine Feature and OSPAR threatened and/or declining habitats and species.
High Value Biotopes	A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Common habitat type supporting common species.
High Value Biotopes	A5.45 - Deep circalittoral mixed sediments	High	Not very common habitat type with the potential to support Priority Marine Features such as the horse mussel *Modiolus modiolus*.
Intertidal species and biotopes	Intertidal species and habitats	Medium	Benthic invertebrates are a WFD biological element.
Medium Value biotopes	A5.44 - Circalittoral mixed sediment	Medium	Not very common habitat type supporting a rich community of species.

Receptor Group	Receptor	Receptor Value	Justification
Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Common habitat type supporting common species. However, subtidal benthic species can provide a food resource for other species of conservation and commercial importance (other benthic species, fish and marine mammals).
Low Value Biotopes	A5.35 - Circalittoral sandy mud	Low	Common habitat type supporting common species. However, subtidal benthic species can provide a food resource for other species of conservation and commercial importance (other benthic species, fish and marine mammals).

14.4.8 Future Baseline

Given the anticipated lifetime of the project, there is the potential that species populations or ranges may alter due to climate change. Species with a natural range that does not currently extend as far north as the corridor may colonise this area in the future as mean water temperatures increase. For example, the decapods *Diogenes pugilator, Goneplax rhomboides*, and *Liocarcinus vernalis*, have extended their range farther into the North Sea during recent decades, with the Belgian coast previously believed to be the northernmost extent of their range (Birchenough *et al*., 2011). These species are now regularly occurring in Dutch and German waters.

Modelling has suggested that, whilst the majority of species that may move out of the North Sea as a result of increasing sea temperatures will do so in a north or north westerly direction, some species may move south or into deeper waters (Weinert *et al*., 2016). Studies of historical changes suggest there will be a lag between sea temperatures rising and species moving, resulting in lower diversity in the North Sea for a time (Hiddink *et al*., 2014). However, the *ICES status report on climate change in the North Atlantic* (Birchenough *et al*., 2011) suggests that more species will move into the North Sea from the south than will leave it to the north, suggesting that the long-term change may be an increase in biodiversity.

This is unlikely to occur by the time of cable installation, so no effects would be expected on these species during this phase. During operation and decommissioning, effects on these species are likely to be no greater than on other benthic species. These species are therefore not considered further within this assessment.

14.5 Impact Assessment

The potential impacts of the project during the installation, operation and decommissioning phases have been assessed to determine their magnitude of impact upon the benthic ecology receptors described in Section 14.4, and the subsequent significance of effect. The potential impacts of the project are summarised in Table 14.13, along with the potential pathways of effect for the relevant benthic ecology receptors. A summary table of the assessment is provided in Tables 14.15a-b, which fully details the valuation of each receptor, the magnitude of each impact upon each receptor and also the final significance of effect from the combination of value and magnitude, and whether that effect is considered to be significant in terms of the EIA Regulations.

The assessment is based on the information that has been provided to date in relation to methods of installation, operation and decommissioning. Some aspects of the installation and operation for the project are not yet finalised, as discussed in Chapter 2: Project Description and so, as a precautionary approach, a series of worst-case assumptions have been made for the purposes of the assessment. The various worst-case assumptions for the purposes of the assessment are discussed below:

- **Number of cables and bundling arrangements** – there will be two High Voltage Direct Current (HVDC) cables laid in up to two trenches (either bundled and laid in one trench, or laid separately in two trenches). The fibre-optic cable will be laid in the same trench as one of the HVDC cables (or both if bundled). The assessment will consider bundled cables in a single trench as a worst-case for operational sediment heating effects, and unbundled cables in two trenches as a worst-case for electromagnetic field (EMF) effects, cable trenching and installation and associated effects on habitats and species;
- **Micro-siting of the cables within the 500 m wide consenting corridor and cable separation distances** – the separation distance between the cables, if not laid bundled, is likely to vary

along the consenting corridor. Separation will be a minimum of 20 m and a maximum of 40 m within Scottish Waters (to 12 NM). Separation will then likely be a minimum of 20 m and maximum of the entire consenting corridor between 12 NM to the UK EEZ limit. A bundled cable will be used as a worst-case for operational sediment heating effects, and the maximum separation distances will be used as a worst-case for the EMF effects. Other effects are expected to be similar regardless of separation distance;

- **Cable depth of lowering along the consenting corridor** – the minimum depth of lowering will be 0.4 m in hard substrates and 0.5 m in soft substrates, with an aim to achieve a 0.8m depth of lowering if possible, and a likely maximum depth of lowering of 1.5 m. The minimum depth of lowering will be used for the assessment;
- **Cable burial methods** – a combination of jet-trenching, mechanical trenching or ploughing may be required to protect the cables. Burial will be assumed to be via natural infill rather than active infilling techniques as a worst-case for habitat recovery times. Within UK waters (to 200NM) rock placement will be in the region of 25m either side of the 4 cable crossings and 70m either side of the 14 surface laid pipeline crossings, and at a worst-case for extent of a 1:3 slope. Rock placement at the HDD exit point will be to a depth of 0.8m for a 70m distance at a 1:3 slope;
- **Cable trench** – methods of trenching will generate disturbance of the seabed around the trench, and depending upon the method used the trench and excavated material footprint will be a maximum of 5 m distance either side of the centre-line of the cable (a total of 10 m width) as a worst-case;
- **HDD** – a number of different drilling materials could be used, but it is assumed that the drilling fluid will solely comprise Bentonite;
- **Installation programme** – the detailed installation programme and start date is not yet finalised and so it is assumed that installation could be conducted at any time of year as a worst-case apart from the HDD, which will occur between September-March, and the cable laying, which will be between April-September;
- **Installation programme** – the cable installation programme may vary depending upon cable length used (which will be between 75 km and 170 km) and cable production ability. The worst-case programme duration of 5 years has been used as shown in Chapter 2: Project Description, which is based on use of a 170 km cable due to the time of production of a cable of this length. The cable installation programme in UK waters also assumes a worst-case programme of two separate HVDC cables being installed;
- **Operational repairs** – repairs could be once every 3 years as a likely worst-case and require disturbance of the seabed of up to twice the water depth at the repair location; and
- **Decommissioning phase arrangements** – the majority of the cable will be removed at decommissioning; however some sections may be left in-situ without transferring electricity. Removal will be assessed as a worst-case.

Table 14.13 Summary of impacts of the project and the presence of impact pathways to receptors (indicated with a tick). Those without a tick indicate that no pathway is considered to be present.

