Offshore Wind Power Limited

West of Orkney Windfarm Offshore EIA Report

Volume 1, Chapter 10 - Benthic Subtidal and Intertidal Ecology

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10 BENTHIC SUBTIDAL AND INTERTIDAL ECOLOGY

Chapter summary

This chapter of the Offshore Environmental Impact Assessment (EIA) Report assesses the potential effects from the offshore Project on benthic ecology receptors. This includes direct, indirect, whole Project assessment, cumulative, inter-related effects, inter-relationships, and transboundary effects.

The assessment has been informed by an extensive seabed survey campaign which indicates the offshore Project area contains a patchwork of mixed and coarse sediments, with extensive areas of boulders and cobbles. A range of benthic ecology receptors of conservation importance are present in the offshore Project area, namely: stony and bedrock reef, a variety of offshore subtidal sands and gravels habitats, ocean quahog, and kelp beds.

In depth analysis of seabed survey data acquired during the Project specific surveys, was undertaken to confirm the nature of the reef habitat present in the offshore Project area, which supports lower levels of biodiversity than areas within the nearby protected Solan Bank Reef Special Area of Conservation (SAC). A quantification of the temporary and long term impacts on Annex I reef habitat revealed that the equivalent of up to 0.77% of the area of Annex I reef in SACs would be affected and only 0.5% of Annex I reef in UK SACs would be affected, which is low in national terms.

The following impacts were identified as requiring assessment:

- Construction:
  - Temporary habitat loss / disturbance;
  - Increased suspended sediment concentrations and sediment deposition; and
  - Increased risk of introduction and spread of Invasive Non-Native Species (INNS).
- Operation and maintenance:
  - Temporary habitat loss / disturbance;
  - Long-term loss or damage to benthic habitats and species
  - Colonisation of hard structures;
  - Increased suspended sediment concentrations and associated deposition;
  - Changes in physical processes; and
  - Impact to benthic communities from any thermal load or EMF from the cable during operation; and
  - Introduction and spread of INNS.
- Decommissioning:
  - Removal of hard substrate during decommissioning.

The assessment has taken account of embedded mitigation measures for the assessment of potential effects. Despite the high sensitivity of some receptors to specific impacts, all impacts are assessed to be of low or negligible magnitude and no significant impacts to any benthic receptors are predicted, either for the offshore Project alone, or cumulatively with other plans or projects (developments). Therefore, no secondary mitigation requirements are proposed. There are also no significant inter-related or transboundary effects predicted as a result of the offshore Project. Furthermore, no ecosystem effects are anticipated to occur in relation to benthic habitats and species as prey species or feeding habitats.

Areas of temporary seabed disturbance during construction will recover, especially given the dynamic environment within the offshore Project area, and the recovery of sensitive seabed habitats and communities post-construction will be monitored. The approach to monitoring will be determined in discussion with NatureScot and other relevant stakeholders post-consent but is expected to involve grab sampling and seabed photography, using methods compatible with those used in the benthic baseline survey.

Furthermore, if the project INNS risk assessment indicates the requirement for INNS monitoring, appropriate monitoring will be agreed with Marine Directorate.

10.1 Introduction

This chapter of the Offshore Environmental Impact Assessment (EIA) Report presents the benthic ecology receptors of relevance to the offshore Project and assesses the potential impacts from the construction, operation and maintenance and decommissioning of the offshore Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative and transboundary impacts are also considered.

Table 10-1 below provides a list of all the supporting studies which relate to and should be read in conjunction with the benthic ecology impact assessment. All supporting studies are appended to this Offshore EIA Report and issued on the accompanying Universal Serial Bus (USB).

Table 10-1 Supporting studies

DETAILS OF STUDY	LOCATIONS OF SUPPORTING STUDY
Benthic Subtidal and Intertidal Baseline Report	Offshore EIA Report, Supporting Study (SS) 4: Benthic subtidal and intertidal baseline report.
West of Orkney Windfarm Benthic Environmental Baseline Report	Offshore EIA Report, Supporting Study (SS) 5: Benthic environmental baseline report.
Intertidal Survey Habitat Assessment	Offshore EIA Report, Supporting Study (SS) 6: Intertidal survey habitat assessment.

The impact assessment presented herein draws upon information presented within other impact assessments within this Offshore EIA Report, including chapter 8: Marine physical and coastal processes, which assesses the impacts associated with the suspension of sediments, chapter 9: Water and sediment quality, which assesses the impacts associated with the release of sediment bound contaminants, and chapter 11: Fish and shellfish ecology, which assesses the impacts on fish and shellfish, including species dependant on the benthic environment.

Equally, the benthic ecology chapter also informs other impact assessments. The interaction between the impacts assessed within different topic-specific chapters on a receptor is defined as an ‘inter-relationship’. The chapters and impacts related to the assessment of potential effects on benthic ecology are provided in Table 10-2. For ecological topics, inter-relationships form the basis of understanding for wider ecosystems impacts, which are considered throughout this assessment and summarised in section 10.10. Indirect effects as a result of changes in benthic habitats or species that would affect prey availability for fish and shellfish, marine mammals and other megafauna and offshore ornithology are discussed in chapter 11: Fish and shellfish ecology, chapter 12: Marine mammals and megafauna, and chapter 13: Offshore and intertidal ornithology.

Table 10-2 Benthic ecology interrelationships

CHAPTER	IMPACT	DESCRIPTION
Marine physical and coastal processes (chapter 8, Offshore EIA Report)	Direct and indirect impacts on benthic habitats and benthic species from suspended sediments and sediment deposition.	Changes in marine physical processes could lead to the suspension of sediments which may indirectly result in the smothering of benthic habitats and benthic species which depend on these habitats. These impacts are discussed in section 10.5.6.
	Indirect impacts on benthic habitats and benthic species from changes to hydrodynamics.	Changes in hydrodynamics could lead to increased scour and abrasion which may indirectly result in the loss or disturbance of benthic habitats and benthic species. These impacts are discussed in section 10.5.6.
Water and sediment quality (chapter 9, Offshore EIA Report)	Indirect impacts on benthic habitats and benthic species from changes in water and sediment quality.	Changes in water and sediment quality can result in indirect impacts to benthic habitats which are sensitive to contamination and toxins. These impacts are discussed in section 10.5.6.
Fish and shellfish ecology (chapter 11, Offshore EIA Report)	Temporary and long-term habitat disturbance or loss.	Changes in benthic habitats can lead to an indirect impact on fish spawning and nursery grounds which rely on these habitats. Direct impacts to benthic habitats from the offshore Project are assessed within this chapter. Temporary habitat disturbance or loss due to the presence of the offshore Project area infrastructure are assessed within chapter 11: Fish and shellfish ecology.
	Indirect effects related to changes in availability or distribution of prey species	Colonisation of benthic habitats and species may occur as a result of the offshore Project area infrastructure. These impacts are assessed within section 10.5.6. This can indirectly impact fish species through an increase in reefs and food availability resulting in fish aggregations around these structures. These impacts are assessed in chapter 11: Fish and shellfish ecology.
Marine mammals and megafauna (chapter 12, Offshore EIA Report)	Indirect impacts to marine mammals and other megafauna through long-term benthic habitat change, including the potential for changes to habitat quality.	Changes in benthic habitats can lead to an indirect impact on marine mammals and other megafauna due to changes in prey availability of fish, which may be impacted due to loss / disturbance of the benthic habitat on which they rely. Direct impacts to benthic habitats from the offshore Project are assessed within this chapter. Impacts on marine mammals and other megafauna from long-term habitat changes are assessed within chapter 12: Marine mammals and megafauna.

Offshore and intertidal Ornithology (chapter 13, Offshore EIA Report)	Indirect impacts to Marine Ornithology from potential change in benthic habitat and prey availability.	Changes in benthic habitats can lead to an indirect impact on marine ornithology due to changes in prey availability of fish, which may be impacted due to loss / disturbance of the benthic habitat on which they rely. Direct impacts to benthic habitats from the offshore Project are assessed within this chapter. Impacts on marine ornithology from potential change in benthic habitat and prey availability are assessed within chapter 13: Offshore and intertidal ornithology.

Effects on Annex I habitat receptors identified as a qualifying interest of Special Areas of Conservation (SACs) have been considered by the Habitats Regulation Appraisal (HRA) process which has been undertaken alongside this Offshore EIA Report. The HRA screening process, undertaken in consultation with NatureScot and Marine Scotland[1], concluded that there will be no potential for Likely Significant Effect (LSE) on any SACs with Annex I habitat qualifying interests, therefore no further assessment is required under Stage 2 of the HRA process within the Offshore Report to Inform the Appropriate Assessment (RIAA). For full details, please see the Offshore HRA Screening Report (Offshore Wind Power Limited (OWPL), 2022) and the Offshore RIAA.

This chapter has been written by Xodus Group Limited (Xodus).

10.2 Legislation, policy and guidance

Over and above the legislation presented in chapter 3: Planning policy and legislative context, the following legislation, policy and guidance are relevant to the assessment of impacts from the offshore Project on benthic ecology:

- Legislation:
  - Nature Conservation (Scotland) Act 2004 (as amended);
  - The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended);
  - The Conservation of Offshore Marine Habitats and Species Regulations 2017 ('Habitats Regulations') (as amended);
  - The International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention) 2004;
  - The Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention).
- Policy:
  - The following policies of Scotland's National Marine Plan (Scottish Government, 2015a) apply to this benthic subtidal and intertidal ecology assessment:
    - GEN 9 Natural heritage: Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species; (b) Not result in significant impact on the national status of Priority Marine Features (PMFs); and (c) Protect and, where appropriate, enhance the health of the marine area; and

[1] *Now Marine Directorate.*

    - GEN 10 Invasive non-native species: Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.
  - Orkney Islands Regional Marine Plan: Consultation Draft (Orkney Islands Council, 2022):
    - The Plan sets out an integrated planning policy framework to guide marine development and activities, whilst ensuring the quality of the marine environment is protected, and where appropriate, enhanced. It supports the delivery of a vision for Orkney's coastal and marine environment, economy and communities.
  - Pilot Pentland Firth and Orkney Waters Marine Spatial Plan (Scottish Government, 2016):
    - This non-statutory plan sets out an integrated planning policy framework to guide marine development, activities and management decisions, whilst ensuring the quality of the marine environment is protected;
  - The National Islands Plan (Scottish Government, 2019):
    - The Plan sets out 13 objectives to address crucial sectors within island communities. Under Strategic Objective 8: To improve and promote environmental wellbeing and deal with biosecurity, there is a commitment to protect island biodiversity and to address biosecurity issues;
  - United Kingdom (UK) post-2010 Biodiversity Framework (supersedes the UK Biodiversity Action Plan (UKBAP)) (Joint Nature Conservation Committee (JNCC) and Department for Environment, Food and Rural Affairs (DEFRA), 2012);
  - Orkney Biodiversity Action Plan (BAP) 2018 – 2022 (Orkney's Biodiversity Steering Group, 2018);
  - International Union for Conservation of Nature and Natural Resources (IUCN) red list of threatened species; and
  - Scottish Biodiversity strategy: A route map to 2020 (Scottish Government, 2015b).
- Guidance:
  - Descriptions of Scottish Priority Marine Features (PMFs) (Tyler-Walters et al., 2016); and
  - Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas (Natural England and JNCC, 2019).

10.3 Scoping and consultation

Stakeholder consultation has been ongoing throughout the EIA and has played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the Project and the requirements of the regulators and their advisors.

The Scoping Report, which covered the onshore and offshore Project, was submitted to Scottish Ministers (via Marine Scotland - Licensing Operations Team (MS-LOT)[2]) and The Highland Council (THC) on 1st March 2022[3]. MS-LOT circulated the Scoping Report to consultees relevant to the offshore Project and a Scoping Opinion was received on 29th June 2022. Relevant comments from the Scoping Opinion specific to benthic ecology are provided in Table 10-4 below, which provides a response on how these comments have been addressed within the Offshore EIA Report. Floating foundations are no longer being considered for this current application and neither are the offshore export

[2] MS-LOT have since been renamed the Marine Directorate - Licensing Operations Team (MD-LOT).

[3] The Scoping Report was also submitted to the Orkney Islands Council (OIC), as the scoping exercise included consideration of power export to the Flotta Hydrogen Hub, however, this scope is not covered in the Offshore EIA Report and will be subject to separate Marine Licence and onshore planning applications.

cables in Scapa Flow to the Flotta Hydrogen Hub. Therefore, comments relating to floating foundations and the Flotta Hydrogen Hub are not included in Table 10-4. However, these have been considered within the Gap Analysis.

Further consultation has been undertaken throughout the pre-application stage. Table 10-3 summarises the consultation activities carried out relevant to benthic ecology.

Table 10-3 Consultation activities for benthic ecology

CONSULTEE	DATE	SUMMARY
NatureScot - email response	10th June 2022	Agreement of the benthic survey method statement was received.
NatureScot, OIC, Marine Planning and Development – meeting	29th June 2022	Presented details on the geotechnical, geophysical and benthic surveys that had already been undertaken, together with the plans and approaches for further surveys.
NatureScot – meeting	7th February 2023	Presented findings of the geophysical and benthic surveys, how areas of potential Annex I stony reef have been qualified, and the analysis approach, and next steps.
NatureScot – email response	1st March 2023	Following the consultation meeting on 7th February 2023 (see above), NatureScot responded to a list of follow-up questions issued by Offshore Wind Power Limited (OWPL) via email. NatureScot's feedback was sought on the approach to interpreting and delineating Annex I reef (including the use of a rugosity study (see section 10.4.4.2.3)) and advise on the assessment of long term loss or damage to benthic habitats and species from cable protection. The key points from NatureScot's response are summarised below. Confirmation that NatureScot agrees with the approaches taken to interpret Annex I habitats in the survey area and to categorise the stony reefs encountered. Agreement from NatureScot that the rugosity study has provided useful further detail on the delineation of areas of low/medium reef, giving a better understanding of the habitat, highlighting the patchiness of the area and allowing the identification of areas that are unlikely to be reef. NatureScot pointed out that, in general, the greater the sediment component within the habitat, the patchier the stony reef is likely to be and consequently of lower 'reefiness'; the patchiness is itself an attribute of the reef and therefore any further delineation of the habitat is not likely to add value to the assessment of what is and is not a reef.
		NatureScot advised looking in more detail at the benthic sampling to identify areas with rich biodiversity, especially the presence of Priority Marine Features, which would add to the understanding of the

CONSULTEE	DATE	SUMMARY
		conservation value of the seabed and possibly help in identifying areas to avoid during infrastructure layout.
		NatureScot advised that the introduction of rock protection for the Project will not create such a large shift in habitat as that experienced in more sedimentary areas, meaning that habitat alteration may not have such a large impact. However, NatureScot also advised that rock protection and/or mattresses match up as much as possible with the existing hard substrate, in terms of size, shape and type of rock/materials used in order to minimise habitat alteration.
		With respect to areas of temporary disturbance: although these are expected to recover due to the dynamic environment in the Project area, NatureScot advised that monitoring requirements, to understand the potential recovery, should be discussed and agreed.
NatureScot – meeting	24th May 2023	Presented an overview of the assessment of effects on Annex I habitats, focussing on impacts to the seabed such as temporary habitats loss / disturbance, sediment deposition and long-term loss or damage to benthic habitats and species.

Table 10-4 Comments from the Scoping Opinion response relevant to benthic ecology

CONSULTEE	COMMENT	RESPONSE
Scottish Ministers (via MS-LOT)	The Scottish Ministers highlight the concerns raised within the representation from NatureScot regarding the limited information on site-specific surveys and the inclusion of only general high level information within in section 2.3 of the Scoping Report. Therefore, in line with the NatureScot representation, the advice given by the Scottish Ministers is proportionate to the level of detail provided within the Scoping Report.	Noted – see section 10.4.3 for further information on Project specific surveys. NatureScot have been consulted on the methodology / results of the site-specific surveys since Scoping.
Scottish Ministers (via MS-LOT)	The Scottish Ministers are broadly content with the study area as described in section 2.3 of the Scoping Report. In line with the NatureScot representation, the Developer must provide clarification on the surveys to be undertaken in the intertidal area. With regards to data sources to inform the EIA Report, the Scottish Ministers direct the Developer to the OIC representation and MSS advice and advise that the data sources identified must be considered in the EIA Report. Finally, the Scottish Ministers recommend that the scope of the baseline surveys is agreed with NatureScot in advance.	The site-specific intertidal survey data is included within section 10.4. The additional offshore references have been reviewed and have been included within the assessment where relevant. The scope of the baseline surveys were agreed with NatureScot in advance (29th June 2022) and provisional results have been shared. The baseline survey scope was also sent to MS-LOT via email on the 18th May 2022.
Scottish Ministers (via MS-LOT)	The Scottish Ministers broadly agree with the impact pathways included in table 2-18 which are scoped in for further assessment in the EIA Report. However, in addition and in line with the NatureScot representation, The Scottish Ministers advise that impacts on habitat loss and disturbance from pre-construction seabed preparation works and, if required, scour protection, must be scoped into the EIA Report. In regards to the colonisation of hard structures and changes in prey species availability, the Scottish Ministers advise that the EIA Report must fully address the NatureScot representation.	Pre- construction seabed preparation works and scour protection impacts have been scoped into the EIA and associated habitat loss from these activities are assessed in section 10.6. The colonisation of hard structures and the associated changes in prey species availability has also been assessed within section 10.6.