Receptor	Subtidal habitats	Subtidal species
Potential development impact		
Seabed Preparation and Cable Installation		
Habitat loss	✓	✓
Habitat creation - cable protection	✓	✓
Physical disturbance and displacement (disturbance of bottom sediments)	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)		✓
Changes to water quality (release of hazardous substances)		✓
Changes to water quality (release of drilling fluids)	✓	✓
Introduction of invasive non-native species		✓
Operation		
Change in hydrodynamic regime (scour & accretion)	✓	✓
Sediment heating		✓
EMF from the cable		✓
Introduction of invasive non-native species		✓
Physical disturbance during inspection & repair	✓	✓
Decommissioning - if cable removed		
Habitat loss	✓	✓
Physical disturbance and displacement (disturbance of bottom sediments)	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)		✓
Changes to water quality (release of hazardous substances)		✓
Introduction of invasive non-native species		✓

14.5.1 Receptors Scoped Out of the Assessment

As the cable will be routed under the cliff using HDD at the landfall, there will not be any impacts on the intertidal environment. As such, intertidal habitats and species have been scoped out of further assessment.

Norwegian Boundary Sediment Plain NCMPA and Turbot Bank NCMPA have been scoped out of further assessment as they are too far away (more than 25 km) for their benthic features to be affected by the Project.

Underwater noise and vibration was scoped out of the assessment during the scoping phase as it was considered there would not be any significant effects on benthic species.

14.5.2 Primary and Tertiary Mitigation

The primary and tertiary mitigation measures (see Chapter 2: Project Description) and that have been considered within the assessment are described below:

- The results of the benthic survey operations were used to inform the design of the consenting corridor, Annex 1 habitats have been excluded from the boundary of the consenting corridor by at least 50 m;
- For HDD activities, the drill will stop before it reaches the end point of the hole and all the excess material and drilling fluid will then be pumped out of the hole to minimise loss of HDD fluid. Therefore, only the final short drilling section will result in a of fluids and solids to the sea;
- For cable operation, a depth of lowering of at least 0.4 m in hard substrate and 0.5 m in soft substrate will be achieved, which will reduce EMF and sediment heating effects. Greater depths of lowering will be achieved where possible;
- For cable operation, electric fields will be contained within cable armouring due to shielding effects. The use of direct currents in the marine cables will prevent the formation of induced electric fields outside the cable armouring. Magnetic fields can, however, be detected beyond the cable armouring (Gill *et al.*, 2005);
- To minimise the introduction of invasive non-native species, all vessels used during construction, operation and decommissioning will follow the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BWM) which entered into force in 2017;
- To minimise the introduction of invasive non-native species, all vessels used during construction, operation and decommissioning will be sourced from the North Atlantic Biogeographic region, or will be subject to appropriate decontamination procedures if sourced from elsewhere to remove the risk of INNS introduction – through the use of hull anti-fouling materials; and
- To minimise changes to water quality (release of hazardous substances), all vessels used during construction, operation and decommissioning will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations.

14.5.3 Seabed Preparation and Cable Installation Phase Impacts

14.5.3.1 Habitat Loss

The cables will be approximately 230 km long within UK waters. A 'worst-case scenario' has been assumed for this assessment that an area of seabed up to 10 m wide along the length of each cable laid may be disturbed during trenching (5 m either side of each cable). An area of approximately 2.3 km^2 for each cable will therefore be temporarily lost of the existing habitat during the installation period.

Habitat within the consenting corridor may be lost as a result of seabed preparation, trenching and laying of the cable and from cable protection such as rock placement. Cable protection will be used in areas where the cable cannot be buried to the required depth (such as at crossing points with other cables). The breakdown for the amount of each habitat type that could be lost during cable installation is provided in Table 14.14. This has been calculated in two ways: a 20 m wide disturbance corridor has been applied along the centreline of the consenting corridor to estimate the area of each habitat that could be lost; and also the proportion of the consenting corridor made up of each habitat type is taken

and applied to the total area of habitat loss (approximately 4.6 km^2) to provide another estimate of the area of each habitat that could be lost.

Table 14.14 Habitat Loss Estimates from Cable Installation

EUNIS Habitat	Total habitat areas within consenting corridor (km^2)	Habitat loss estimated from a 20m disturbance strip along the centre of the consenting corridor (km^2)	Habitat loss estimated from distributing the total area of disturbance proportionally across the areas of biotopes present within the consenting corridor (km^2)
A3.1	0.02	0	0.001
A5.13	0.025	0	0.001
A5.14	0.126	0.021	0.005
A5.15	4.868	0.179	0.173
A5.25	5.743	0.187	0.205
A5.26	12.001	0.461	0.427
A5.27	19.350	0.533	0.689
A5.35	28.152	1.025	1.003
A5.361	52.472	1.912	1.869
A5.44	1.253	0.057	0.045
A5.45	2.278	0.102	0.081
A5.611[†]	0.136	0.007	0.005
Pockmarks	2.329	0.102	0.083
Grand Total	**128.754**	**4.586**	**4.586**

[†] This is not reef and therefore does not qualify as Annex I habitat.

The trench may be subject to backfilled rock placement during the laying process (see Chapter 2: Project Description for details) or using natural infilling which allows the trench to be filled in over time by the collapse of the trench walls and settling of suspended material. Recovery of the seabed habitats disturbed by trenching will be longest if trenches are left to infill naturally. Recovery of habitats within the disturbed areas would take a number of years and will vary between biotopes.

The removal of the two out of service (OOS) cables will disturb around a 4 km length of seabed within the consenting corridor.

The rock placement at crossing points will be up to a 1 m burial depth for the four cable crossings, and 2 m burial depth for the 14 surface laid pipeline crossings. Existing habitat loss beneath the rock placement in UK waters will therefore be a maximum of 300 m^2 for each cable crossing, 1,680 m^2 for each surface laid pipeline crossing, and 336 m^2 at the HDD exit point. As detailed in the Construction Method Statement (NorthConnect, 2018) crossing designs are subject to agreement with the relevant asset owners, hence the figures utilised here, based on standard designs, are subject to change. Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to change the nature of the seabed substrate and so will result in a temporary loss of habitat.

14.5.3.1.1 Designated Sites

The Southern Trench Proposed MPA is designated in part due to the presence of burrowed mud habitats and the consenting corridor overlaps with this area. The only areas of burrowed mud that have been recorded are in the northern and north-western portions of this proposed MPA and no areas of burrowed mud were identified in the Southern Trench pMPA during the benthic survey operations. Hence no loss of the burrowed mud habitat within the pMPA is expected. As such, there will be **no change** to this designated site in terms of its benthic ecology feature.

14.5.3.1.2 Very High Value Biotopes

As described above in Section 14.4.4, there were 12 different biotopes recorded within the consenting corridor. The value of these habitats varies from low to very high. Some pockmark areas are located within the consenting corridor and have been assessed as very high value receptors. In addition, areas of the following very high value biotopes are present within the consenting corridor:

- A3.1 - Atlantic and Mediterranean high energy infralittoral rock; and
- A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment.

Biotope A3.1 is assigned a very high value only for its potential to support EC Habitat Directive Annex I feature, Bedrock Reef or Stony Reef, rather than the presence of confirmed reef. It is located to the west of the HDD marine exit point, close to shore, and will therefore not be affected by the Project.

The areas of biotope A5.611 present within the consenting corridor are not reef forming and therefore have not been classified as an Annex I habitat. Only 5.1% out of a total of 0.14 km^2 (14 ha) of this habitat within the consenting corridor could be disturbed by cable installation, based on the habitat loss estimates presented in Table 14.14.

Pockmark areas will be avoided where possible due to the engineering challenges they present. This assessment is therefore considered to be worst-case. The pockmark areas are in soft sediment and an estimate of up to 0.1 km^2 of pockmark areas will be lost during installation activities for the Project which is 4.4% of the pockmark habitat within the consenting corridor. Pockmarks are created by seeping gas and it is likely that in areas with active gas seeps, the gas will find another route to the surface in the surrounding area and will create a new pockmark. The pockmark habitat is expected to have a high sensitivity to this effect. The communities associated with these areas are expected to re-establish as fauna migrate from the surrounding areas with recovery occurring in the medium term (2-10 years) (Tyler-Walters, 2018).

Due to the very low proportion of habitat affected within the consenting corridor and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on these **very high** value receptors. The overall significance of this effect is therefore assessed to be **minor, non-significant**.

14.5.3.1.3 High Value Biotopes

The high value biotopes recorded within the consenting corridor that may be lost within the area of disturbance during cable laying are:

- A5.13 - Infralittoral coarse sediment;
- A5.14 - Circalittoral coarse sediment;
- A5.15 - Deep circalittoral coarse sediment;
- A5.25 - Circalittoral fine sand;

- A5.27 - Deep circalittoral sand;
- A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud; and
- A5.45 - Deep circalittoral mixed sediments.

Based on the habitat loss estimates provided above in Table 14.14, the total area of high value biotopes that may be lost during installation of the cable is up to 3.02km^2. This represents approximately 3.6% of the high value biotopes present within the consenting corridor. In general, it is expected that the cable will be installed to a minimum depth of lowering of 0.4 m, which means that all infauna within these biotopes will be lost within the footprint of the cables.

Recovery of these biotopes is expected to occur within the medium (2-10 years) (Tillin, 2016a; De-Bastos, 2016) with the exception of A5.361, which is expected to occur in the long term (>10 years) (Hill & Tyler-Walter, 2018).

Due to the very low proportion of habitat affected and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on **high** value receptors and the overall significance of this effect is therefore assessed to be **minor, non-significant**.

14.5.3.1.4 Medium Value Biotopes

The only medium value biotope recorded within the consenting corridor is A5.44 - Circalittoral mixed sediment. Approximately 0.06 km^2 of the habitats and species present within the A5.44 habitat complex will be lost as a result of installation activities, which is approximately 4.5% of the total area of this biotope within the consenting corridor. In general, it is expected that the cable will be buried to a minimum depth of 0.4 m which means that all infauna within these biotopes will be lost within the footprint of the cables.

Recovery is expected to take a similar period of time as the high value biotopes based on the sediment types and range of species present, which is generally considered to occur within the medium term (2-10 years).

Due to the very low proportion of habitat affected and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on a **medium** value receptor and the overall significance of this effect is therefore assessed to be **negligible, non-significant**.

14.5.3.1.5 Low Value Biotopes

The low value biotopes within the consenting corridor are:

- A5.26 - Circalittoral muddy sand; and
- A5.35 - Circalittoral sandy mud.

Estimates from Table 14.14 of 0.461 km^2 of A5.26 and 1.025 km^2 of A5.35 will be lost as a result of installation activities, which is approximately 3.81% of of A5.26 and 3.6% of A5.35 within the consenting corridor. In general, it is expected that the cable will be buried to a minimum depth of 0.5 m in soft sediments which means that all infauna within these biotopes will be lost within the footprint of the cables.

These biotopes are common and support common species. The habitat is likely to be found in nearby areas and a loss of this habitat within the cable footprint is unlikely to result in a change of function for the wider habitat and supporting species. As such, the magnitude of this impact is assessed to be

negligible on a **low** value receptor and the overall significance of the effect is therefore **negligible, non-significant.**

14.5.3.2 Habitat Creation

In areas where the cable is protected with rock placement or other means, the presence of these structures will act as a new hard substrate in otherwise generally soft sediment environments. The introduction of new habitat in the form of rock placement has the potential to encourage species to colonise the area that would otherwise be unable to thrive in this area, and thus increase species diversity. This, however, also poses the risk of colonisation by invasive, non-native species.

Based on information provided in Section 14.5.3.1, introduction of new habitat beneath the rock placement in the UK EEZ will be a maximum of 300 m^2 for each cable crossing, 1,680 m^2 for each surface laid pipeline crossing, and 336 m^2 at each HDD exit point. Assuming a worst-case of two separately laid cables and three HDD exit points, altogether the introduction of new habitat beneath rock placement will total 5.0 ha (0.05 km^2). Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to change the nature of the seabed substrate and so will not result in any habitat creation, and is not considered further.

The rock will remain in place for the lifetime of the Project.

14.5.3.2.1 Designated Sites

There will be no effect on the burrowed mud habitat of the Southern Trench Proposed MPA and no effect on any of the other nearby designated sites as a result of the introduction of new habitat, so this magnitude of impact is assessed as **no change**.

14.5.3.2.2 Very High Value Biotopes

The placement of rock may create hard substrate habitat in the limited areas where it is placed. The magnitude of the impact for hard substrate biotopes is assessed as **negligible**, and as **no change** for soft substrate receptors.

14.5.3.2.3 High, Medium and Low Value Biotopes

The high, medium and low value biotopes are all characterised by sedimentary habitat. The introduction of a hard substrate would not therefore result in creation of any habitat of these biotopes. The magnitude of the impact on these **high, medium** and **low** value biotopes is **no change**.

14.5.3.3 Physical Disturbance and Displacement

As discussed in Section 14.5.2.1, the area which may be affected by physical disturbance and displacement will be within the consenting corridor, and the total area of the corridor is approximately 4.6 km^2. In addition to the direct loss of habitat assessed above, benthic habitats and species may be smothered by sediments during side casting from the trench.

Smothering is most likely to affect sessile or limited mobility epifauna, or infauna in surficial sediments (near the sediment-water interface). However, given the limited extent of seabed disturbance likely to affect benthic habitats at any one time during the installation period, the magnitude of impact on benthic species is assessed to be **negligible**. The overall effect significance is therefore **minor, non-significant** for the species within **very high** and **high** value biotopes and **negligible, non-significant** for species within **medium** and **low** value biotopes. The benthic ecology feature of the Southern Trench proposed MPA will not be affected and given the distance between the consenting corridor and

benthic qualifying features of the site (areas of burrowed mud). Hence, no change will occur in these sites and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.3.4 Changes to Water Quality (Resuspension of Sediments and Increased Sediment Loading)

Trenching and rock placement activities, as well as the OOS cable removal, may re-suspend seabed sediments into the water column. Trenching (jetting) techniques will cause a greater level of suspended sediments compared to the use of ploughing equipment. Any sediment suspension and deposition as a result of the trenching and rock placement activities will be very localised and short-term in duration (see Chapter 11: Water Quality (Offshore)).