CONSULTEE	COMMENT	RESPONSE
Scottish Ministers (via MS-LOT)	Due to the large design envelope, impacts arising from suspended sediments will vary depending on the foundation type and/or construction/decommissioning methods used. In line with the NatureScot representation, the Scottish Ministers advise that significant effects must be quantified and the impacts assessed in the EIA Report, noting that these may differ in relation to habitats and species.	The effects resulting from resuspension and deposition of sediments have been quantified and assessed in the EIA (see section 10.6). Chapter 8: Marine physical and coastal processes provides further detail on the modelling and quantification of suspended sediments.
Scottish Ministers (via MS-LOT)	In section 2.3.4.1.4 of the Scoping Report the Developer has identified protected sites with benthic interests. The Scottish Ministers draw the Developers attention to the NatureScot representation and advise that all of the protected features of the North-West Orkney Nature Conservation Marine Protected Area ("MPA") must be scoped into the EIA. In addition, the Mucklehead and Selwick SSSI must be scoped into the EIA Report in relation to potential landfall areas. The Scottish Ministers also highlight the NatureScot representation regarding the potential presence of the flapper skate Priority Marine Feature ("PMF") within the Proposed Development area, which must also be scoped into the EIA Report in addition to the species identified in Table 2-15 of the Scoping Report.	The current consent application does not include connection to the Flotta Hydrogen Hub which will be subject to a separate later consent application. Therefore, the Mucklehead and Selwick Site of Special Scientific Interest (SSSI) is out with the current study area for the benthic, subtidal and intertidal ecology. Flapper skate and sandeel and their supporting habitats are considered in chapter 11: Fish and shellfish ecology. Chapter 8: Marine physical and coastal processes considers impacts on the other features of the North-West Orkney Nature Conservation Marine Protected Area (NCMPA).
Scottish Ministers (via MS-LOT)	As highlighted in the representation from NatureScot, only limited information is provided within the Scoping Report in regards to how impacts will be assessed. The Scottish Ministers advise that the advice regarding a qualitative assessment, and consideration of indirect impacts on birds, fish and marine mammals, must be fully addressed within the EIA Report. In addition, the Developer must also fully implement the advice from MSS in relation to the assessment approach.	Where relevant, indirect impacts on other receptors such as birds, fish and marine mammals have been considered within the Offshore EIA report in chapter 11: Fish and shellfish ecology, chapter 12: Marine mammals and megafauna, and chapter 13: Offshore and intertidal ornithology. Where qualitative assessment has been required, targeted discussions were undertaken as part of the engagement sessions.

CONSULTEE	COMMENT	RESPONSE
		Marine Scotland Science advice has been implemented, where applicable.
Scottish Ministers (via MS-LOT)	In regards to cumulative impacts, the Scottish Ministers highlight the representation from NatureScot regarding impacts to Scapa Flow from other types of development, aquaculture and port and harbour construction. The Scottish Ministers advise that the NatureScot advice should be fully addressed in the cumulative assessment within the EIA Report.	Advice on cumulative assessment has been taken into consideration within the EIA. The specific requirements for Scapa Flow are not applicable to the current scope of this EIA.
Scottish Ministers (via MS-LOT)	Regarding mitigation and monitoring, the Scottish Ministers advise that the full range of mitigation techniques and published guidance are considered within the EIA Report as highlighted in the NatureScot representation. In line with the MSS advice, the Invasive Non-Native Species (INNS) management plan should be extended to include a detailed INNS monitoring plan.	The development of a detailed Invasive Non-Native Species (INNS) monitoring plan will be considered. This will be developed post-consent in consultation with relevant stakeholders. The INNS risk assessment / management plan will be provided with the application. The plan will indicate whether there is a risk of INNS. Further monitoring will only take place if the risk assessment indicates there is a potential issue.
Scottish Ministers (via MS-LOT)	Sections 1.3.4.1.5 and 1.3.4.2 the Scoping Report states that the primary method for installation of the inter-array and interconnector cables and export cables is burial, method of which is yet to be decided. The EIA Report must be clear on the range of burial depths that have been considered as part of the assessment. Where reliance is placed on a subsequent cable plan or cable burial risk assessment as mitigation, the EIA Report must explain how this measure will mitigate the effects, what measures are proposed for inclusion and the effectiveness and degree of confidence that can be placed on such measure. It is recommended that such plans are included alongside the EIA Report.	The target / range of burial depths and potential methods for the different types of cable are described in chapter 5: Project description, together with an estimate of the percentage of cable lengths of which burial will be possible. This will be confirmed once the Cable Burial Risk Assessment (CBRA) is undertaken (post consent). The results of the CBRA will be used to inform the cable plan.
Scottish Ministers (via MS-LOT)	If there is any potential for cable protection to be used, this must be assessed in the EIA Report including details on materials, quantities and location. In addition, any seabed levelling or removal of substance or objects from on or under the seabed, required for installation of both the inter-array cables and export cables, will require consideration in the EIA Report and may require a marine licence.	The options for and potential lengths of cable requiring protection of cable are described in chapter 5: Project

CONSULTEE	COMMENT	RESPONSE
	Should seabed preparation involve dredging, the EIA Report must identify the quantities of dredged material and identify the likely location for deposit. The Developer may also be required to submit pre-dredge sample analysis, this should include supporting characterisation of the new or existing deposit sites. The Scoping Report at section 2.1.4.1.1 identifies that boulders are likely to be present at the site of the Proposed Development. The EIA Report must provide the anticipated estimate of boulders to be cleared (including how much uncertainty may be associated with the figures presented). Clear narrative must be provided within the EIA Report to show how this has been estimated.	description. Specific locations of cable protection installation are not known at the current time. Seabed preparation activities, including dredging have been assessed in the EIA, but not included in the Project Marine Licence application as the specific deposit location is still to be confirmed, i.e. already licenced site, or Project specific location. Boulder clearance is expected to be required as part of seabed clearance activities. An estimation of the areas of boulders to be removed are provided in Table 10-15 and the potential impacts associated with this clearance has been assessed in section 10.6.1.
Scottish Ministers (via MS-LOT)	Section 1.3.4.1.4 of the Scoping Report states that the Proposed Development may require up to 5 OSPs and are proposed to have piled jacket foundations. The location of the OSPs are yet to be determined. It is further stated that scour protection may also be required, the options being considered are concrete mattresses, rock placement and artificial fronds. The Scottish Ministers advise that the EIA Report must include a full and detailed description of any scour protection that may be required.	The options for scour protection, if required are described in chapter 5: Project description and potential impacts from the worst case scenario assessed in chapter 8: Marine physical and coastal processes. Scour protection will only be implemented where required and will be minimized as far as is practicable. This will be informed by a scour assessment, undertaken post consent.
Marine Scotland Science (MSS)	MSS agree with the study areas. Maps to show the degree of overlap between known Priority Marine Feature/protected feature records and the developments in the two areas would be useful.	Maps showing the distribution of PMFs and protected features such as Annex I habitats have been provided in Figure 10-10.
MSS	The data sources referenced are relevant. Further data resources include the Marine Recorder database which can be downloaded to show all benthic biotopes and indicates survey effort as well as sample descriptions. National Biodiversity Network (NBN) Atlas may also be useful for individual bivalve records where presence may be indicative of suitable habitat for beds or aggregations to occur (in the absence of dedicated survey effort). The offshore area is a region of Scotland with relatively low survey effort and data gaps. Therefore, predictive species and habitat models could be reviewed e.g. for	The additional offshore references have been reviewed and have been included within the assessment where relevant. The current consent application does not include connection to the Flotta Hydrogen Hub which will be subject to a separate later consent application. Therefore, the presence of maerl,

CONSULTEE	COMMENT	RESPONSE
	Arctica islandica (Reiss *et al.*, 2011) horse mussel beds, flame shell beds (Millar *et al.*, 2019) and maerl beds (Simon-Nutbrown *et al.*, 2020) to inform the EIA and future surveys.	flame shell and horse mussel beds are out with the study area for benthic subtidal and intertidal ecology.
MSS	MSS agree with the proposed management measures and the inclusion of an invasive non-native species (INNS) management plan, but advise extending this to include a detailed INNS monitoring plan.	The development of a detailed INNS monitoring plan will be considered. This will be developed post-consent in consultation with relevant stakeholders. The INNS risk assessment / management plan will be provided with the application. The plan will indicate whether there is a risk of INNS Further monitoring will only take place if the risk assessment indicates there is a potential issue.
MSS	Long-term loss or damage to benthic habitats and species is scoped in in Table 2-18 but not included in the summary table (5-1). MSS agree with table 2-18 that long term intertidal and subtidal habitat loss is likely, for example due to abrasion caused by anchor lines and moorings. Techniques for monitoring such loss should be explored and consider the potential for both positive and negative effects for biodiversity.	The EIA predicts that areas of temporary seabed disturbance during construction activities will recover, especially given the dynamic environment within the offshore Project area. However, OWPL will monitor the recovery of seabed habitats and communities post-construction. The approach to monitoring will be determined in discussion with NatureScot/relevant stakeholders during the post-consent stage, but is expected to involve grab sampling and seabed photography in both disturbed and undisturbed areas, using methods compatible with those used in the benthic baseline survey. There is the potential for monitoring of INNS, if the results of the INNS risk assessment indicate it is required. Any monitoring requirements will be agreed post-consent during finalisation and approval of the INNS management plan. Direct impacts on the intertidal area are avoided due to the use of Horizontal Directionally Drilling (HDD) for cable landfall installation.

CONSULTEE	COMMENT	RESPONSE
		Floating foundations are no longer under consideration for this consent application. Therefore, abrasion caused by anchor lines and moorings has not been assessed in the Offshore EIA Report and a monitoring plan for the assessment of abrasion is not required.
MSS	MSS agree with scoping out transboundary impacts.	Noted and agreed.
MSS	The assessment approach seems reasonable. The list of guidance resources in 2.3.3 includes defining *Sabellaria* reef, which may be relevant if *Sabellaria* aggregations are found. However, we advise that this should be extended to include and explore definitions for other biogenic structures recorded in the proposed development areas, such as horse mussel beds, flame shell beds and maerl beds. Shucksmith *et al.* (2019) describe thresholds applied for these in Table 1 as well as sample descriptions of PMFs in Scapa Flow. Descriptions and background information for sensitive PMFs can be found at the bottom of this webpage Improving protection given to Priority Marine Features outside the Marine Protected Area network – Scottish Government – Citizen Space (consult.gov.scot).	Habitat assessment has included assessment for all potential PMF identified with the survey areas, not only reef structures. The current consent application does not include connection to the Flotta Hydrogen Hub which will be subject to a separate later consent application. Therefore, the presence of maerl, flame shell and horse mussel bed are out with the study area for benthic subtidal and intertidal ecology.
MSS	Finally, given the lack of survey effort for this region of Scotland, as described above, dedicated survey work is welcomed and should provide suitable coverage of the area and take account of survey gaps. Consideration should be given to the fact that there are difficulties in identifying some of the key habitats and species in this region (e.g. flame shell beds and *Arctica islandica*) with traditional sampling techniques (e.g. grab, drop down video and still imagery). Wort *et al.* (2022) provide a review of DNA methods and sampling regimes for benthic monitoring.	An extensive seabed survey programme was undertaken to inform the EIA, the details of which are described in this chapter, and included seabed sampling and analysis and photography / video sampling. The survey strategy took account of data gaps and environmental DNA (eDNA) sampling techniques were considered (e.g. for ocean quahog (*Arctica islandica*)) and discussed with eDNA vendor. It was determined that due to resolution of data, the value of benthic eDNA sampling in this instance though was not going to be pursued as part of the offshore benthic survey campaign.

CONSULTEE	COMMENT	RESPONSE
NatureScot	The information provided in this section of the Scoping Report is high level with little information provided on the project site-specific studies. Therefore, our advice below is proportionate to the level of detail provided in the Scoping Report.	Project specific surveys were undertaken to inform the EIA. NatureScot have been consulted on the scope of project-specific surveys / studies for benthic and intertidal ecology. Results of these surveys were presented to NatureScot as part of EIA consultation.
NatureScot	Study area We are content with the study area proposed as described in Section 2.3.2, which includes the area that will be directly impacted by the offshore infrastructure and the adjacent areas that may be affected by indirect impacts. Although, the intertidal area is not specifically mentioned here it is noted in Section 2.3.3.1, that 'intertidal surveys will also be conducted at the cable landfalls'. It would be useful to have clarification on what surveys will be undertaken here.	The survey strategy, including approach to intertidal baseline was presented separately and agreed with NatureScot prior to the survey being undertaken. The site-specific intertidal survey data is included within section 10.4.4.2.
NatureScot	Baseline environment We are content that Table 2-14, Section 2.3.3 captures relevant baseline datasets. We welcome the planned benthic and intertidal surveys to help inform baseline characterisation and recommend that survey scopes are agreed in advance.	A detailed benthic and environmental survey to inform the EIA was undertaken across the offshore Project area in August 2022 – September 2022. The proposed method statement was submitted to NatureScot and confirmation of agreement was received via email communication on the 10th June 2022.
NatureScot	Baseline environment Section 2.3.4.1.4 identifies protected sites with benthic interests in proximity to the OAA and ECC. All of the protected features of the North-west Orkney Nature Conservation Marine Protected Area (NC MPA), which borders and slightly overlaps with the ECC should be screened in. In addition, impacts on the Mucklehead and Selwick Site of Special Scientific Interest (SSSI) may need to be considered depending on where the landfall lies in relation to this protected area.	All protected features of the nearby NCMPA have been screened in (see chapter 11: Fish and shellfish ecology for further details on the North-west Orkney NCMPA) along with any impacts to SSSI features, although the latter may be part of terrestrial component of the assessment. The North-West Orkney NCMPA is also designated for the geomorphological feature of sandbanks, sand wave fields and sediment wave fields representative of the Fair Isle Strait Marine Process Bedforms Key Geodiversity Area. However, as

CONSULTEE	COMMENT	RESPONSE
		no work will be undertaken within the North-West Orkney NCMPA, there will not be any impacts to this geomorphological feature and it has not been considered further in this chapter. The current consent application does not include connection to the Flotta Hydrogen Hub which will be subject to a separate later consent application. Therefore, the Mucklehead and Selwick SSSI is out with the current study area for the benthic, subtidal and intertidal ecology.
NatureScot	Baseline environment We expect consideration to be given to key Annex 1 habitats and Priority Marine Features (PMFs) in the EIA Report.	Annex I habitats and PMFs have been fully considered in this chapter, chapter 11: Fish and shellfish ecology, chapter 12: Marine mammals and megafauna, and chapter 13: Offshore and intertidal ornithology.
NatureScot	Baseline environment We are aware that flapper skate (a PMF) and their eggs, may be present in the project area due to the large number of empty egg cases that wash up on the west coast of Orkney (Shark Trust, Great Egg Case Hunt, Orkney Skate Trust). Female flapper skate are thought to lay eggs on cobble/boulder habitat in 20-50m but may lay in shallower or deeper water than this. Flapper skate on the west coast of Scotland exhibit high occupancy of the deep trenches (100-150m) in the seabed in the summer with a seasonal trend of (large females especially, which suggests an association with egg laying) moving into shallow water (25-75m) over winter months (Thorburn *et al.* 2021). Therefore, potential impacts to flapper skate should be included in the EIA Report.	The consideration of flapper skate has been included in the EIA, particularly in chapter 11: Fish and shellfish ecology. The associated ecological effects on the trophic levels as a result of benthic impacts and how this may influence population impacts for fish and shellfish species of interests have been considered in the EIA where relevant within section 10.6.
NatureScot	Habitat loss and disturbance	Habitat loss and disturbance associated with pre-construction, construction, operation and maintenance, and decommissioning has been assessed in the EIA in section 10.6.

CONSULTEE	COMMENT	RESPONSE
	Habitat loss and disturbance (both temporary and long term) is a key impact pathway detailed in Table 2-18, Section 2.3.6 for construction, operation and maintenance and decommissioning. All appropriate pre-construction seabed preparation works should also be included.	
NatureScot	Habitat loss and disturbance We recommend that if scour protection is required, that potential impacts are scoped in for assessment.	Impacts of scour protection have been included in the relevant chapters throughout the EIA. Introduction of scour is assessed in chapter 8: Marine physical and coastal processes. Colonisation of hard structures is included in section 10.6 and 10.7.
NatureScot	Suspended sediments The potential creation and dispersal/settlement of suspended sediments may vary with differing foundation types and/or construction/decommissioning methods. It will be important to consider if this will have significant effects and for this to be quantified and the impacts correctly assessed. There will be differing impacts on different habitats and species and these should be carefully considered.	The differing scenarios that will incur deposition and sediment resuspension have been assessed in chapter 8: Marine physical and coastal processes, where further detail on the modelling and quantification of suspended sediments is provided. Selected scenarios representing worst case have been assessed in the benthic ecology chapter.
NatureScot	Colonisation of hard structures We agree with the consideration and inclusion of hard structure colonisation in Table 2-18, Section 2.3.6. This is important in considering the potential spread of marine invasive non-native species and ensuring appropriate mitigation and monitoring is embedded to combat this, both of which may differ depending on the foundation type(s) used. This will also be useful from an engineering perspective – depending on the hard structure in question, removal of encrusted growth may be necessary throughout the life time of the wind farm development, and if so, should be factored in to the assessment.	Colonisation of hard/introduced substrates and its management has been considered in the EIA. See section 10.6.2.3 for the full assessment. The effects of removal of encrusted growth has been assessed in section 10.6.2.7.

<table>
<tr><th>CONSULTEE</th><th>COMMENT</th><th>RESPONSE</th></tr>
<tr><td>NatureScot</td><td>Colonisation of hard structures

As noted in the Scoping Report, the introduction of hard structures (e.g. turbine and OSP foundations, scour protection and cable protection) could also result in a change in community type from species typical of sedimentary habitats to those typical of hard substrata. We recognise that the long-term effect of such introduction is not fully understood at present, and that this change may provide positive and/or negative effects for different receptors and as such should be carefully considered. This will also help inform how any local increase in species diversity may influence prey species availability.</td><td>Colonisation of hard substrates and its management has been considered in the EIA. See section 10.6.2.3 for the full assessment.</td></tr>
<tr><td>NatureScot</td><td>Colonisation of hard structures

It would therefore also be helpful if commentary is provided in the EIA Report on stabilisation operations to allow further understanding of the potential nature conservation impact. This would include:
• Location of dump sites;
• Type/size/grade of rock to be used;
• Tonnage/volume to be used;
• Contingency tonnage/volume to be used;
• Method of delivery to the seabed;
• Footprint of rock; and
• Assessment of the impact.</td><td>Colonisation of hard substrates and its management has been considered in the EIA. See section 10.6.2.3 for the full assessment.

The quantity and footprint of stabilisation material (rock) and infrastructure has been quantified in section 10.5.6 and assessed in the EIA.

See chapter 5: Project description for further details on external protection.

The assessment has been based on the information available on the Project design at the current time. Specific locations and methods for cable protection and scour protection requirements are not currently available, however conservative estimates have been used to inform a worst case assessment. These details will be available post consent.</td></tr>
<tr><td>NatureScot</td><td>Colonisation of hard structures

Where protective material cannot be avoided, we recommend using a more targeted placement method e.g. fall pipe vessel rather than using vessel-side discharge methods. We also recommend that consideration is given to minimise the amount of hard substrate material used during the</td><td>The worst case scenario has been assessed within the impact assessment. Chapter 5: Project description includes details on protective materials which has been minimised as far as is</td></tr>
</table>

CONSULTEE	COMMENT	RESPONSE
	operations and maintenance, of the wind farm and that the worst case quantity is assessed for the lifetime of the project. Where materials have to be used we also encourage that consideration is given to the choice of materials (composition and size) and their ability to be recovered during decommissioning, including any potential opportunities for nature inclusive design.	practicable and the deposition of hard structures and associated impact have been assessed within this chapter. The mitigations for deployment method, accuracy of placement and material used (such as composition and fraction size has been considered with regard to minimising ecological effects. Long term loss or damage to benthic habitat and species, colonisation of hard structures and increased sediment concentrations and sediment deposition are assessed in section 10.6. The installation methods are not yet finalised and they will be within the post-consent stage.
NatureScot	Changes in prey species availability Table 2-18 doesn't capture changes in prey availability as a result of habitat loss or disturbance. However, it is noted in Section 1.4.2.4 that in addition to impacts on individual receptors, a more holistic approach to consider impacts at an ecosystem scale and across trophic levels will also be taken, which is welcomed. Consideration across key trophic levels will enable better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance as a result of impacts to benthic habitats and how this may influence population impacts for marine mammal (and other top predator) interests.	The associated ecological effects on the trophic levels as a result of benthic impacts and how this may influence population impacts for marine mammal (and other top predator) interests has been considered in the EIA within chapter 11: Fish and shellfish ecology, chapter 12: Marine mammals and megafauna, and chapter 13: Offshore and intertidal ornithology. An assessment of ecosystem effects is provided in section 10.10 of this chapter. See Table 10-15 for details on external protection.
NatureScot	Approach to assessment Limited information is provided on how impacts to benthic interests will be assessed. However, it is noted in Section 2.3.9 that a marine ecology working group will be established to discuss survey methods, interim results, assessment methods and outputs.	Meetings with NatureScot to discuss the survey approach, the survey results and approach to assessment of Annex I habitats, in particular has taken place. The benthic survey method statement was submitted to NatureScot for consultation and approval of the survey method statement was received via email on the 10th June 2022. Further details on consultation are included within section 10.3.

CONSULTEE	COMMENT	RESPONSE
NatureScot	Approach to assessment The EIA Report should where possible quantitatively describe the impact of habitat loss and disturbance (temporary and permanent) from the development alone and in combination with other developments. If it is not possible to quantify impacts, then further discussion, perhaps through the technical working group, around a qualitative assessment will be required.	The EIA has, wherever possible, quantified impacts. See section 10.5.6 for further details. Where qualitative assessment has been required, targeted discussions were undertaken as part of the engagement sessions.
NatureScot	Approach to assessment Consideration should also be given to indirect impacts on birds, fish and marine mammals, where appropriate.	Indirect impacts to other receptors have been included in the assessment within section 10.6, wherever relevant. An assessment of ecosystem effects is provided in section 10.10 of this chapter.
NatureScot	Cumulative impacts We are content with the approach outlined in Section 2.3.7 but advise that, particularly for Scapa Flow, there may be the potential for cumulative effects from other types of development, aquaculture and port/harbour construction in particular, and these should be included in any cumulative assessment.	These development types were considered in the identification of other developments which could result in cumulative effects with the offshore Project. No aquaculture or port/harbour developments were identified as potentially acting cumulatively with the offshore Project. It should be noted that the offshore export cables to the Flotta Hydrogen Hub which overlap with Scapa Flow no longer forms part of this current consent application.
NatureScot	Mitigation and monitoring Where impact pathways have been identified and are scoped in, we advise that the full range of mitigation techniques and published guidance is considered and discussed in the EIA Report.	The relevant guidance considered for the in section 10.2, and embedded mitigations are outlined in section 10.5.4. Additional mitigation and monitoring measures will only be considered where appropriate i.e. if any impacts are considered to be significant.

CONSULTEE	COMMENT	RESPONSE
NatureScot	Mitigation and monitoring There may be a need for strategic monitoring to understand the impact of hard structure colonisation and change in community structure and local species diversity.	The impact of hard structure colonisation has been assessed in section 10.6.2.3. The impact was assessed to be not significant therefore further mitigation and monitoring is not required.
NatureScot	Transboundary impacts We advise that there are unlikely to be any transboundary impacts for benthic features.	Agreed. No benthic transboundary effects are expected.
Orkney Islands Council	The Environmental Report should clearly quantify the area of natural and semi-natural habitat that would be damaged or lost to each alternative route under consideration. Where possible, opportunities to incorporate benefits for biodiversity should be identified.	Details on the site selection process and alternatives are detailed in chapter 4: Site selection and consideration of alternatives. Potential opportunities for biodiversity enhancement has been highlighted where possible within section 10.6. The worst case scenario footprints have been quantified within section 10.5.6.
Orkney Islands Council	Further sources of data that could be used to inform the EIAR in relation to biodiversity impacts, especially benthic impacts, include: • Engaging the Fishing Industry in Marine Environmental Survey and Monitoring Scottish Marine and Freshwater Science Vol 12 No 3 Engaging the Fishing Industry in Marine Environmental Survey and Monitoring - Engaging the Fishing Industry in Marine Environmental Survey and Monitoring | Marine Scotland Data Publications; • Biological analyses of seabed imagery from within and around Marine Protected Areas in Orkney, Shetland, Inner Sound, and Islay and Jura in 2019; and • Scottish Marine and Freshwater Science Vol 12 No 2 Biological analyses of seabed imagery from within and around Marine Protected Areas in Orkney, Shetland, Inner Sound, and Islay and Jura	The suggested data sources have been reviewed. The coverage of the publications focusses on the coasts of the Orkney Islands and Scapa Flow and the associated marine protected areas at these locations. It should be noted that the offshore export cables to the Flotta Hydrogen Hub which overlap with Scapa Flow no longer forms part of this current consent application.

CONSULTEE	COMMENT	RESPONSE
	in 2019 - Biological analyses of seabed imagery from within and around Marine Protected Areas in Orkney, Shetland, Inner Sound, and Islay and Jura in 2019 | Marine Scotland Data Publications.	
Orkney Islands Council	As the current draft National Planning Framework 4 is likely to be published during the progress of this proposed offshore wind farm development, opportunities should be explored as to how the proposal will contribute to the conservation and enhancement of biodiversity (draft NPF4L Policy 3: Nature Crisis).	Opportunities to contribute towards conservation and enhancement of biodiversity have been considered at all stages of the Project. See chapter 3: Planning policy and legislative context which provides further details on National Planning Framework 4 (NPF4). In addition, OWPL have prepared a Biodiversity Enhancement Plan (OWPL, 2023) to ensure that any proposed enhancements are suited to the environment that they are situated in benefit not only the primary species but the wider ecosystem.
Orkney Islands Council	Table 2.16 Summary and Key Issues for Benthic Subtidal and Intertidal Ecology The EIAR should address the potential impacts on the PMFs listed, as well as Flame Shell beds and potential EMF impacts. The potential impacts on sandeel should be linked to potential impacts on ornithology.	The Offshore EIA Report has assessed potential impacts on relevant PMF features / species, including potential Electromagnetic Field (EMF) effects on sensitive species within section 10.6.2.6. Impacts on sandeel will primarily be considered within chapter 11: Fish and shellfish ecology and have been discussed in the impacts of prey species within chapter 13: Offshore and intertidal ecology. The current consent application does not include connection to the Flotta Hydrogen Hub which will be subject to a separate later consent application. Therefore, the presence of flame shell beds is outwith the study area for benthic ecology.
Orkney Islands Council	2.3.9.1 Analysis and Assessment Approaches Include OIC (delegate) as a consultee.	OIC was present at the consultation meeting held on 29th June 2022. See section 10.3 for consultation meeting details.

10.4 Baseline characterisation

This section outlines the current baseline for benthic ecology within the benthic ecology offshore study area. The baseline has been characterised using site-specific surveys, desk-based sources and data sources provided through consultation (see Table 10-5).

10.4.1 Study area

The study area is defined by the offshore Project area and a larger area formed by buffers around the offshore Project area.

The offshore Project area consists of the Option Agreement Area (OAA) and offshore Export Cable Corridor (ECC), within which the offshore infrastructure, including Wind Turbine Generators (WTGs) and associated foundations and substructures, the Offshore Substation Platforms (OSPs) and associated foundations, the inter-array cables, interconnector cables and offshore export cables will be installed. This includes the intertidal area along the Caithness coast which takes into account the offshore export cables landfall options at Greeny Geo and Crosskirk where intertidal habitat assessments have been undertaken. The two offshore ECC and associated landfalls are referred to as offshore ECC east (Crosskirk) and west (Greeny Geo).

A larger area has been established using a 10 km buffer around the OAA and a 15 km buffer around the offshore ECC (Figure 10-1), to take into account the wider areas that may be affected by indirect impacts such as sediment suspension and resettlement. This is based on the mean spring tidal excursion distance from the UK Atlas of Marine Renewable Energy Resources meso-scale model (ABPmer, 2008). Different buffer distances are applied to the OAA and offshore ECC to account for the variation in excursion distance between the two Project elements. The proximity of the offshore export cables to faster and stronger flows through the Pentland Firth between the Scottish mainland and Orkney Islands accounts for the larger excursion distance for the offshore ECC.

Where appropriate, a larger impact area has been considered, for example, in relation to the potential introduction of INNS.

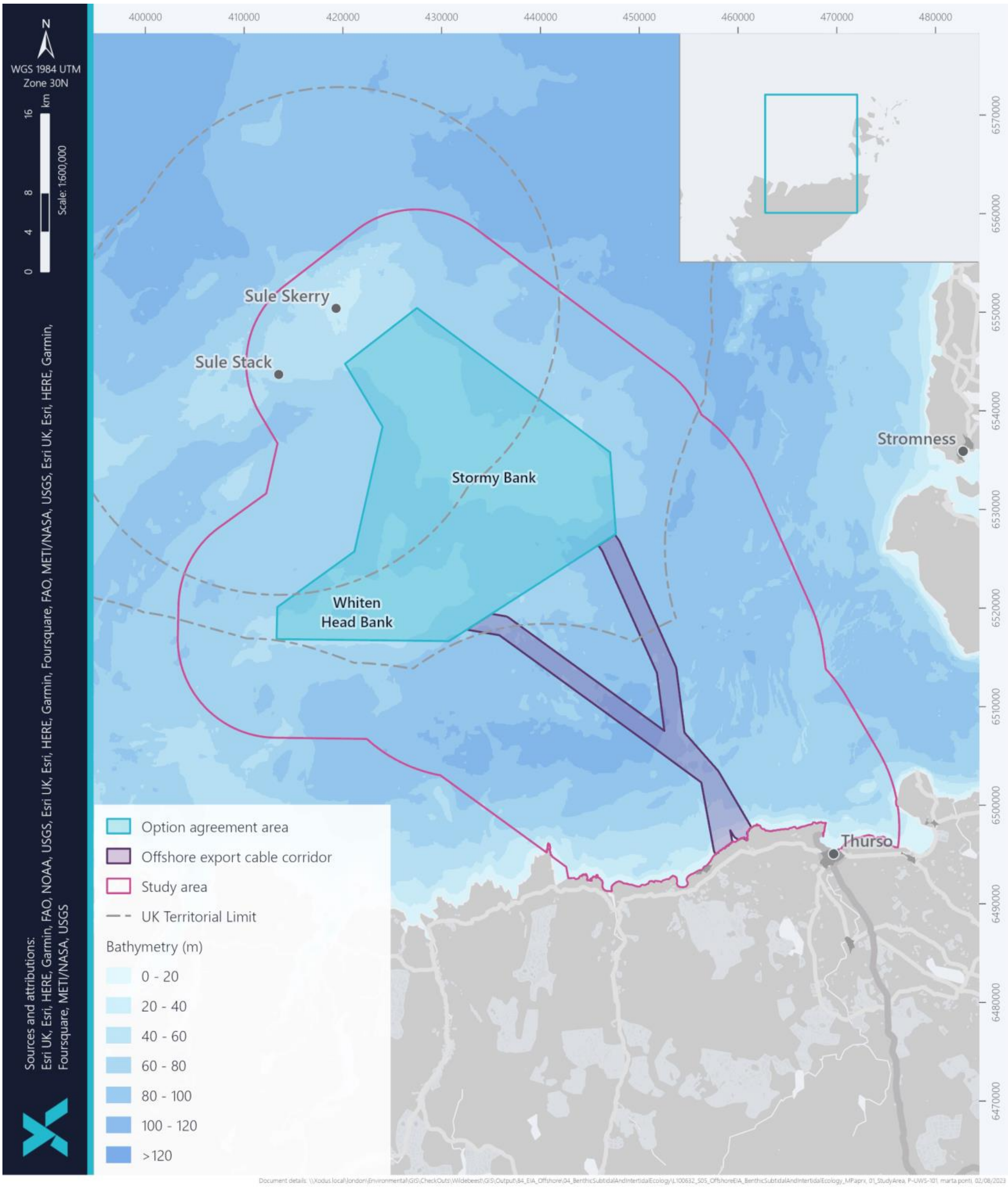

Figure 10-1 Benthic subtidal and intertidal ecology offshore study area

10.4.2 Data sources

The data sets and literature with relevant coverage to the offshore Project, which have been used to inform the baseline characterisation for benthic ecology are outlined in Table 10-5.