Larger, heavier particles of sediment such as sand are likely to settle quickly and within a short distance of the cable. Smaller, lighter particles of sediment such as silt may remain in the water column for a far longer period of time and may travel further from the cable before resettling. The consenting corridor comprises the following split of seabed substrate types:

- 69% muds and gravels;
- 29% sands and silts; and
- 2% rocky and hard substrates.

High levels of suspended solids can potentially clog filtering apparatus of filter feeding species, thereby reducing feeding efficiency (Yukihira *et al*. 1999) which could result in reduced survival and potentially mortality of individuals.

14.5.3.4.1 Designated Sites

There will not be any effect on the burrowed mud of the Southern Trench Proposed MPA or on any of the benthic ecology features of nearby designated sites and so there will be **no change**. Due to the distance between the Scanner Pockmark SAC and the consenting corridor, impacts on this site are also assessed as **no change**.

14.5.3.4.2 Very High Value Biotopes

Biotopes A3.1 and A5.611 are found in medium to high energy environments with high water movement. The characterising species of biotopes in medium to high energy environments are expected to be able to tolerate intermittent episodes of sediment deposition and the nature of this medium to high energy environments ensures that sediment plumes will be rapidly dissipated. Pockmark habitats are located in soft silty sediments which are depositional. As such their characterising species are adapted to this environment and are expected to be able to tolerate periods of sediment deposition (Tyler-Walters, 2018). The other Very High value biotopes outside of the consenting corridor are not expected to receive significant levels of sediments as a result of cable installation. This impact will be temporary during the construction phase of the Project and the magnitude is assessed to be **negligible**. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.4.3 High Value Biotopes

Most of the characterising species in these high value biotopes (A5.13, A5.14, A5.15, A5.25, A5.27, A5.36/ A5.361, and A5.45) are active burrowing species that are expected to be able to burrow to the surface. However, not all species exhibit sufficient ability to burrow out especially if buried underneath a deep layer of sediments (for examples see Tillin, 2016b). Given the limited extent of this effect and

the temporary nature, the magnitude of this impact is assessed to be **negligible** on a **high** value receptor. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.4.4 Medium and Low Value Biotopes

The habitat complexes of medium and low value biotopes (A5.44, A5.26 and A5.35) support a wide range of species that are likely to exhibit a variety of responses to increases in sediment in the water column and turbidity. The sensitivity of these biotopes is therefore assessed on a precautionary basis as of very high sensitivity. However, given the limited increase in sediment loading within a localised extent, the magnitude of this impact is assessed to be **negligible**.

The overall effect on these **medium** and **low** value biotopes is assessed to be **negligible, non-signifcant**.

14.5.3.5 Changes to Water Quality (Release of Hazardous Substances)

Trenching, OOS cable removal and rock placement activities may resuspend seabed sediments which could contain contaminants. Sediment contamination was assessed from samples taken during the benthic survey and found elevated levels of cadmium, copper, nickel and chromium at some sampling locations within the consenting corridor (Section 14.4.6.1).

Any sediment, and thus contaminant resuspension and deposition as a result of the trenching and rock placement activities, will be very localised and short-term in duration (see Chapter 11: Water Quality (Offshore)). Chapter 11: Water Quality (Offshore) concludes there are very low levels of contaminants in the sediment and so any resuspension of sediments may not increase the levels of contaminants that come into contact with benthic habitats and species.

The running aground of a vessel or a collision could lead to a fuel release, and cleaning fluids, oils and hydraulic fluids used on board vessels and during ROV operations could be released overboard or accidentally discharged. Also, discharges of grey water, sewage, food waste and drain water from vessels outside of 12 nm may occur. These discharges can be potentially harmful and can lead to localised organic enrichment and a change in the balance of the food chain. As discussed further within Chapter 11: Water Quality (Marine Environment), given that all vessels will be compliant with IMO and MARPOL then the risk of oils and other contaminants entering the marine environment is very low. Neither organic enrichment nor oxygen depletion is considered likely, due to the relatively small cumulative volume of any discharges. Furthermore, in relation to the amount of shipping activity in the North Sea area, the additional activity of the installation vessels is considered to be negligible in terms of potential effects on water quality (Chapter 11: Water Quality (Offshore)), hence is not assessed further.

The effects of the release of drilling fluids for the HDD are considered separately in Section14.5.3.6.

14.5.3.5.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in water quality as a result of the Project. All other designated sites are also too far from the consenting corridor to be affected by any changes in water quality. This effect has been assessed to have **no change** on designated sites.

14.5.3.5.2 All Biotopes

There is potential for some metals to be released into the water column after re-suspension during installation activities which may have a localised effect on water quality. This temporary local effect

on water quality is unlikely to cause a detectable change to the species and habitats along the consenting corridor and, therefore, the magnitude of impact upon all biotopes is assessed as **negligible**. The overall effect significance is assessed to be **minor, non-significant** for **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes.

14.5.3.6 Changes to Water Quality (Release of Drilling Fluids)

From Chapter 2: Project Description, the estimated HDD fluid losses to the sea from the three HDD holes, for the two HVDC cables and one fibre optic cable, will be 3,000 m^3. The estimated solid losses to the sea will be 18 m^3. These losses will not be concurrent from all three HDD holes, but will be sequential as holes are drilled individually and so only 1,000 m^3 of water and 6 m^3 of solids will be discharged at any one time.

The drilling compound to be used during the HDD operations is bentonite, a naturally occurring clay. Hence the solids which will escape into the marine environment as a result of the release of drilling fluid will be a combination of bentonite and pulverised rock from the drilling operations. Hence, all of the solids are naturally occurring and environmentally inert. The potential impact on benthic habitats associated with the release of drilling fluids is, therefore, increased sediment loading and smothering when the solids drop out of suspension.

It is noted that the impacts resulting from the release of drilling fluids will be restricted to the immediate vicinity of the HDD exit point. This area is subject to high tidal currents and, hence, the solids released into the water column will be rapidly dispersed, and any solids which are deposited on the seabed will be removed quickly by natural scouring.

14.5.3.6.1 Designated Sites

The burrowed mud feature of the Southern Trench pMPA has only been found much further to the north of the HDD exit point. As such there will be **no change** to this feature within the Proposed MPA. No other designated sites will be affected by this activity.