Table 10-5 Summary of key datasets and reports

TITLE	SOURCE	YEAR	AUTHOR
EMODnet Broad-scale Seabed Habitat Map for Europe (EUSeaMap)	https://emodnet.ec.europa.eu/en/seabed-habitats	2021	European Marine Observation and Data Network (EMODnet)
Orkney Islands Regional Marine Plan (consultation draft)	https://www.orkney.gov.uk/Service-Directory/D/orkney-islands-regional-marine-plan.htm	2022	OIC
State of the Environment Assessment: A Baseline Assessment of the Orkney Islands Marine Region	https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/20210107-OIC-Report-V9-screen%20v2.pdf	2020	OIC
Sectoral Marine Plan: Regional Local Guidance **Offshore Wind Energy in Scottish Waters: Regional Locational Guidance**	https://www.gov.scot/publications/sectoral-marine-plan-regional-locational-guidance/documents/	2020	Scottish Government
The Marine Scotland National Marine Plan Interactive (NMPi) Maps • **Spatial data relating to benthic subtidal and intertidal ecology on NMPi;** • **NatureScot (2018): Ocean Quahog; and** • **Mapping European Seabed Habitat (MESH) project data.**	https://marinescotland.atkinsgeospatial.com/nmpi/	2023a	Marine Scotland[4]
Descriptions of Scottish Priority Marine Features (PMFs)	https://www.nature.scot/sites/default/files/Publication%202016%20-%20SNH%20Commissioned%20Report%20406%20-%20Descriptions%20of%20Scottish%20Priority%20Marine%20Features%20%28PMFs%29.pdf	2016	Tyler-Walters *et al.*

[4] *Now Marine Directorate.*

TITLE	SOURCE	YEAR	AUTHOR
Sitelink NatureScot	https://sitelink.nature.scot/home	2023	NatureScot
Synthesis of Information on Benthos of Area SEA 5	https://www.gov.uk/government/publications/strategic-environmental-assessment-5-supporting-documents	2004	Department of Energy & Climate Change (now Department for Energy Security and Net Zero (DESNZ))
UK Offshore Energy Strategic Environmental Assessment 4 (OESEA4)	https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-4- oesea4	2022	BEIS (now DESNZ)
The Benthic Environment of the North and West of Scotland and Northern and Western Isles: Sources of information and overview	https://tethys.pnnl.gov/sites/default/files/publications/Wilding_et_al_2005.pdf	2005	Wilding *et al.*
North-West Orkney NCMPA	https://jncc.gov.uk/our-work/north-west-orkney-mpa/	2017	JNCC
The Marine Life Information Network (MarLIN)	https://www.marlin.ac.uk/	2023	MarLIN
Feature Activity Sensitivity Tool (FeAST)	https://www.nature.scot/professional-advice/protected-areas-and-species/priority-marine-features-scotlands-seas/feature-activity-sensitivity-tool-feast	2023b	Marine Scotland

10.4.3 Project site-specific surveys

10.4.3.1 Geophysical survey

10.4.3.1.1 Offshore

Ocean Infinity were contracted by OWPL to conduct an offshore geophysical survey across the offshore Project area between April and September in 2022, in order to characterise the seabed, sediment and substrates. The geophysical data acquired during the survey consisted of:

- Multibeam Echo Sounder (MBES) bathymetry and backscatter;
- Side-Scan Sonar (SSS) between 300 kilohertz (kHz) and 600 kHz at 75 m range;

- Magnetometer;
- Sub-Bottom Profiler (SBP) to approximately 10 m below seabed; and
- Ultra-High Resolution Seismic (UHRS) to approximately 100 m below seabed.

The findings of the geophysical survey have been detailed in three reports:

- Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 1 – OAA Results Report (Ocean Infinity, 2023a);
- Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 2a – Export Cable Corridor (ECC) Results Report (Whiten Head Bank to Crosskirk) (Ocean Infinity, 2023b); and
- Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 2b – ECC Results Report (Stormy Bank to Crosskirk) (Ocean Infinity, 2023c).

10.4.3.1.2 Nearshore

OWPL contracted Spectrum Geosurvey Limited ("Spectrum") between August and October 2022 to complete a marine geophysical survey across the nearshore area of the offshore ECC and proposed landfalls. The survey was completed to a similar specification as that described for the offshore (see "offshore" section above) and included the acquisition of MBES, SSS, magnetometer and SBP data. Also associated with this survey is the completion of an intertidal survey which is described in chapter 8: Marine physical and coastal processes. The results of nearshore marine geophysical survey are detailed in the Volume 1 – West of Orkney Windfarm Nearshore Geophysical Survey Results and Charts Report (Spectrum, 2023).

10.4.3.2 Benthic and environmental survey

10.4.3.2.1 Offshore

A benthic and environmental survey including habitat assessment was completed by Ocean Infinity between August and September 2022 in the OAA and along the offshore ECC. The survey design was informed by the previously acquired geophysical MBES and SSS data. During the offshore survey, sampling was conducted successfully at 99 sampling locations, of which 73 were sampled using a combination of Drop Down Video (DDV) and grab sampling, and 26 were sampled using only DDV (17 standalone DDV transects and 9 of the proposed grab locations).

Grab samples were successfully acquired at 73 of the planned 82 locations. At each sampling location, one sample was acquired for faunal analyses (SS5: Benthic environmental baseline report), one sample for Particle Size Analysis (PSA), and one sample for sediment chemistry and contaminants analysis. For the faunal, particle size, and sediment chemistry and contaminant grab sampling, the primary grab sampler utilised was the Dual Van Veen (DVV) (DVV; 2 x 0.1 m^2) and the secondary grab sampler, e.g., in areas of coarse sediment, was the Hamon Grab (HG) (HG; 0.1 m^2).

In addition to the benthic sampling, sampling of surface and bottom water was conducted for eDNA analysis, together with Conductivity, Temperature and Density (CTD) profiling throughout the water column at 20 sampling locations.

10.4.3.2.2 Nearshore

A nearshore benthic and environmental survey was carried out in October 2022 by Spectrum Geosurvey Limited and Ocean Ecology Limited. Benthic nearshore sampling was performed at nine sampling locations, of which four were sampled using a combination of DDV and grab sampling, and five were sampled using only DDV. Three out of four locations were successfully sampled for faunal, PSA, and sediment chemistry and contaminant analyses. The primary grab sampler utilised for nearshore faunal grab sampling was the HG (0.1 m^2), and for nearshore PSA and contaminants sampling, the Shipek grab sampler (0.05 m^2) was utilised.

In addition to the benthic sampling, water sampling, together with CTD profiling, was performed at five sample locations (SS5: Benthic environmental baseline report).

An intertidal survey was undertaken at potential landfall locations Greeny Geo and Crosskirk (see SS4: Benthic subtidal and intertidal baseline report for further details). This involved the collection of Unmanned Aerial Vehicle (UAV) aerial imagery accompanied by a Phase I walkover survey to gather detailed information on the benthic communities present for subsequent habitat / biotope mapping purposes (SS6: Intertidal survey habitat assessment).

Further details on the analysis of the site-specific survey data are provided in the SS4: Benthic subtidal and intertidal baseline report.

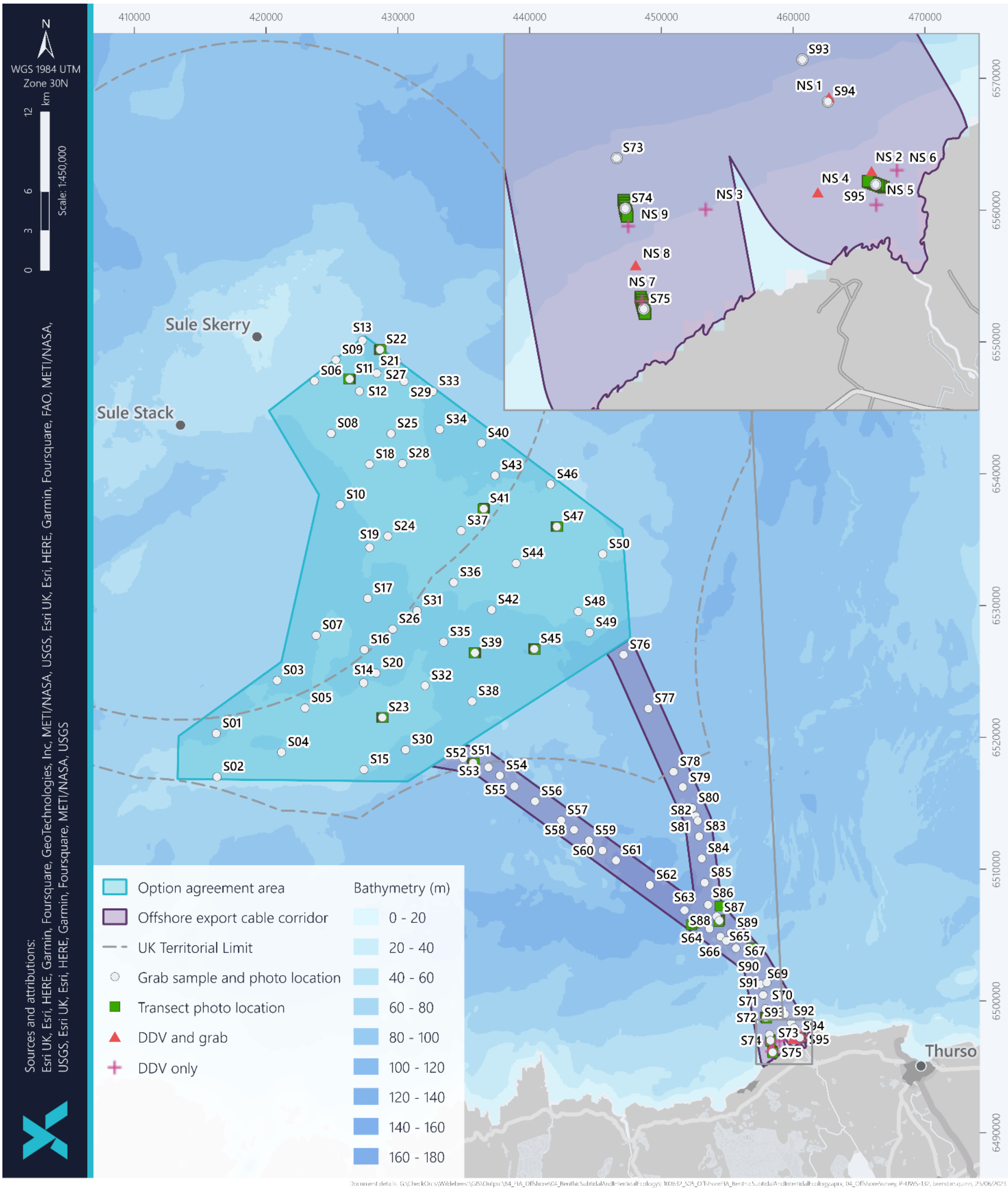

Figure 10-2 Overview of environmental sampling undertaken (see SS5: Benthic environmental baseline report)

10.4.4 Existing baseline

The current baseline environment for benthic ecology has been informed primarily by Project site-specific surveys and augmented by a review of literature and available data sources. The following sections describe the physical characteristics and then discusses the benthic fauna and associated habitats across the OAA and offshore ECC. This section is to be read alongside SS4: Benthic subtidal and intertidal baseline report.

10.4.4.1 Bathymetry and seabed sediments

10.4.4.1.1 Bathymetry

The OAA is characterised by a varied topography dominated by two relatively shallow banks, Stormy Bank in the north of the OAA with a minimum depth of approximately 45 m and the Whiten Head Bank in the south of the OAA with a minimum depth of 47 m (SS5: Benthic environmental baseline report; NatureScot, 2016). The bank features are separated from one another by a deeper area in the centre of the OAA which reaches varying depths of 60-80 m (SS5: Benthic environmental baseline report) (Figure 10-3).

The maximum depth along the eastern offshore ECC, as surveyed, is approximately 99 m, while the maximum depth along the western offshore ECC is approximately 111 m (Figure 10-3).

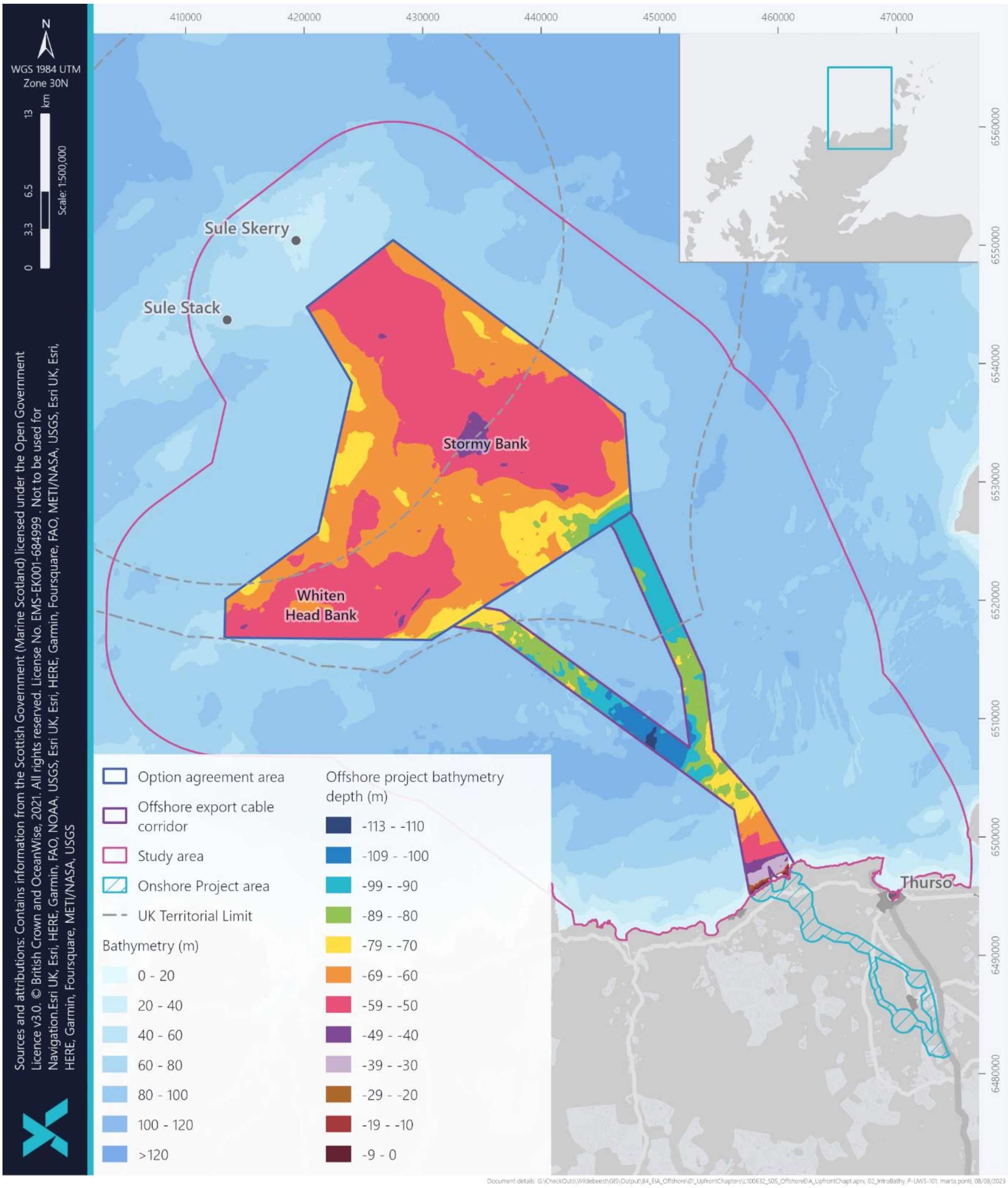

Figure 10-3 Offshore Project boundary and bathymetry[5]

[5] *It is standard practice is present the EMODnet bathymetry data as positive numbers, while the Project specific bathymetry is provided as minus number. Regardless of the values sign both are presenting the water depth.*

10.4.4.1.2 Seabed sediments

The desk based study predicted that there were four broad types of seabed sediment within the study area, classified (as per British Geological Survey (BGS) Web Map Services (WMS)) as gravelly sand, slightly gravelly sand, sandy gravel, and sand (Marine Scotland, 2023a; Figure 10-4). The site specific survey confirmed that the sediment fractions across the OAA primarily comprised sand and gravel with varying ratios, and the offshore ECC was dominated by sand (SS5: Benthic environmental baseline report). The most prominent sediment types were described as 'sand', 'gravelly sand' and 'sandy gravel'. The amount of fine particles (mud, consisting of clay and silt) was generally low over the offshore Project area, ranging from 0 % to 8.2 % (mean 1.5 %). More detail of the sediments across the Project is provided in SS4: Benthic subtidal and intertidal baseline report, chapter 8: Marine physical and coastal processes and chapter 9: Water and sediment quality.

The environmental survey concluded that metal concentrations were generally low, with grab samples exceeding some threshold values for arsenic and/or nickel (SS5: Benthic environmental baseline report). In addition, hydrocarbon content was generally low but variable, with higher concentrations noted in the nearshore samples. Polycyclic Aromatic Hydrocarbon (PAH) concentrations exceeded threshold values and Environmental Protection Agency (EPA) 16 PAH in samples from five sample locations. Concentrations of Polychlorinated Biphenyls (PCBs) were low and exceeded the limit of detection in samples from seven locations, all of which exceeded threshold values. Organotin (Monobutyltin (MBT), Dibutyltin (DBT), Tributyltin (TBT)) concentrations were below the detection limit at all sampled locations. In addition, concentrations of organochloride pesticide concentrations and brominated flame retardants were generally low (further details in SS5: Benthic environmental baseline report). More detail of sediment contaminants is provided in chapter 9: Water and sediment quality.