14.5.3.6.2 High Value Biotopes

The HDD exit point is within the biotope A5.25 - Circalittoral fine sand which has been assessed to be high value. The majority of the characterising species within this biotope will be infauna. It is expected that most infaunal species will be able to burrow towards the surface following deposition of drilling solids given their likely dispersion within the strong tidal currents, however, there may be some mortality of individuals within the localised area as a result of smothering from the released drilling solids. The magnitude of this effect is assessed to be **negligible** as the impact is expected to be undetectable at the population level and in terms of habitat integrity on this **high** value biotope. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.6.3 Very High, Medium and Low Value Biotopes

No other biotopes are expected to be affected by the release of drilling fluid at the HDD exit point, as these biotopes are not within the vicinity of the potential effect.

14.5.3.7 Introduction of Invasive Non-Native Species

Vessels to be used for installation have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports which, if released, could settle in the benthic environment. Once INNS become established and disperse within a new habitat they can outcompete local species for space and resources, prey directly on local species, or introduce

pathogens (Roy *et al*., 2012). However, as the BWM Convention has been ratified and all vessels will be fully IMO compliant, which make the risk of an INNS being introduced very low.

14.5.3.7.1 Designated Sites

Any released INNS by the vessels to be used for installation could colonise the Project site and surrounding area and compete with benthic species for resources, causing a potential decline in population abundance. Whilst this is possible, it is considered to be unlikely given the existing extent of shipping activity which exists within the North Sea.

Scanner Pockmark SAC is approximately 450 m south of the consenting corridor but may be less than 100 m south of the consenting corridor, if proposed changes to the boundary of the SAC are approved. Without any mitigation, the potential effect significance on this **very high** value site is assessed to be **minor, non-significant**.

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by the potential introduction of INNS as a result of the Project. Given the distance between the consenting corridor and all other designated sites for benthic ecology features, there will not be any risk of effects from potential INNS colonising these sites and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change** giving an overall effect significance of **no change.**

14.5.3.7.2 Very High Value Biotopes

MarLIN assesses the biotopes A4.213, A4.2211 and A5.611 to not be sensitive to the introduction or spread of INNS (Tillin and Hiscock, 2016; Tillin *et al*. 2018a; Tillin *et al*. 2018b), but does not provide assessment for habitat complexes such as A3.1 and A4.2. Only biotopes A3.1 and A5.611 are actually within the consenting corridor, but the other biotopes close to the corridor have the potential to be affected by the introduction of non-native species. As such, a precautionary assessment of very high sensitivity has been made for these habitats including pockmarks. However, the risk of introduction of non-native species to these **very high** value habitats is considered low, the magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Without any mitigation, the potential effect on these biotopes is assessed to be **minor, non-significant**.

14.5.3.7.3 High Value Biotopes

The sensitivity of A5.251 is assessed to be high as INNS such as slipper limpet, *Crepidula fornicata*, *Didemnum* sp. and non-native predatory gastropods may find these habitats favourable and outcompete the native species. As a precautionary assessment, all **high** value biotopes are assessed to have very high sensitivity. The magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Without any mitigation, the potential effect significance on these biotopes is assessed to be **minor, non-significant**.

14.5.3.7.4 Medium and Low Value Biotopes

The habitat complexes of **medium** and **low** value biotopes support a wide range of species that are likely to exhibit a variety of responses to the introduction of INNS. The sensitivity of these biotopes is therefore assessed on a precautionary basis as of very high sensitivity. The magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Therefore, without any mitigation, the potential effect on these biotopes is assessed to be **minor, non-significant**.

14.5.4 Operation and Maintenance

14.5.4.1 Change in Hydrodynamic Regime

Where seabed type and morphology are expected to change, such as locations where rock has been placed on soft substrates, there may be localised changes in the flows causing scour and accretion, but these are likely to be very localised to near the areas of rock placement and only occur in the short term as an equilibrium re-establishes.

14.5.4.1.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in hydrodynamic regime as a result of the project. Given the distance between the consenting corridor and the other designated sites for benthic ecology features, any changes in the hydrodynamic regime will not be detectable in these sites or on their populations, and the magnitude of impact upon designated sites for benthic ecology features is therefore assessed as **no change.**

14.5.4.1.2 Very High Value Biotopes

A3.1 - Atlantic and Mediterranean high energy infralittoral rock is present within the consenting corridor, however, these habitats are located to the west of the HDD exit point, hence the cables will pass beneath them via HDD ducts. As such, no changes to hydrological regime will occur in these areas, and the impact is assessed as **no-change**.

Pockmarks are unlikely to be affected by the localised scour and abrasion effects caused by changes in seabed type and morphology. This impact is assessed to result in **no change** for pockmark habitats.

A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment has a medium sensitivity to scour and abrasion and it is possible that the *Sabellaria spinulosa* tubes could become damaged (Cook et al., 2014), however, this will be a localised impact of **negligible** magnitude to which these biotopes are expected to have a low sensitivity. The overall effect significance is assessed to be **minor,non-significant** for A5.611 habitats which are not Annex I features within the consenting corridor.

14.5.4.1.3 High Value Biotopes

A5.361 - Sea pens and burrowing megafauna in circalittoral fine mud are assessed to have a low sensitivity to the levels of scour and abrasion likely to be caused by changes in seabed type and morphology from the Project. However, bivalves and other species require contact with the surface for respiration and feeding, so siphons and delicate feeding structures may be damaged or withdraw because of scour. Overall, species are expected to be tolerant of the impact and so are assessed to have a low sensitivity to this effect. All high value biotopes are expected to have a similar tolerance of the impact and are therefore assessed to have low sensitivity to the effect.

The magnitude of this localised impact is assessed to be **negligible** and the overall effect significance is assessed to be **minor, non-significant** for all **high** value biotopes.

14.5.4.1.4 Medium and Low Value Biotopes

The medium value habitat complex A5.44 - Circalittoral mixed sediment generally supports infaunal species that are expected to have a high tolerance of minor changes in hydrodynamics. The biotopes within the low value A5.26 - Circalittoral muddy sand and A5.35 - Circalittoral sandy mud habitat complexes may be dominated by infaunal species or by epifauna such as brittlestars or other

echinoderms. These biotopes are expected to have a high tolerance to this effect and so are considered to have a low sensitivity.

The magnitude of this localised impact is assessed to be **negligible** and the overall effect significance is assessed to be **negligible, non-significant** for all **medium** and **low** value biotopes.

14.5.4.2 Sediment Heating

When operational, the HVDC cables will emit heat. If bundled and placed at a depth of lowering of 0.5 m below the seabed (as a worst-case for soft substrates), the temperature rise at the seabed immediately above the cable will be 1°C above background levels, and will rapidly decrease within increased distance away from the cable.