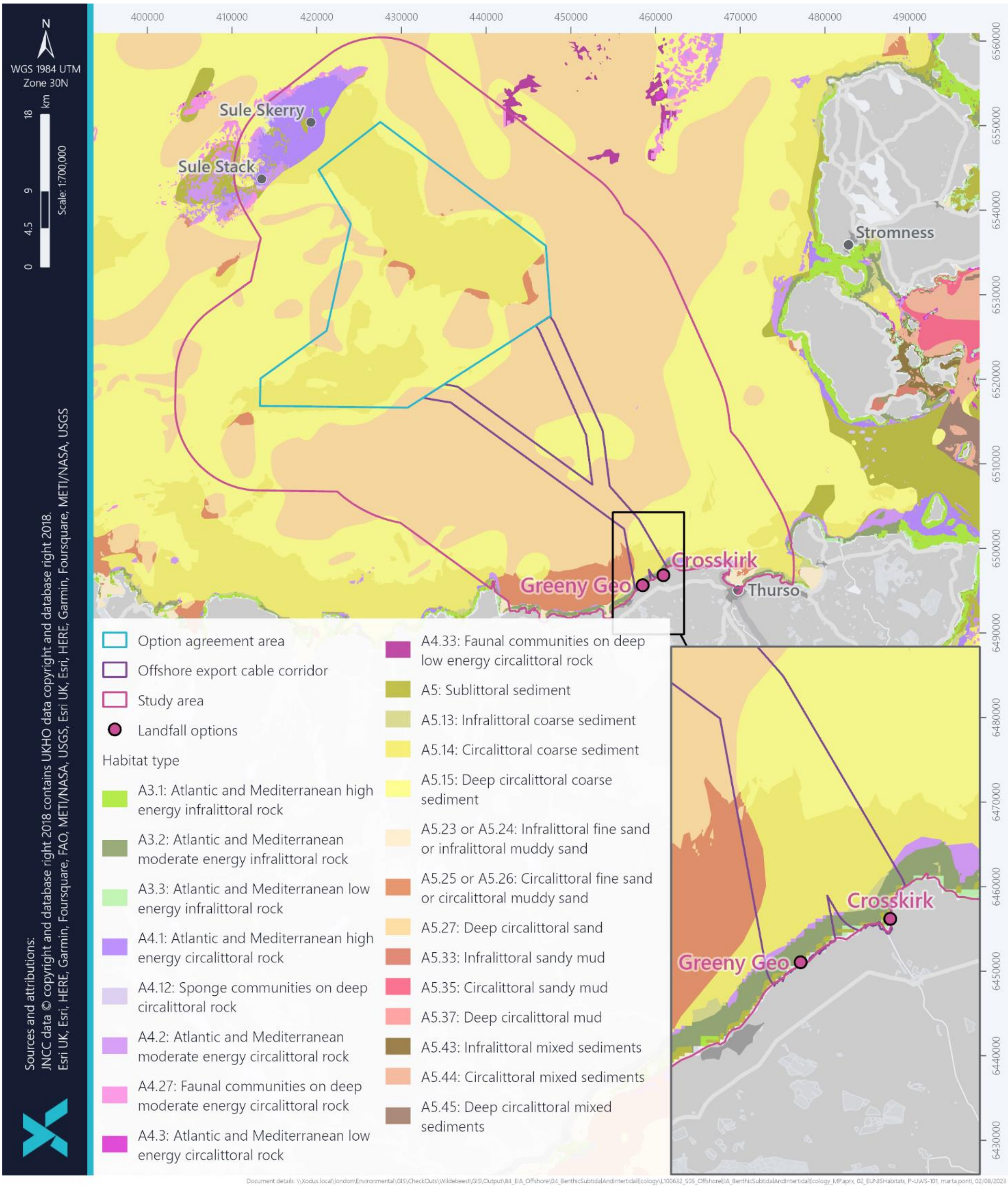

Figure 10-4 Predicted European Nature Information System (EUNIS) Habitats from the UKSeaMap

10.4.4.2 Benthic habitats and species

10.4.4.2.1 Summary of habitats

In the OAA, the seabed in the Whiten Head Bank area in the south of the OAA is characterised by mixed and rocky sediments, dense cobbles and boulders, with large areas classified as MC42 – Atlantic circalittoral mixed sediment and MC12 – Atlantic circalittoral rock. The Stormy Bank to the north of the OAA is comprised predominantly of mixed sediments (MC42) and circalittoral coarse sediment associated with scour depressions (SS5: Benthic environmental baseline report). Elsewhere the seabed in the OAA is made up of a patchwork of various coarse sand and gravel habitats which varied in sediment fraction size and community composition with depth (SS5: Benthic environmental baseline report). Large portions of the OAA are characteristic of Annex I stony reef (further discussed in Section 10.4.4.2.3). An overview of the benthic habitats in the OAA is presented in Figure 10-5. In the offshore ECC, the majority of the sampling locations were similar to the OAA with generally higher portion of sands and less coarse material with the biotopes MC52 – Atlantic circalittoral sand, MC32 – Atlantic circalittoral coarse sediment and MC42 – Atlantic circalittoral mixed sediment as well as MC53 – Atlantic circalittoral rock (SS5: Benthic environmental baseline report). As with the OAA, these habitats closely reflect the predicted EUNIS habitats identified from desk based data sources such as NMPi (Marine Scotland, 2023a; UKSEAMAP, 2019). An overview of the benthic habitats in the offshore ECC is presented in Figure 10-6.

As discussed above, there are a variety of habitats present across the offshore Project area. The heterogenous nature of the mixed and coarse sediments in particular results in a varied benthic community which includes both infaunal sediment dominated communities as well as epifaunal communities, including sessile epilithic fauna associated with rocky hard substrates as described below. Seabed in the nearshore waters off the north coast of Caithness is broadly described as being dominated by rippled fine sand with a sparse epifauna. Two large areas of MC12 – Atlantic circalittoral rock and MB12 – Atlantic infralittoral rock characterise the width of both the offshore ECC west and offshore ECC east route options. The bedrock comprises exposed bedrock with kelp as well as patches comprising sand and gravel. The presence of large boulders is noted predominantly at the lower edge of MB12 – Atlantic infralittoral rock bordering MC52 – Atlantic circalittoral. A kelp forest of *Laminaria hyperborea* grows on the hard substrate at depths of approximately 20 m.

At the landfall sampling locations, the coastline was found to be dominated by high energy rocky habitats (A1/MA1) supporting a variety of marine invertebrates, fucoids and seaweed. An intricate mosaic of rocky habitats of different energies was present across both survey areas, while soft sediments, mostly coarse sediment, gravel and shingle, were limited to the most sheltered areas across both the Crosskirk and Greeny Geo sample locations sites (SS6: Intertidal survey habitat assessment). The landfall installation method that has been selected is HDD, therefore the intertidal area within the vicinity of the offshore Project area will not be affected and has not been considered further within the impact assessment. Further information on the intertidal baseline is provided SS4: Benthic environmental baseline report.

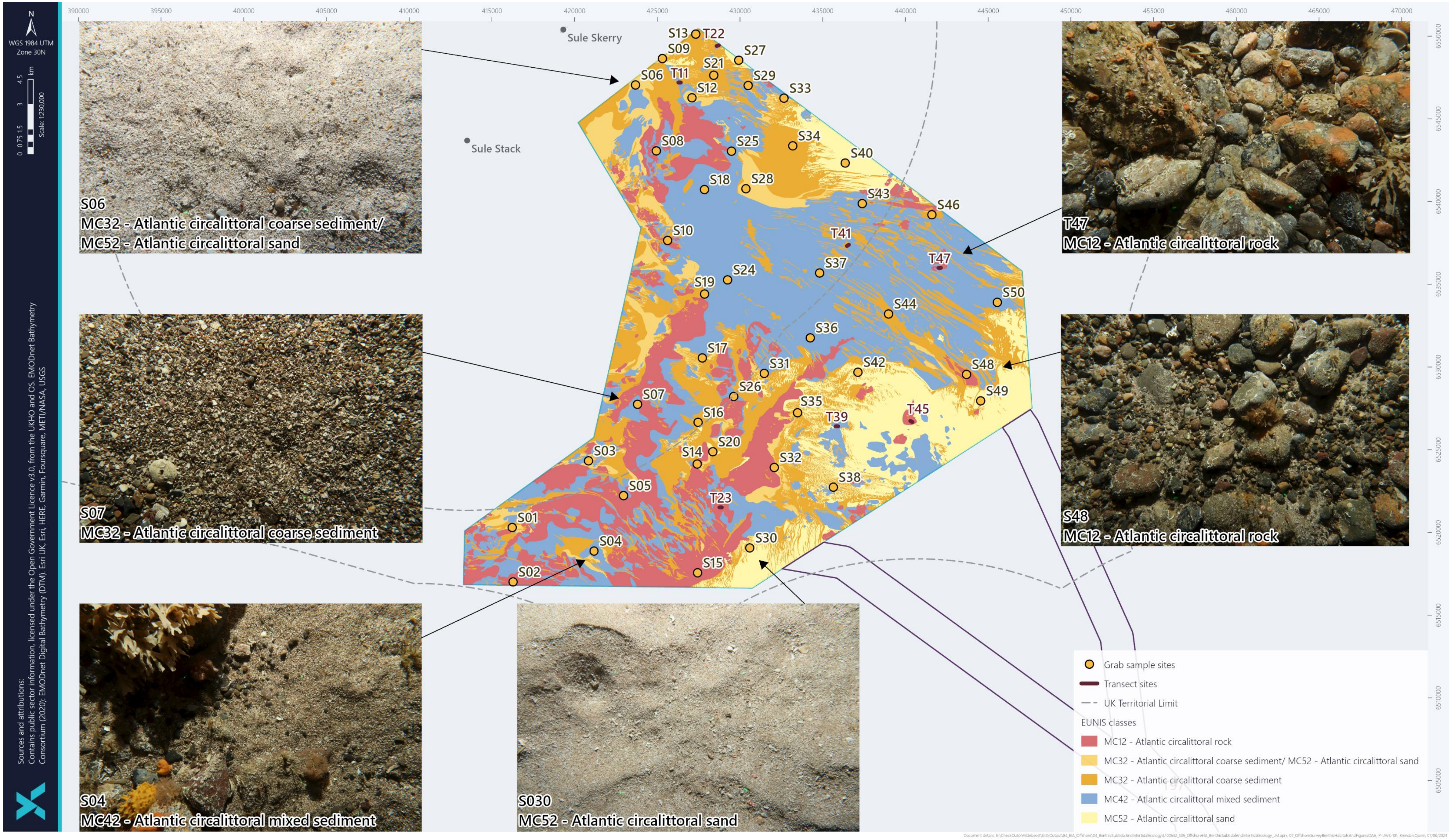

Figure 10-5 Overview of habitats in the OAA (SS5: Benthic environmental baseline report)

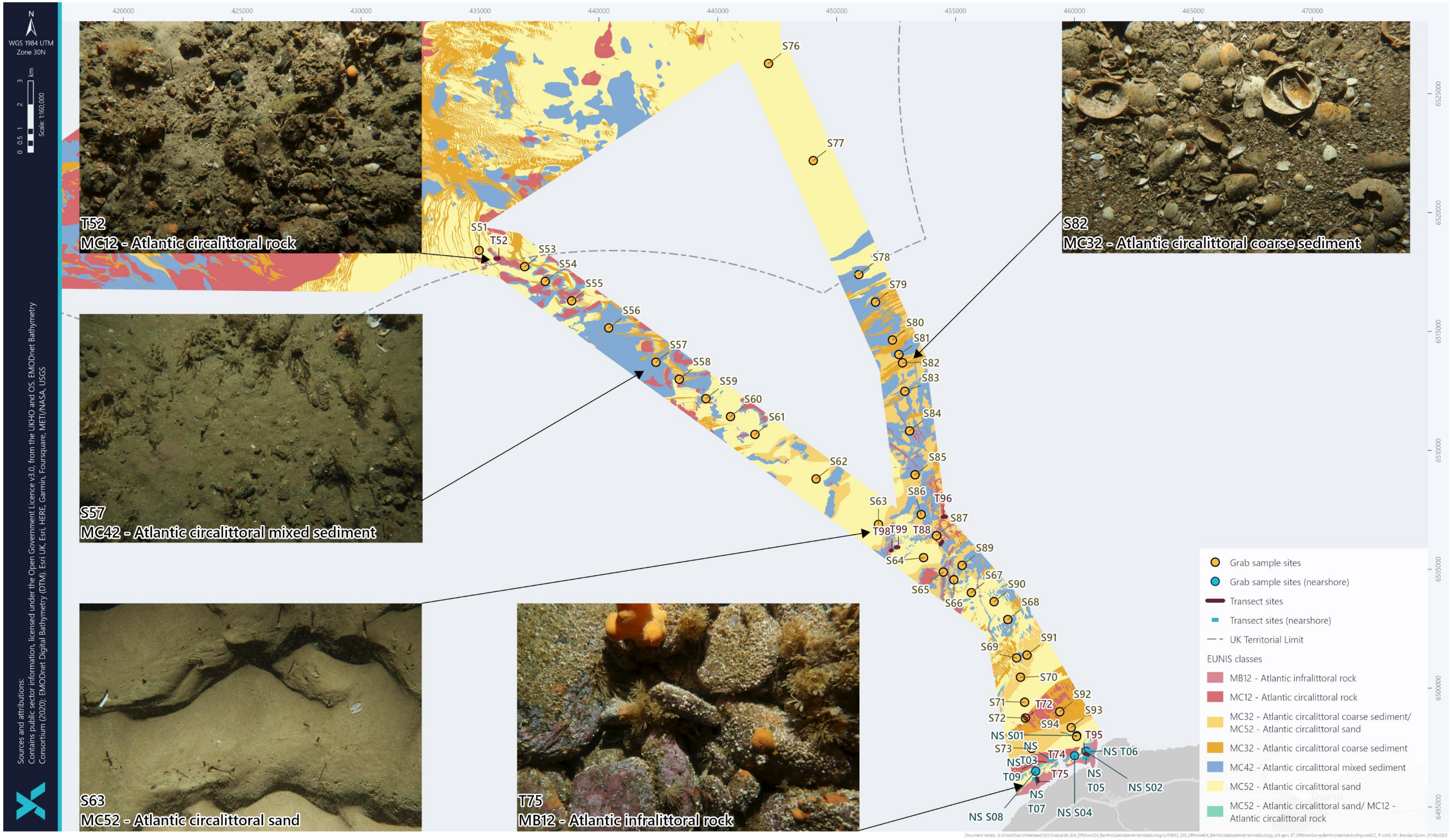

Figure 10-6 Overview of habitats in the offshore ECC (SS5: Benthic environmental baseline report)

10.4.4.2.2 Benthic communities and biotopes

The infaunal communities across the offshore Project area were dominated by polychaete annelids in terms of abundance (53%) and species diversity (47%). The second most prominent phylum were arthropods (13% abundance, 29% diversity) and molluscs (12% abundance and 18% diversity) respectively. The most abundant and widespread taxa in the survey area included the polychaete *Owenia* sp., which forms tubes in sandy sediments, and the sea urchin (*Echinocyamus pusillus),* which is found buried in coarse sands and gravels. The number of taxa was highly variable between stations, reflecting the range of water depths and sediment types, but there were no signs of disturbed communities relating to any pollution sources. Multivariate analysis of the infaunal data was used to reveal statistically significant groups of sampling locations, which provided more refinement (EUNIS Level 4/5), described below, over the seven broadscale EUNIS habitats delineated from the camera-based assessment as described in section 10.4.4.2.1.

The grab samples also contained a wide variety of sessile colonial epifauna. These were dominated by bryozoans, both in terms of diversity of species (70%) and overall abundance (76%). Other important colonial epifauna included cnidarians such as the octocoral *Alcyonium digitatum* and sponges (Porifera). Octocorals are listed on the Scottish Biodiversity List (SBL).

Further details of the infaunal communities and the results of the statistical analyses are provided in the SS4: Benthic subtidal and intertidal baseline report and the full environmental baseline survey report (SS5: Benthic environmental baseline report).

Water samples (surface and bottom water) for eDNA analyses were obtained from 20 sampling locations during the offshore survey, and the analyses conducted included invertebrates. Several invertebrate species were identified in the bottom-water samples, although these must be interpreted with caution because presence of a benthic species' DNA in the water column does not necessarily mean it is present on the adjacent seabed (for example, the DNA may originate from the planktonic larval stages of benthic species or have been transported by another animal and dispersed through physical processes). In addition, it is noted that hard-shelled organisms such as crustaceans typically shed less DNA than soft-bodied organisms. Benthic species recorded in the bottom-water samples included a variety of polychaetes, molluscs and echinoderms and a few crustaceans, as well as epifaunal species including barnacles, sea squirts and colonial epifauna. No IUCN red list taxa or PMFs were detected, although it is noted that several taxa could not be discriminated beyond family level.

The environmental baseline survey identified 15 specific sedimentary biotopes, the majority of which fall within the broad habitat of offshore subtidal sands and gravels which covers a large proportion of the offshore Project area which is estimated to be approximately 377 km^2 (57%) of the OAA and 93.27 km^2 (75%) of the offshore ECC area. The range of depths and topographic variability across the offshore Project area from 111 m depth to the shallows along the coastline are considered to be reflective of the variety of the seabed communities identified.

The taxonomic assemblage from the grab sample locations indicates that the most commonly occurring sedimentary biotopes in the OAA and offshore ECC were:

- MB3233 – *Moerella* spp. With venerid bivalves in Atlantic infralittoral gravelly sand and a variant of this habitat with a low presence of *Asbjornsenia pygmaea* followed by habitat complexes;
- MC4214 – *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment;
- MC5211 – Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand;

- MC521 – Faunal communities of Atlantic circalittoral sand; and
- MC42 – Atlantic offshore circalittoral mixed sediment.