A literature review of the likely sensitivity of benthic invertebrates to this heating was conducted but sparse information was available for specific thresholds at which effects could occur (see MMT 2018 for details), and from which the data and references for the assessment detailed below is sourced. For details on the specific effect on crustaceans and molluscs see relevant shellfish sections in Chapter 15: Fish and Shellfish.

14.5.4.2.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in sediment temperature as a result of the project. Given the distance between the consenting corridor and other designated sites for benthic ecology features, no change in sediment temperature will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.4.2.2 Very High Value Biotopes

Pockmark habitats are not thought to be vulnerable to increases in temperature (Defra & JNCC, 2008). *Sabellaria spinulosa* appears to have a high tolerance for changes in temperature and so A5.611 is expected to have a low sensitivity to this effect. It is important to note that the A5.611 habitat within the consenting corridor is not reef-building and is not an Annex I habitat. Given the limited change in temperature within a localised extent, the magnitude of this impact is assessed to be **no change**. The overall effect significance on these **very high** value biotopes is assessed to be **no change**.

14.5.4.2.3 High Value Biotopes

The biotope A5.361 is assessed to have a low sensitivity to increases in sediment temperature as the characterising sea pens are distributed throughout the Mediterranean, where water temperatures are higher and so this biotope is expected to have a high tolerance to increases in sediment temperature. The other biotopes of **high** value are also assessed to have a low sensitivity to changes in temperature. Given the limited change in temperature within a localised extent, the magnitude of this impact is assessed to be **no change**.

The overall effect significance on these high value biotopes is assessed to be **no change**.

14.5.4.2.4 Medium and Low Value Biotopes

The habitat complexes of medium and low value biotopes support a wide range of species that are likely to exhibit a variety of responses to increases in sediment temperature. The sensitivity of these biotopes is therefore assessed on a precautionary basis as being of very high sensitivity. However, given the limited change in temperature within a localised extent, the magnitude of this impact is

assessed to be **no change**. The overall effect significance on these **medium** and **low** value biotopes is assessed to be **no change**.

14.5.4.3 Electromagnetic Fields (EMFs)

When operational, the HVDC cables will emit a magnetic field. As they are direct current cables then no electric fields will be created, and any induced electric fields will be contained within the cables' armouring. An assessment of the EMFs created by the project is provided in Chapter 18: Electromagnetic Fields. At worst-case burial depths of 0.4 m in hard substrates and 0.5 m in soft substrates, then the magnetic field at the seabed would be at most 640 µT, and would reduce to <300 µT within 2 m of the seabed at both worst-case and best case separation distances.

A literature review of the likely sensitivity of benthic invertebrates to EMFs was conducted, but the literature reviewed found very little information on specific thresholds at which effects could occur (see Appendix E.1 for details), and from which the data and references for the assessment detailed below is sourced. For an assessment of effect on crustaceans and molluscs, see relevant shellfish sections in Chapter 15: Fish and Shellfish, respectively where the effect of EMF from the cables was assessed to be negligible. Polychaetes are not expected to have any sensitivity to EMFs. The embryos of the purple sea urchin, *Strongylocentrotus purpuratus*, have been shown to have a sensitivity to EMF (see Appendix E.1) where exposure to EMFs as low as 1-100 µT caused interference with embryonic development.

14.5.4.3.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in EMF as a result of the project. Given the distance between the consenting corridor and the other designated sites for benthic ecology feature, no change in EMF will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.4.3.2 Very High, High, Medium and Low Value Biotopes

There is a paucity of data on the specific effects of EMF on benthic habitats and the species they support. As such, a precautionary assessment of high sensitivity has been assumed for all biotopes. The extent of the effect will be along the entire length of the cable and for several metres either side of each cable. Most species are expected to be unaffected by EMF but for those species that are sensitive to the effect the impact is not expected to cause a detectable effect on the integrity of the population and so magnitude of the impact is assessed to be **negligible**. The overall effect significance is therefore assessed to be **minor, non-significant** for all **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes.

14.5.4.4 Introduction of Invasive Non-Native Species

Vessels to be used for repairs have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports which, if released and are mobile in nature, could compete with benthic ecology populations.

Any released INNS by the vessels to be used for repairs could compete with benthic ecology species for resources, causing a potential decline in population abundance.

Whilst this is possible, it is considered to be unlikely given the extent of shipping activity and habitat disturbance which currently exists within the North Sea and given that the BWM Convention has been

ratified and all vessels will be fully IMO compliant. The magnitude of impact upon all benthic ecology receptors is assessed as **Negligible**.

14.5.4.5 Physical Disturbance During Inspection & Repair

To conduct repairs on the cables, they must be brought to the surface and then re-laid which will disturb the seabed along the consenting corridor for a distance that is determined by the water depth. Cable repairs in water depths of up to 100 m in the UKTW would result in 200 m of seabed disturbance, whereas between 12 nm to the UK EEZ limit seabed disturbance would occur over a distance of 300 m, due to increased water depths around of 150m. One repair every three years is assumed as a worst-case based on previous project experiences and so, over the lifetime of the project (40 years), repairs could occur 13times. This would disturb a maximum total of a 4.2 ha of seabed assuming the repair disturbs a 10 m wide strip of the seabed around the consenting corridor.

Smothering is most likely to affect sessile or limited mobility epifauna, or infauna in surficial sediments (near the sediment-water interface). Given the limited extent likely to be affected at any one time during the operation period, the magnitude of impact is assessed to be **negligible**. The overall effect significance is therefore **minor, non-significant** for **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes. The benthic ecology feature of the Southern Trench proposed MPA will not be affected and given the distance between the consenting corridor and designated sites for benthic ecology features, then no change in sediment temperature will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.5 Decommissioning Phase Impacts

Impacts during the decommissioning phase associated with the removal of the cable (if required), are anticipated to be of a similar or lesser magnitude than for cable installation. On a precautionary basis for the following impacts, the magnitude of impact is assessed to be of the same as for installation:

- Habitat loss;
- Physical disturbance and displacement;
- Changes to water quality (resuspension of sediments and increased sediment loading);
- Changes to water quality (release of hazardous substances); and
- Introduction of invasive non-native species.

No other impacts are anticipated during decommissioning.

14.5.6 Impact Assessment Summary

A summary table of the impact assessment for benthic ecology receptors is presented in Tables 15.15a-b, which also considers the overall significance of effect from the assigned receptor value/sensitivity and magnitude of impact, and the confidence in the assessment. No impacts are assessed as being significant under the provisions of the EIA regulations.

Table14.15a Benthic ecology impact assessment summary for the installation phase

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat loss	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat loss	High Value Biotopes	A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Habitat creation	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
		A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		High	Non-significant
		Pockmarks	Very High	No change	No change		High	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	No change	No change		High	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat creation	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	No change	No change		High	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	No change	No change		Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	No change	No change		Medium	Non-significant
Physical Disturbance	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical Disturbance	Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical Disturbance	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (resuspension of sediments and increased sediment loading)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (resuspension of sediments and increased sediment loading)	High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (release of hazardous substances)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Very High Value Biotopes	Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (release of drilling fluids)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	High	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.14 - Circalittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.15 - Deep circalittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.25 - Circalittoral fine sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.27 - Deep circalittoral sand	Very High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.45 - Deep circalittoral mixed sediments	Very High	Negligible	Minor	Adverse	High	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.35 - Circalittoral sandy mud	Very High	Negligible	Minor	Adverse	High	Non-significant

* The highest ranking is used so if the value is low but sensitivity is very high a ranking of very high is used.

Table14.15b Benthic ecology impact assessment summary for the operation phase

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Very High Value Biotopes	Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	No change	No change		Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*,	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ophelia borealis and *Abra prismatica* in circalittoral fine sand						
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Sediment heating	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	No change	No change		Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	No change	No change		Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Sediment heating	High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	No change	No change		Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	No change	No change		Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	No change	No change		Medium	Non-significant
EMF from cable	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
EMF from cable	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Introduction of invasive non-native species	Designated Sites	Southern Trench proposed MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
		Scanner Pockmark SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Physical disturbance during inspection and repair	Designated Sites	Southern Trench proposed MPA	High	No change	No change		Medium	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		Medium	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical disturbance during inspection and repair	High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant

* The highest ranking is used so if the value is low but sensitivity is very high a ranking of very high is used.

14.6 Mitigation Measures

As no effects were considered to be significant under the provisions of the EIA Regulations, then no secondary mitigation is required to be implemented.

As set out within section 14.3.5, the habitat mapping used for the assessment has been interpreted from geophysical survey data. This means that there is only limited confidence in the precise nature of the habitat boundaries mapped. It is therefore proposed to conduct a pre-installation visual survey of the final cable route to confirm the biotopes present, and biotope boundaries, and thus that the assessment of effects of the project upon benthic ecology are accurate.

14.7 Residual Effects

On the basis of the current data known given the statements in 14.6 no effects were assessed to be of moderate or greater significance. As such, no mitigation measures were required and there was no reduction in the residual significance of effects.

14.8 Cumulative Effects

The adult phases of benthic species are generally sessile or have limited mobility. Effects from this project and other developments will only have a cumulative interaction with the benthic habitat and species where the development is within a short distance of the project.

Cumulative impacts on benthic habitats and species have been considered from impacts originating from the installation, operation or decommissioning of the project as assessed in Sections 14.5-14.7 above, with impacts from other planned or consented projects upon the same receptor populations.

No cumulative assessment is conducted for existing operations or built projects as this forms part of the baseline environment that the assessment in Section 14.5 was conducted on. Furthermore, the potential for synergistic impacts from the project, where one impact may cause another impact, have been assessed in Section 14.5 above (for example an impact upon water quality leading to an impact upon benthic ecology receptors).

A list of cumulative projects requiring assessment within the Environmental Impact Assessment Report has been agreed with Marine Scotland and further detail is provided in Chapter 6: Cumulative Assessment. The relevant marine projects are considered individually below.

14.8.1 Moray East/West Offshore Windfarm Development

Given the distance between the project and the Moray East/West Offshore wind farm, 100 km to the north west of the project, there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated**.**

14.8.2 Inch Cape Offshore Windfarm

Given the distance between the project and the Inch cape offshore wind farm, 110 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated**.**

14.8.3 Neartna Gaoithe Offshore Windfarm

Given the distance between the project and the Neartna Gaoithe offshore wind farm, 130 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.4 Seagreen Phase 1 Wind Farm

Given the distance between the project and the Seagreen Phase 1 offshore wind farm, 110 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.5 Beatrice Offshore Wind Farm

Given the distance between the project and the Beatrice offshore wind farm, 100 km to the north west of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.6 European Offshore Wind Development Centre EOWDC, Aberdeen Bay

The European offshore wind deployment centre is situated 40 km to the south of the project. As this project is currently being constructed then no cumulative effects during installation are anticipated given there is no programme overlap. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.7 Hywind Scotland Pilot Park Offshore Wind Farm

The Hywind Scotland pilot park offshore wind farm is situated 20 km to the south of the project and is currently operational so has been considered as part of the baseline against which the project has been assessed.

14.8.8 Kincardine Offshore Windfarm, 86 MW floating turbines

The Kincardine offshore wind farm is situated 50 km to the south of the project. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.9 Aberdeen Harbour Dredge and Harbour Extension Project

The Aberdeen harbour dredge and harbour extension project is situated 40 km to the south of the project. As this project is currently being constructed then no cumulative effects during installation

are anticipated given there is no programme overlap. Given the distance between the project and the Aberdeen harbour dredge and harbour extension project then no cumulative impacts with this project are anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.8.10 Peterhead Port Authority Harbour Masterplan

The Peterhead Port Authority Harbour Masterplan is limited in extent to within the existing breakwaters and existing harbours of Peterhead Port, 3 km to the north of the project. No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.8.11 North Sea Network Link Interconnector Cable

The North Sea Network (NSN) Link Interconnector cable project is situated 130 km to the south of the project. Given the distance between the project and the NSN Link Interconnector cable project there is unlikely to be any interactions between the effects of the project and the effects of the NSN Link Interconnector cable that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated**.**

14.8.12 NorthConnect HVDC Subsea Cable (rest of the North Sea: from UK median line-start of Norwegian fjord)

The remaining section of the NorthConnect HVDC subsea cable, not assessed within this EIAR as it is situated within Norwegian waters, is anticipated to have similar effects to the project given that installation will occur from the Norwegian coast to the UK median line utilising similar installation methodologies and equipment, and operation will be transmitting the same electricity along the same cables so sediment heating and EMF levels will be the same. Whilst installation will be occurring at the same time as the project, impacts will not be synergistic given the distance occurring between the installation activities. Small losses of habitats within the UK section of the Project and within Norway waters will not have a significant effect on the functioning of these habitats. Similarly for operation, impacts will be occurring at the same magnitude along the length of the cable route, rather than being cumulatively greater than the individual impacts. Assuming similar mitigation as applied for the UK section of the project will be applied in Norwegian waters, then no cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.9 Summary

A summary of the potential effects of the project, alone, is presented in Table 14.15a-b. No potential effects have been assessed as an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations). Section 14.8 assesses the project cumulatively with other proposed plans or projects and there are not predicted to be any cumulative impacts that are considered to be an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.10 References

Birchenough, S.N.R.; Degraer, S.; Reiss, H.; Borja, A.; Braeckman, U.; Craeymeersch, J.; De Mesel, I.; Kerckhof, F.; Kröncke, I.; Mieszkowska, N.; Parra, S.; Rabaut, M.; Schröder, A.; Van Colen, C.; Van Hoey, G.; Vincx, M.; Wätjen, K. (2011). Responses of marine benthos to climate change, in: Reid, P.C. et al. (Ed.) ICES status report on climate change in the North Atlantic. ICES Cooperative Research Report, 310: pp. 123-146.