One additional sediment habitat assemblage from the offshore ECC not found in the OAA:
- MC6215 – *Lagis koreni* and *Phaxas pellucidus* in Atlantic circalittoral sandy mud (SS5: Benthic environmental baseline report).

The predicted habitats in the OAA as well as parts of the offshore ECC are predominantly comprised of coarse sands and gravels which covers much of the region to the north-west of Orkney. An overview of the delineated habitats across the OAA and selected still images of the range of habitats present are provided in Figure 10-5. This area is characterised by areas of sand and coarse sediment, which makes it an ideal habitat for sandeels (refer to SS7: Fish and shellfish ecology baseline report). There are also benthic species that are important to commercial fisheries (further detail in SS7: Fish and shellfish ecology baseline report), such as brown crab (*Cancer pagarus*), common lobster (*Nephropidae spp*.), and scallops (*Pecten maximus*). Despite the heterogeneity of sediment communities identified from macrofaunal analysis, almost all the biotopes were representative of subtidal sands and gravels. The exception was a resemblance to the sandy mud community MC6215: *Lagis koreni* and *Phaxas pellucidus* in Atlantic circalittoral sandy mud. Circalittoral sandy mud is generally described by JNCC as being characterised by a mud fraction of >20%. In the case here, PSA has confirmed that the sand fraction was >90 % (mud <10%) at these stations and therefore the habitats present are considered to be sand (SS5: Benthic environmental baseline report). Therefore, this EUNIS biotope was considered to be another variant of the subtidal sands and gravel communities present across the offshore Project area (SS5: Benthic environmental baseline report).

In addition to the infauna-dominated sediment habitats, there were a number of epifauna- dominated habitats that resembled stony and bedrock reef. More detail on these habitats is provided in section 10.4.4.2.3.

The variety of benthic habitats present across the offshore Project area described above overall contribute significantly to the marine ecological food web, and supports sedentary filter feeding organisms (rocky substrates) and deposit feeders (sediment substrates) through to predatory invertebrates and higher trophic levels including fish species, seabirds and marine mammals. It is also considered that many of the benthic faunal groups such as molluscs, cnidarian and echinoderms have pelagic stages in their life cycle and therefore also contribute to the zooplankton assemblage and the pelagic food web. As highlighted in the Scottish Marine Energy Research (ScotMER) evidence map, the effects on these ecosystem functions are a key consideration in determining the impact significance (Scottish Government, 2023).

10.4.4.2.3 Annex I (1170) reef habitats

The circalittoral coarse sediments that were predicted to occur throughout the majority of the OAA and part of the offshore ECC were interpreted from survey data to be made up of a patchwork of mixed and coarse sediments with extensive areas of boulders and cobbles in the south-west of the OAA on the Whiten Head Bank. These rocky sediments have sedimentary and rocky components and considered to represent 'Medium' resemblance stony reef (SS5: Benthic environmental baseline report). The stony reef areas were assessed in accordance with the criteria outlined in JNCC Report No.432 (Irving, 2009) and JNCC Report No.656 by Golding *et al*. (2020).

Stony reefs were identified across the survey area, with the majority of coverage in the OAA as well as parts of the offshore ECC. A map showing the extent of 1170 Annex I reef area across the offshore Project area is provided in

Figure 10-8. The majority of the 'Low to Medium reefs' are located within the northern section of the OAA overlapping Stormy Bank whereas the 'Medium reefs' are predominantly in the southern section of the OAA overlapping the Whiten Head Bank. 'Potential Reefs' are mainly located in the offshore ECC and the western section of the OAA.

Small patches of stony reef were also observed to have associated *Sabellaria* aggregations where the habitat complex MC128: *Sabellaria* on Atlantic circalittoral rock was observed. These were discrete locations and were not considered to represent *Sabellaria* biogenic reef habitat and were instead assessed to be a component of the geogenic reef assemblage under the EUNIS habitat MC128 – *Sabellaria* on Atlantic circalittoral rock.

In addition to the stony reef area, Annex I bedrock reef habitat was identified in the offshore ECC along the landfall areas. This bedrock was associated with the habitat complex MB121: Kelp and seaweed communities on Atlantic infralittoral rock (see also Section 10.4.4.3). An overview of the Annex I reef extent across the offshore Project area is provided in Table 10-6. Overall, there is predicted to be up to 312 km^2 of Annex I reef across the offshore Project area.

The highest epibenthic biodiversity across the OAA and ECC were associated with the mixed sediment habitats which were interspersed with cobbles and boulders, constituting reef features (SS5: Benthic environmental baseline report). The conspicuous fauna included colonial forms such as bryozoans and cnidarians (including hydroids and octocorals) while species composition was dominated by molluscs, arthropods and cnidarians.

It should be noted that all areas of delineated Annex I reef in the OAA and ECC were very patchy in nature and associated with sands and gravels in almost all cases. This patchiness was most prominent in areas of 'Potential reef', 'Low' and 'Low to Medium' reef which comprised about 57% of all the delineated reef areas. The 'Medium' resemblance reef that made up the remaining 43% of the delineated Annex I reef area was concentrated in the Whiten Head Bank area and also the north-western corner of the OAA. The analysis of epifauna from the stills images revealed that all the top sites with the greatest epifaunal species diversity were from sites delineated as 'medium' resemblance reef (SS5: Benthic environmental baseline report; SS4: Benthic subtidal and intertidal baseline report). Therefore, it can be assumed that these 'Medium' reef areas are of a higher biodiversity value. An example photograph outlining the most biodiverse station across the offshore Project area (Station S10), located in an area of 'Medium' resemblance reef in the OAA) is provided in Figure 10-7.

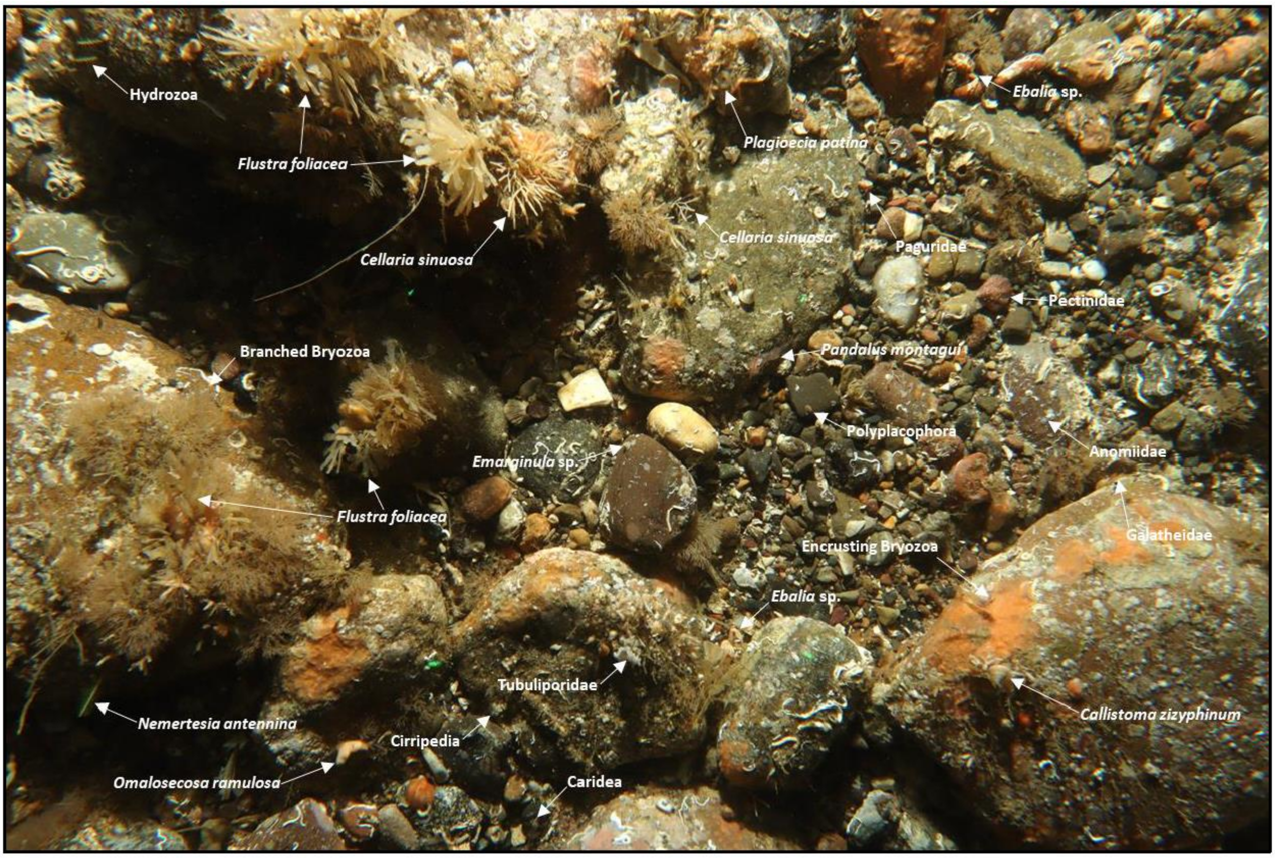

Figure 10-7 Example still photograph taken at Station OAA_S10 - the station with the most biodiverse epifauna in offshore Project area (SS5: Benthic environmental baseline report).

These reef features present in the offshore Project area not only play an important role in ecosystem function as a direct habitat for epilithic species to colonise, but also provide shelter from predators and foraging habitat for mobile epifauna such as crustaceans, molluscs and echinoderms which are in turn important prey items demersal fish species including whiting, ling, Norway pout and skate and anglerfish, many of which are commercially important and/or have conservation value (SS5: Benthic environmental baseline report; SS7: Fish and shellfish ecology baseline report).

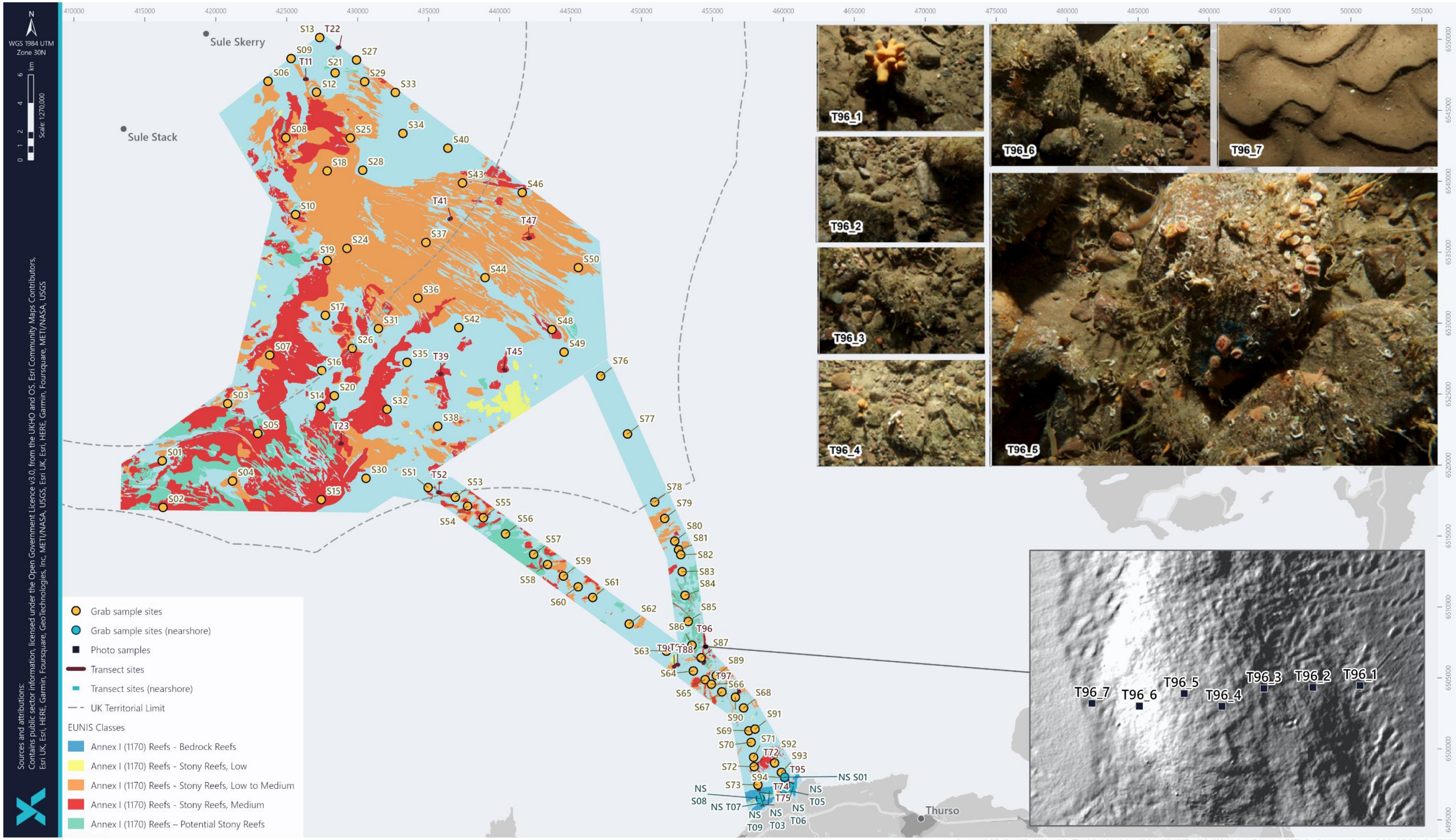

Figure 10-8 1170 Annex I reef extent across the offshore Project area (SS5: Benthic environmental baseline report)

It is noteworthy that in addition to reefs, the intertidal survey also identified potential presence of Annex I habitat 'submerged or partially submerged sea caves', and PMFs 'kelp beds' and 'kelp and seaweed communities on sublittoral sediment' (SS6: Intertidal survey habitat assessment).

Table 10-6 Extent of Annex I 1170 Reef habitat across the offshore Project area

ANNEX I (FROM PROJECT SPECIFIC SURVEY DATA)	AREA WITHIN OAA (KM^2)	% OF OAA	AREA WITHIN OFFSHORE ECC (KM^2)	% OF OFFSHORE ECC	TOTAL OAA & OFFSHORE ECC (KM^2)	% OF TOTAL AREA
Annex I (1170) reefs – bedrock reefs	0.00	0.00	2.60	2.09	2.60	0.33
Annex I (1170) reefs – potential stony reefs	29.87	4.55	12.55	10.07	42.42	5.43
Annex I (1170) reefs – stony reefs, low	6.29	0.96	0.31	0.25	6.61	0.85
Annex I (1170) reefs – stony reefs, low to medium	116.75*	17.77	8.90	7.14	125.65	16.06
Annex I (1170) reefs – stony reefs, medium	126.91	19.34	7.37	5.91	134.28	17.17
Total	279.82	42.62	31.74	25.46	311.56	39.8
*Calculated based on rugosity study – see below.						

Rugosity Study to refine area of 'low to medium' reef

In an attempt to provide further information on the characteristics and patchiness of the "Low to Medium" resemblance stony reefs within the OAA, a Vector Ruggedness Measure (VRM) was utilised to create a seabed roughness model, termed rugosity.

The model, created in ESRI's Geographic Information Systems (GIS) software ArcGIS, provided indicative trends with regard to seabed variability and was used to model the variability within the delineated area of the large area of 'Low to Medium' reef identified in the north and east of the OAA (Figure 10-9). The approach aimed at quantifying and further differentiating between areas of 'reef features likely present' and 'reef features likely absent'. The value intervals were based on the ground truthing imagery and grab samples and divided into three categories of interpretation, category I represents the reef features likely absent whereas categories II and III represented 'reef features likely present' (Table 10-7).

Table 10-7 VRM model intervals

VRM VALUES (UNITLESS)	ID	% OF OAA	CATEGORY
0.000001073 – 0.000045		Reef Features Likely Absent	I
0.000045 – 0.00023		Reef Features Likely Present	II
0.00023 – 0.0027		Reef Features Likely Present	III

The produced model indicates that variability can be tied to stony reefs, to an extent. While it is not possible to delineate between the Low and Medium resemblance, mainly due to patchiness being a natural progression, the VRM indicates that the flattest areas i.e. lowest variability, Category I (blue), are unlikely to be reefs. Category II (yellow) are areas interpreted as likely to be associated with reefs. Category III (red), also likely to be associated with reefs, is interpreted to represent mottled seabed features, as noted in the SSS, and where rapid variations on a small scale were further noted in the MBES data (SS5: Benthic environmental baseline report).

The rugosity study illustrates the high degree of variability across this area and helps put into context the likely extent of 'Low to Medium' reef. Of particular note, there was a relatively high extent of the Category I (blue) representing low variability and low reef potential.

The extrapolated and delineated seabed surface assessed as Low and Medium stony reefs resemblance covered an area of approximately 156 km^2. The reef features within this area are patchy a delineation on that level was not feasible. The rugosity, and the inherent variability interpreted to be associated with the ground-truthed stony reefs, indicates that the likely coverage of stony reefs within this area is approximately 93 km^2, 60 % of the area.