British Standard. (2010). Methods of test for soils for civil engineering purposes 1377-2:1990. BSI.

Canadian Council of Ministers of the Environment. (2002). Canadian sediment quality guidelines for the protection of aquatic life: Summary tables. Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.Clarke, K. R., & Gorley, R. N. (2006). PRIMER v6: User Manual/Tutorial. PRIMER-E. Plymouth, 192pp.

Cefas (2014). Chemical Action Levels. Available from: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#suitability-of-material. Accessed: 27/02/18.

CIEEM (Chartered Institute of Ecology and Environmental Management). (2016). Guidelines for Ecological Impact Assessment in the United Kingdom: Terrestrial, Freshwater and Coastal. 2nd Edition January 2016.

Clarke, K. R., & Warwick, R. M. (2001). Change in marine communities: An approach to statistical analysis and interpretation, 2nd edition. Plymouth: PRIMER-E.

Cook, E. J., Payne, R. D. and Macleod, A. (2014) Marine biosecurity planning – identification of best practice: A review. Scottish Natural Heritage Commissioned Report No. 748.

Dando, P.R. (2001). A review of pockmarks in the UK part of the North Sea, with particular respect to their biology. Technical report produced for Strategic Environmental Assessment – SEA2. Department of Trade and Industry Technical Report No. TR_001.

De-Bastos, E.S.R. (2016). Paramphinome jeffreysii, Thyasira spp. and Amphiura filiformis in offshore circalittoral sandy mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1109.

Defra & JNCC. (2008). Impact Assessment of Scanner Pockmark SAC. Options stage. Version 1. 22 pp. [cited 12-06-2018]. Available from: http://jncc.defra.gov.uk/PDF/ScannerPockmark_ImpactAssessment_18July08_.pdf.

European Commission. (2007). Interpretation manual of European Union Habitats - EUR 27. European Commission.

European Environment Agency (EEA). 2017. EUNIS habitat type hierarchical view. http://eunis.eea.europa.eu/habitats-code-browser.jsp

European Environment Agency (EEA). 2018. EUNIS habitat classification. Available from: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification#tab-european-data. Accessed: 05/07/18.

Gill AB, Huang Y, Gloyne - Philips I, Metcalfe J, Quayle V, Spencer J, & Wearmout HV, (2009). COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2 : EMF - sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE - EMF - 1 - 06).

Gubbay, S. (2007). Defining and managing Sabellaria spinulosa reefs: Report of an inter-agency workshop Report of an inter-agency workshop. Joint Nature Conservation Committee.

Hin, J., Osté, L., & Schmidt, C. (2010). Guidance Document for Sediment Assessment, Methods to determine to what extent the realization of water quality objectives of a water system is

impeded by contaminated sediments. Ministry of Infrastructure and the Environment - DG Water.

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. Peterborough: JNCC Report No.432.

Kröncke I. (2011). Changes in Dogger Bank macrofauna communities in the 20th century caused by fishing and climate. Estuarine, Coastal and Shelf Science 94: 234-245.

Künitzer A, Basford D, Craeymeersch JA, Dewarumez JM, Dörjes J, Duineveld GCA, Eleftheriou A, Heip C, Herman P, Kingston P, Niermann U, Rachor E, Rumohr H & de Wilde PAJ. (1992). The benthic infauna of the North Sea: species distribution and assemblages. ICES Journal of Marine Science 49: 127-143.

Hiddink, J.G., Burrows, M.T. & Molinos, J.G. (2014). Temperature tracking by North Sea benthic invertebrates in response to climate change. Global Change Biology, 21 (1): 117-129.

Hin, J., Osté, L., & Schmidt, C. (2010). Guidance Document for Sediment Assessment, Methods to determine to what extent the realization of water quality objectives of a water system is impeded by contaminated sediments. Ministry of Infrastructure and the Environment - DG Water.

Hill, J.M. & Tyler-Walters, H. (2018). Seapens and burrowing megafauna in circalittoral fine mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/131.

MMT. (2018). Benthic Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey In (Vol. Rev A): MMT.

NorthConnect. (2016). HVDC Cable Route Scoping Report. 93 pp.

NorthConnect. (2018). HVDC Cable Infrastructure – UK Construction Method Statement,

OSPAR. (2008). OSPAR List of Threatened and/or Declining Species and Habitats. retrieved from: https://www.ospar.org/documents?d=32794 (2017-09-05).

OSPAR. (2009). Agreement on CEMP Assessment Criteria for the QSR 2010. Agreement number: 2009-2, OSPAR Commission.

Pearce, B., Taylor, J., Seiderer, L.J. (2007). Recoverability of Sabellaria spinulosa Following Aggregate Extraction: Marine Ecological Surveys Limited.

Roy H. E., Bacon J., Beckmann B., Harrower C. A., Hill M. O., Isaac N. J. B., Preston C. D., Rathod B., Rorke S. L., Marchant J. H., Musgrove A., Noble D., Sewell J., Seeley B., Sweet N., Adams L., Bishop J., Jukes A. R., Walker K. J & Pearman D. (2012). Non-Native Species in Great Britain: establishment, detection and reporting to inform effective decision making. Report to Defra WC0738.

Saunders, G., Bedford, G.S., Trendall, J.R., and Sotheran, I. (2011). Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Volume 5. Benthic Habitats. Unpublished draft report to Scottish Natural Heritage and Marine Scotland.

Tillin, H.M., Marshall, C. & Gibb, N. (2018a). Sabellaria spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1171.

Tillin, H.M., Marshall, C. & Gibb, N. (2018b). Sabellaria spinulosa on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/377.

Tillin, H.M., & Hiscock, K., (2016). Urticina felina and sand-tolerant fauna on sand-scoured or covered circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 20-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/290.

Tillin, H.M. (2016a). Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1131.

Tillin, H.M. (2016b). Moerella spp. with venerid bivalves in infralittoral gravelly sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 05-07-2018]. Available from: http://www.marlin.ac.uk/habitat/detail/1111.

Tyler-Walters, H. (2018). Seeps and vents in sublittoral sediments. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1161.

Weinert, M., Mathis, M., Kröncke, I., Neumann, H., Pohlmann, T., & Reiss, H. (2016). Modelling climate change effects on benthos: Distributional shifts in the North Sea from 2001 to 2099. Estuarine, Coastal and Shelf Science, 175, 157-168. doi:10.1016/j.ecss.2016.03.024.

Yukihira H., Klumpp D. W. & Lucas J. S. (1999). Feeding adaptations of the pearl oysters Pinctada margaritifera and P. maxima to variations in natural particulates. Mar Ecol Prog Ser 182:161-173.