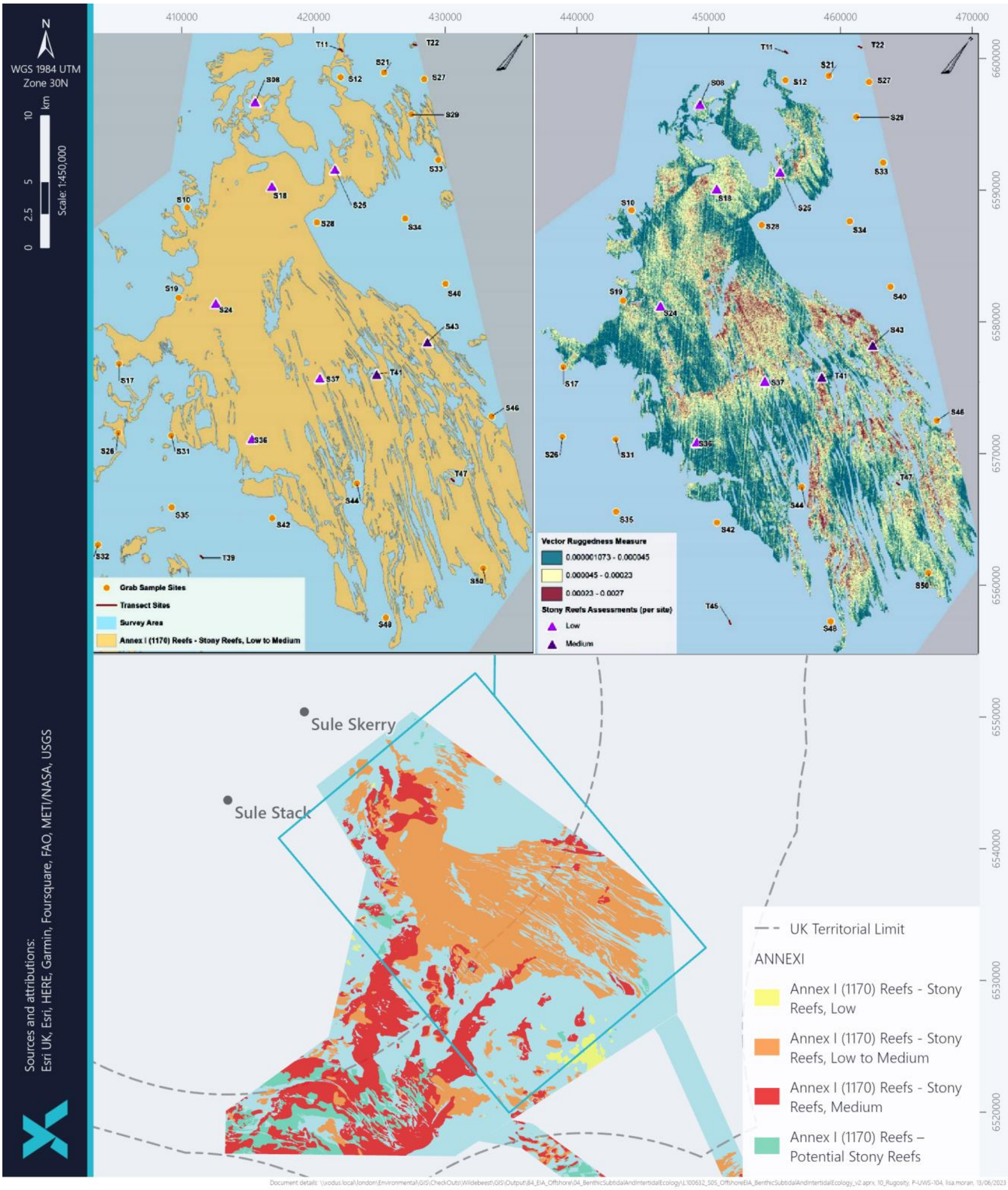

Figure 10-9 VRM rugosity model superimposed on classified habitats in the OAA (see SS5: Benthic environmental baseline report)

10.4.4.2.4 Non-native species

One non-native taxon was identified during the baseline survey; the polychaete *Goniadella gracilis* was identified at 23 different grab sampling locations with a total of 80 individuals. The species was described from eastern North America, and the first British records are from 1970 in Liverpool Bay (Eno *et al*., 1997; SS5: Benthic environmental baseline report).

10.4.4.3 PMFs

The presence of the PMF species and OSPAR Threatened and/or Declining Species ocean quahog was confirmed by the site-specific survey. Juvenile ocean quahog were recorded across the OAA and offshore ECC area and two adult specimens were recorded in the offshore ECC (SS5: Benthic environmental baseline report). This corroborated the desk-based study which identified one existing record of the ocean quahog (*Arctica islandica*) within the OAA and 16 existing records within the offshore ECC (Figure 10-10) (Marine Scotland, 2023a).

Offshore sands and gravels are also a PMF. All sediment habitats identified in the offshore Project area can be considered to represent PMF offshore sands and gravel habitat.

Kelp beds were also present in the nearshore areas of the offshore ECC, associated with exposed areas of bedrock, corresponding to the biotope EUNIS habitat MB121 – kelp and seaweed communities on Atlantic infralittoral rock (SS5: Benthic environmental baseline report; SS6: Intertidal survey habitat assessment).

It is worth noting that a single juvenile horse mussel (*Modiolus modiolus)* specimen was identified in the site specific survey. No adults were identified and there was no evidence of aggregations of this species (SS5: Benthic environmental baseline report).

In addition to these PMFs discussed above, two SBL species were identified in the site specific survey. These were the hydroid species sea tamarisk (*Tamarisca tamarisca*), which was observed at four sample stations and the gastropod snail (*Ceratia proxima)* which was observed at one station.

10.4.4.4 Designated sites

The nearest marine protected area is the North-West Orkney NCMPA located approximately 11.5 km to the northeast of the OAA (Figure 10-10). The NCMPA is designated for its importance to biodiversity (sandeels) and geodiversity (marine geomorphology of the Scottish Shelf Seabed including sandbanks and sand and sediment wave fields) (JNCC, 2017).

The Solan Bank Reef SAC is located approximately 25 km to the west of the OAA (Figure 10-10). The site is designated for two types of Annex I reef habitat, bedrock and stony reef. The reef is situated on a geological feature known as 'Solan Bank High', and the bedrock provides an underwater landscape of sea cliffs reaching approximately 10 m in height (JNCC, 2023).

The areas of bedrock and stony reef in the Solan Bank Reef SAC that had the highest biodiversity were those with highest relief from the seabed and away from the effects of scour from the surrounding course sediment (Whomersley *et al.*, 2010). The outcropping bedrock supports Kelp and foliose red seaweed in the shallowest areas of the infralittoral (<28m to 48 m depth). The most frequent epibenthic assemblage is dominated by encrusting fauna such as byozoans with coralline red algae in shallower areas. These areas of high relief had an associated higher diversity of bryozoan and hydrozoan turf species and were often characterised by increasing abundance of dead man's fingers (*Alcyonium digitatum)*, Devonshire cup coral (*Caryophyllia smithii)*, Jewel anemone *Corynactis viridis* and plumose anemone (Metridium *senile*) (Whomersley *et al.*, 2010). In areas less dominated by bryozoans, brittlestars such as *Ophiocomina nigra* and *Ophiothrix fragilis* were prominent (Whomersley *et al.*, 2010). There was no evidence that the rich epifaunal assemblages reported from surveys in the Solan Bank Reef SAC were present in the OAA or offshore ECC.

It is worth reiterating that the areas of low relief bedrock were observed to be strongly affected by scour from the surrounding sediments which resulted in a much lower level of faunal biodiversity (Whomersley *et al.*, 2010). This observation is analogous to the low relief stony reefs in the offshore Project area which were recorded in the site specific survey to be subject to scour and observed to contain lower biodiversity than the more diverse examples observed in from the Solan Bank Reef SAC. Therefore, the Annex I reef in the offshore Project area is considered similar to the lower lying rocky areas of the Solan Bank Reef SAC that are subject to scour with a more impoverished biodiversity.

The Ushat Head SSSI is located on the north Caithness coasts and is immediately adjacent to a potential landfall but lies outwith of the benthic ecology study area (Figure 10-10; NatureScot, 2023). The site is designated for heathers and creeping willow *Salix repens* which are the main dwarf shrubs. In addition, Scottish primrose (*Primula scotica)*, small-fruited yellow sedge (*Carex viridula)*, Roseroot (*Sedum rosea)* and kidney vetch (*Anthyllis vulneraria)* are abundant. Maritime species including spring squill (*Scilla verna)*, sea campion (*Silene uniflora)* and sea plantain (*Plantago maritima)*. It should be noted that no Project works will occur within the SSSI. Other SSSIs are located within the wider study area (Strathy Coast, Red Point Coast, Sandside Bay, Holborn Head and Pennylands) and are designated for maritime cliffs, saltmarsh and/or other terrestrial features.

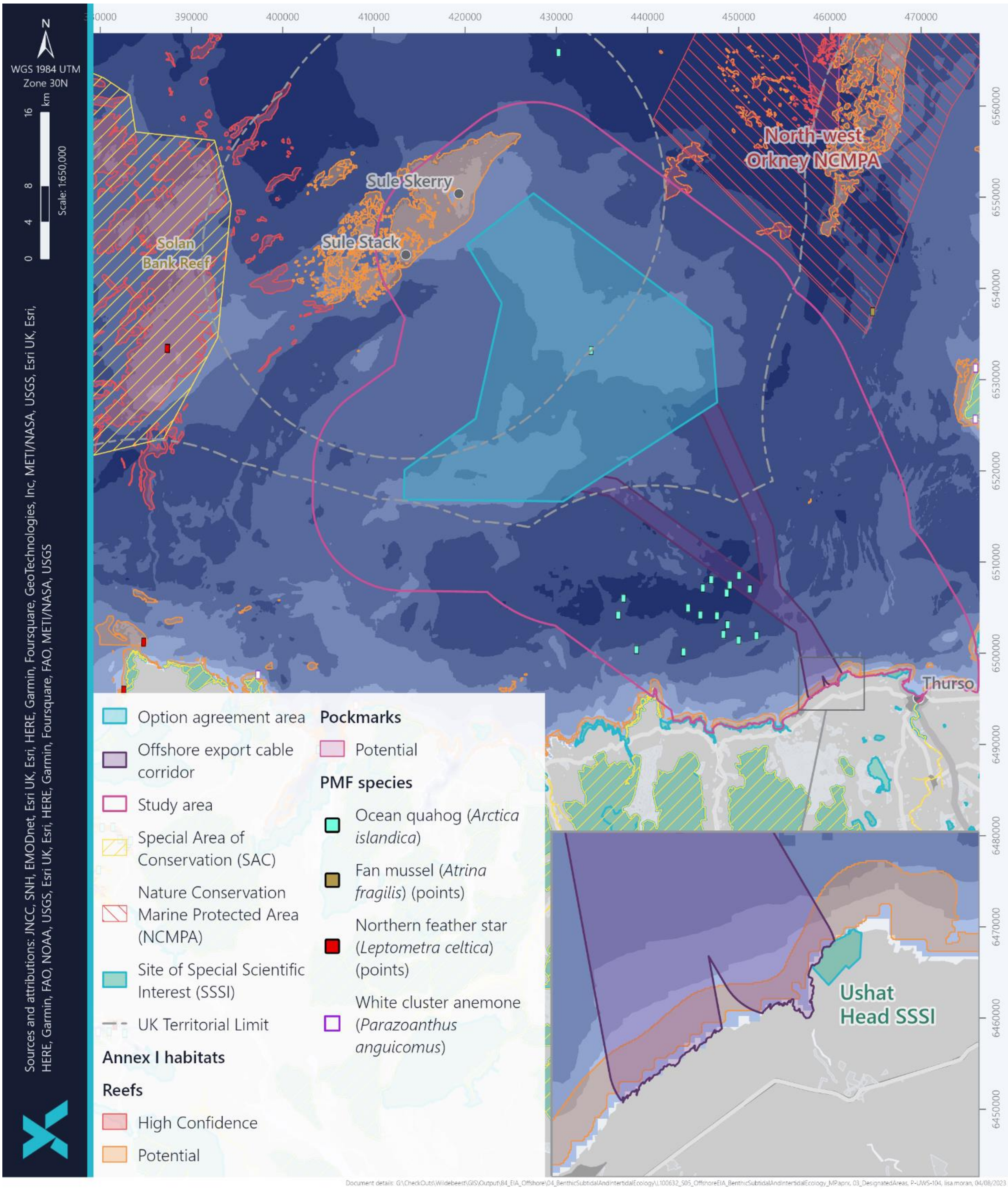

Figure 10-10 Designated sites, Annex I habitats and PMF species (Marine Scotland, 2023a)

10.4.4.5 Summary of key receptors

The key receptors including benthic species and habitat are detailed in Table 10-8, along with their key sensitivities and recoverability. The sensitivities used for this impact assessment have been largely drawn from the Marine Evidence based Sensitivity Assessment (MarESA) accessed via the MarLIN website and supplemented by the Feature Activity Sensitivity Tool (FeAST). MarESA sensitivity assessments are provided for a range of biotopes, whereas the FeAST tool focusses on features of NCMPAs.

Table 10-8 Key species/habitats and their associated sensitivity and recoverability

RECEPTOR	DESIGNATION(S)	ASSOCIATED BIOTOPES	LOCATION (OAA, OFFSHORE ECC)	SENSITIVITY	RECOVERABILITY
Annex I (1170) bedrock reefs	Habitats Directive	• Atlantic infralittoral rock (MB12).	Offshore ECC	• No specific data in MarLIN on this receptor. Expected to be similar to Annex I stony reef as per below.	• No specific data in MarLIN on this receptor. Expected to be similar to Annex I Stony Reef as per below.
Annex I (1170) stony reefs	Habitats Directive	• Atlantic offshore circalittoral mixed sediment (MD42); • Atlantic circalittoral rock (MC12); and • *Sabellaria* on Atlantic circalittoral rock (MC128).	OAA and offshore ECC	From MarESA (MarLIN, 2023a): • Moderate sensitivity to substratum loss and displacement; • Low sensitivity to abrasion / disturbance of the surface of the substratum or seabed; • Low sensitivity to smothering; and • Very low sensitivity to increased suspended sediments).	• High intolerance but high recoverability to substratum loss; • High recoverability to abrasion / disturbance of the surface of the substratum or seabed; and • Low to moderate intolerance to suspended sediment and smothering with high to very recoverability (MarLIN, 2023a).
Offshore subtidal sands and gravels	• PMF • SBL	• Atlantic offshore circalittoral mixed sediment (MD42); • Faunal communities of Atlantic circalittoral sand (MC521); • *Moerella* spp. With venerid bivalves in Atlantic infralittoral gravelly sand (MB3233) (MarLIN, 2023b); • *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment (MC4214) (MarLIN, 2023c); • *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment (MC2211); • *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212) (MarLIN, 2023d); • *Echinocyamus pusillus*, Ophelia borealis and *Abra prismatica* in circalittoral fine sand (MC4212) (MarLIN, 2023e); • *Branchiostoma lanceolatum* in Atlantic circalittoral coarse sand with shell gravel (MC3215) (MarLIN, 2023f); • *Hesionura elongata* and *Microphthalmus similis* with other interstitial polychaetes in Atlantic infralittoral mobile coarse sand (MB3234) (MarLIN, 2023g); and • Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand (MarLIN, 2023h); and	OAA and offshore ECC	From MarESA (MarLIN, 2023c) • High sensitivity to physical change (to another sediment type); • Low sensitivity to increase in suspended sediment; • Low sensitivity to abrasion and physical disturbance; and • Low to medium sensitivity to light and heavy smothering. From FeAST (Marine Scotland, 2023b) • Medium sensitivity to Disturbance of substratum surface; and • High sensitivity to substrata removal.	• No resistance and very low resilience to physical change (to another sediment type); • Medium resistance and high resilience to increase in suspended sediment; • Medium resistance and high resilience to abrasion and physical disturbance; and • Medium resistance and high to medium resilience to light and heavy smothering (MarLIN, 2023c).

RECEPTOR	DESIGNATION(S)	ASSOCIATED BIOTOPES	LOCATION (OAA, OFFSHORE ECC)	SENSITIVITY	RECOVERABILITY
		• *Lagis koreni* and *Phaxas pellucidus* in Atlantic circalittoral sandy mud (MC6215) (MarLIN, 2023j).			
Kelp beds	• PMF under A3.115 Laminaria hyperborea with dense foliose red seaweeds on exposed infralittoral rock • Blue carbon habitat[6]	• Kelp and seaweed communities on Atlantic infralittoral rock (MB121).	Offshore ECC	From MarESA (MarLIN, 2023h): • High sensitivity to habitat change; • Medium sensitivity to abrasion / disturbance of the surface of the substratum or seabed; • Not sensitive to light smothering, and low sensitivity to heavy smothering; and • High sensitivity to introduction or spread of INNS. From FeAST (Marine Scotland, 2023b): • Medium Sensitivity to introduction or spread of non-indigenous species and translocations; • Low sensitivity to substrata surface disturbance; and • Medium sensitivity to sub-surface disturbance or penetration.	• No resistance and very low resilience to habitat change; • Medium resilience and low resistance to abrasion / disturbance of the surface of the substratum or seabed; • High resilience and resistance to light smothering and medium resilience and high resistance to heavy smothering; and • Low resistance and very low resilience to introduction or spread of INNS (MarLIN, 2023h).
Ocean quahog	• OSPAR Convention's List of Threatened and/or Declining Species and Habitats • PMF species	• Atlantic offshore circalittoral mixed sediment (MD42); and • Faunal communities of Atlantic circalittoral sand (MC521).	OAA and offshore ECC	From MarESA (MarLIN, 2023i): • High sensitivity to physical change (to another sediment type); • High sensitivity to habitat structure changes – removal of substratum (extraction); • High sensitivity to abrasion / disturbance of the surface of the substratum or seabed; • Not sensitive to light or heavy smothering; and • No evidence of sensitivity level to the introduction or spread of INNS (MarLIN, 2023i). From FeAST (Marine Scotland, 2023b); • High Sensitivity to the introduction of non-indigenous species and translocations. • Medium sensitivity to disturbance of substratum surface; • High sensitivity to the disturbance of substratum subsurface; • High sensitivity to substrata removal; • High sensitivity to another seabed type; • Medium sensitivity to high siltation changes; and	• Low resistance and very low resilience to physical change (to another sediment type); • No resistance and very low resilience to habitat structure changes – removal of substratum (extraction); • Low resistance and very low resilience to abrasion / disturbance of the surface of the substratum or seabed; • High resilience and resistance to light and heavy smothering; and • No evidence of resistance to the introduction or spread of INNS (MarLIN, 2023i).

[6] *Blue carbon refers to the ability of coastal or marine habitats to capture and store atmospheric carbon dioxide. Plants, calcifying organisms, and sediments can sequester and store carbon, in both the short term (i.e. plants) and long term (i.e. reefs and deep-sea sediments).*

RECEPTOR	DESIGNATION(S)	ASSOCIATED BIOTOPES	LOCATION (OAA, OFFSHORE ECC)	SENSITIVITY	RECOVERABILITY
				• Not sensitive to low siltation changes.	
Octocorallia	SBL	• Atlantic offshore circalittoral mixed sediment (MD42); and • Atlantic circalittoral rock (MC12).	OAA, offshore ECC	From MarESA (MarLIN, 2023j): • Moderate sensitivity to substratum loss; • Low sensitivity to smothering; • Very low sensitivity to increased suspended sediment; and • Moderate sensitivity to displacement (MarLIN 2023j).	• High recoverability from substratum loss; • High recoverability from smothering; • Very high recoverability to increased suspended sediment; and • High recoverability to displacement (MarLIN 2023j).
Sea tamarisk *(Tamarisca tamarisca)*	SBL	• Atlantic circalittoral rock (MC12).	OAA, offshore ECC	No data	No data
Ceratia proxima	SBL	-	Offshore ECC	No data	No data

10.4.5 Future baseline

In the absence of the offshore Project, the future benthic ecology environment at the offshore Project is likely to experience long term changes as a result of a combination of climatic (e.g. rising sea temperatures) and non-climatic factors (e.g. fishing pressure), which may in fact interact and influence responses to climate change (Moore and Smale, 2020). Climate change is leading to increases in ocean temperature, changes to ocean chemistry, sea-level rise, changing salinities and oceanographic patterns and increased extreme events including storminess and marine heatwaves (Stocker, 2013).

In the long term, climate change is predicted to result in increased sea temperatures, changed ocean chemistry, sea-level rise, changed salinities and oceanographic patterns and an increased frequency of extreme events including storms and heatwaves (Hughes *et al.*, 2018). The predicted rise in sea temperatures may result in an increased abundance of warm-water species and a decline in cold-water species, with associated shifts in abundances and species composition (Moore and Smale, 2020). An example includes the increase in warmer-water kelp species *Lamnaria ochroleuca* in the Western English Channel which now competes with *L. hyperborea* (Smale *et al.*, 2015).

A description of the future baseline of the offshore Project in terms of climate change and the potential effects from climate change to the biological environment, including benthic ecology receptors, is included in the Climate and carbon assessment (SS1: Climate and carbon assessment).

10.4.6 Summary and key issues

Table 10-9 Summary and key issues for benthic ecology

SUMMARY AND KEY ISSUES

OFFSHORE PROJECT AREA

Offshore and nearshore habitats

Analysis of geophysical data and drop down camera identified five EUNIS (Level 3) habitats across the offshore and nearshore area and two EUNIS level 4 habitat complexes as follows:

- Atlantic infralittoral rock (MB12);
  - Habitat complex- Kelp and seaweed communities on Atlantic infralittoral rock (MB121).
- Atlantic circalittoral rock (MC12);
- Atlantic circalittoral coarse sediment (MC32);
- Atlantic circalittoral sand (MC52); and
- Atlantic circalittoral mixed sediment (MC42).

Further refinement assigned sediment EUNIS habitats based on the grab sampling results. This process identified ~16 EUNIS habitats which are associated with the infaunal and epifaunal assemblages identified from the benthic taxonomy. These were reflective of the broad habitats identified from the initial camera based habitats assessment.

Intertidal habitats

- Littoral rock was the dominant intertidal habitat;
- There was a variety of littoral rock EUNIS biotopes assigned based on the level of wave exposure (ranging from low to high) and zonation along the shore from low spring tide to the strand line;
- The biotopes indicated full range of rocky shore macroalgae zonation;
- Greeny Geo had the most exposed, high energy sites; and
- Limited littoral coarse sediment (shingle and gravel shores) which were restricted to sheltered areas, especially inlet at Crosskirk survey area.

Key conservation habitats & species

- Ocean quahog (PMF, OSPAR threatened or declining species);
- Offshore Subtidal Sands and Gravels (PMF, SBL Habitat);
- Stony and bedrock reef (Annex I);
- Kelp beds (PMF);
- Octocorallia (e.g. *Alcyonium digitatum*) (SBL);
- Hydroid, *Tamarisca tamarisca* (SBL taxa); and
- Gastropod, *Ceratia proxima* (SBL Taxa).

10.4.7 Data limitations and uncertainties

OWPL has undertaken a comprehensive site specific environmental survey campaign using a combination of geophysical data acquisition, ground-truthed with camera stills and transects and sediment grab sampling within the offshore Project area (see section 10.4.3 and 10.4.4 for further detail). As such, it is not considered that there are any data limitations or uncertainties.

ScotMER:

The scope of the benthic subtidal and intertidal ecology assessment undertaken for the West of Orkney Windfarm offshore wind project directly addresses and will provide useful data to inform some of the key research themes identified by the ScotMER benthic receptor group[7], including:

- Species or feature distribution; data – extensive Project specific surveys and associated analysis (including novel rugosity analysis) have allowed detailed mapping of seabed features, habitats and species distribution.
- Impacts on ecosystem function – Potential ecosystem effects have been an integral aspect of the EIA.
- Impact of changes in current flow on benthic communities – A Project specific numerical model 'The West of Orkney model' was developed as part of the marine physical and coastal processes assessment. The results of this modelling have informed the benthic and subtidal ecology assessment.
- EMF impacts – EMF calculations undertaken by a cable contractor have informed the assessment of EMF effects.

10.5 Impact assessment methodology

10.5.1 Impacts requiring assessment

The impacts identified as requiring consideration for benthic ecology are listed in Table 10-10. Information on the nature of impact (i.e. direct or indirect) is also described.

Table 10-10 Impacts requiring assessment for benthic ecology

POTENTIAL IMPACT	NATURE OF IMPACT
Construction (including pre-construction) and decommissioning*	
Temporary habitat loss / disturbance	Direct/indirect
Increased suspended sediment concentrations and sediment deposition	Direct/indirect

[7] https://www.gov.scot/publications/benthic-species-specialist-receptor-group/.

POTENTIAL IMPACT	NATURE OF IMPACT
Increased risk of introduction and spread of INNS	Direct/indirect
Removal of hard structures during decommissioning	Direct
Operation and maintenance	
Temporary habitat loss / disturbance	Direct
Long-term loss or damage to benthic habitats and species	Direct
Increased suspended sediment concentrations and sediment deposition	Direct/indirect
Colonisation of hard structures	Direct
Changes in physical processes	Direct/indirect
Impact to benthic communities from any thermal load or EMF arising from the cable during operation	Direct
Introduction and spread of INNS	Direct/indirect
** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the offshore Project considered analogous with, or likely less than, those of the construction stage. Where this is not the case, decommissioning impacts have been listed separately and have been assessed in section 10.6.3.*	

10.5.2 Impacts scoped out of the assessment

The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 10-11.

Table 10-11 Impacts scoped out for benthic ecology

IMPACT SCOPED OUT	JUSTIFICATION
Construction (including pre-construction) and decommissioning	
Accidental release of pollutants	Accidental releases of pollutants are limited to oil and fluid spills from vessels associated with the Project. Embedded mitigation measures will be adopted to ensure that the potential for release of contaminants is minimised. In this manner, accidental release of

IMPACT SCOPED OUT	JUSTIFICATION
	potential contaminants from construction vessels will be strictly controlled and procedures will be in place to minimise the impact of any accidental release if it occurs. Hence the impact has been scoped out of the EIA.
Release of sediment bound contaminants	The Environmental Baseline Survey (EBS) (SS5: Benthic environmental baseline report) has demonstrated there is no existing sediment contamination, and the findings of chapter 9: Water and sediment quality concur with the conclusion that there is no existing sediment contamination within the offshore Project area. Therefore the associated effects on benthic ecology have been scoped out.
Operation and maintenance	
Accidental release of pollutants	Accidental releases of pollutants are limited to spills of oils and fluids contained within the WTGs or from vessels associated with the Project. The only reasonably feasible scenario for release of pollutants from offshore infrastructure would be a slow leak of fluids; however, the volume would be undetectable, rapidly dispersed and remedied immediately. Embedded mitigation measures will be adopted to ensure that the potential for release of contaminants is minimised. In this manner, accidental releases of potential contaminants from construction vessels will be strictly controlled and procedures will be in place to minimise the impact of any accidental release if it occurs.
Impacts from the release of sediment bound contaminants	The EBS has demonstrated there is no existing sediment contamination, and the findings of chapter 9: Water and sediment quality concur with the conclusion that there is no existing sediment contamination within the offshore Project area. Therefore the associated effects on benthic ecology have been scoped out.

10.5.3 Assessment methodology

An assessment of potential impacts is provided separately for the construction, operation and maintenance and decommissioning stages. The assessment for benthic ecology is undertaken following the principles set out in chapter 7: EIA methodology. The sensitivity of the receptor is combined with the magnitude to determine the impact significance. Topic-specific sensitivity and magnitude criteria are assigned based on professional judgement, as described in Table 10-12 and Table 10-13.

The process for defining sensitivity follows the MarESA and FeAST sensitivity assessments (summarised in Table 10-8), and where applicable, correlates resistance and recoverability to categorise sensitivity. The findings of the marESA and FeAST sensitivity assessments are then considered alongside the value of the receptor for the judgement of overall sensitivity. In addition, the ScotMER evidence map was consulted which summarises and prioritises evidence gaps identified by the Benthic Species ScotMER Receptor Group in relation to the development of offshore wind and marine renewables (Scottish Government, 2023).

Table 10-12 Sensitivity criteria

SENSITIVITY OF RECEPTOR	DEFINITION
High	• The receptor has a very low capacity to accommodate a particular effect with a low ability to recover or adapt; • The receptor has high vulnerability and low recoverability to accommodate a particular effect; • The receptor is of national importance and listed as a qualifying feature of a protected site, and or a primary reason for the selection of a protected site; • The species is listed on Annex IV of the European Union (EU) Habitats Directive as a European Protected Species and/or is a qualifying interest of a SAC and a significant proportion of the national population (>1%) is found within the offshore Project; and/or • The receptor is of very high (International) importance or rarity, e.g. listed on Annex I (habitats) or Annex II (Species) of the EU Habitats Directive and/or those listed on the OSPAR Convention's List of Threatened and Declining Species and Habitats, IUCN Red List of Threatened Species (the 'Red List') including those listed as endangered or critically endangered and/or a significant proportion of the international population (> 1%) is found within the offshore Project.
Medium	• High to Medium importance and rarity, a regional receptor with some capacity to absorb or accommodate change without significantly altering character. However some damage to the receptor is anticipated to occur; and/or • The receptor may be of least concern on the IUCN Red List, listed in the post-2010 biodiversity Framework (previously UK BAP), PMF, SBL, and/or a significant proportion of the regional population (> 1%) is found within the offshore Project.
Low	• Low or medium importance and rarity and the receptor is considered tolerant to change without significant detriment to its character; some limited or minor change may occur; and/or • The receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.
Negligible	• Very low importance and rarity, local receptor and is tolerant to change with no effect on its fundamental character.

Table 10-13 Magnitude criteria

MAGNITUDE CRITERIA	DEFINITION
High	• The impact occurs over a large spatial extent resulting in widespread, long-term, or permanent changes in baseline conditions or affecting a large proportion of receptor extent or population. The impact is very likely to occur and/or will occur at a high frequency or intensity.
Medium	• The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions or affects a moderate proportion of a receptor extent or population. The impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	• The impact is localised and temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor extent or population. The impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	• The impact is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or receptor population. The impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.

The consequence and significance of effect is then determined using the matrix provided in chapter 7: EIA methodology.

10.5.4 Embedded mitigation

As described in chapter 7: EIA methodology, certain measures have been adopted as part of the Project development process in order to reduce the potential for impacts to the environment, as presented in Table 10-14. These have been accounted for in the assessment presented below. The requirement for additional mitigation measures (secondary mitigation) will be dependent on the significance of the effects on benthic ecology receptors.

Table 10-14 Embedded mitigation measures relevant to benthic ecology

MITIGATION MEASURE	FORM (PRIMARY OR TERTIARY)	DESCRIPTION	HOW MITIGATION WILL BE SECURED
Site selection	Primary	The offshore Project, including the OAA and offshore ECC, avoids any overlap with protected sites designated for benthic or intertidal features.	Already secured through the OAA and offshore ECC boundaries.

MITIGATION MEASURE	FORM (PRIMARY OR TERTIARY)	DESCRIPTION	HOW MITIGATION WILL BE SECURED
Landfall installation methodology	Primary	Landfall installation methodology (HDD) will avoid direct impacts to the intertidal area.	Landfall installation methodology will be detailed within the Construction Method Statement (CMS), required under Section 36 Consent and/or Marine Licence conditions.
Environmental Management Plan (EMP)	Tertiary	The development of, and adherence to, an EMP covering pollution prevention, biosecurity and waste management. A Marine Pollution Contingency Plan (MPCP) and INNS management plan will be included within the EMP. The INNS management plan will indicate whether there is a risk of INNS. Further monitoring will only take place if the risk assessment indicates there is a potential issue.	The production and approval of an EMP, including the MPCP and INNS management plan, will be required under Section 36 Consent and/or Marine Licence conditions. An outline EMP is provided as part of the offshore application in OP1: Outline Environmental Management Plan. The outline INNS management plan is contained within the outline EMP.
Consideration of benthic ecology features for final layout	Primary	Consideration of benthic ecology features as part of the constraints mapping exercise, and subsequent micro-siting exercises, to inform final locations of WTGs and associated offshore infrastructure including inter-array cables and offshore export cable routes. The final offshore Project layout will be presented within the Development Specification and Layout Plan (DSLP) and Cable Plan (CaP).	Final layout will be captured in the DSLP, a condition of the Section 36 Consent and/or Marine Licence conditions.
Cable protection	Primary	Suitable implementation and monitoring of cable protection (via burial or external protection). Cables will be buried as the first choice of protection. External cable protection will be used where adequate burial cannot be achieved and this will be minimised as far as is practicable. This	Final cable design will be informed by the CBRA and detailed within the CaP, required under Section 36 Consent and/or Marine Licence conditions.

MITIGATION MEASURE	FORM (PRIMARY OR TERTIARY)	DESCRIPTION	HOW MITIGATION WILL BE SECURED
		will be informed by a CBRA undertaken post consent, following results of the geotechnical survey. Burial or protection of cables increases the distances between cables and benthic subtidal and intertidal ecology receptors, reducing EMF effects.	
Decommissioning Programme	Tertiary	The development of, and adherence to, a Decommissioning Programme, approved by Scottish Ministers prior to construction and updated throughout the Project lifespan.	The production and approval of a Decommissioning Programme will be required under Section 105 of the Energy Act 2004 (as amended).

10.5.5 Worst case scenario

As detailed in chapter 7: EIA methodology, this assessment considers the worst case parameters for the offshore Project which are predicted to result in the greatest environmental impact, known as the 'worst case scenario'. The worst case scenario represents, for any given receptor and potential impact, the design option (or combination of options) that would result in the greatest potential for change.

Given that the worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, the development of any alternative options within the design parameters will give rise to no worse effects than those assessed in this impact assessment. Table 10-15 presents the worst case scenario for potential impacts on benthic ecology during construction, operation and maintenance, and decommissioning.

Table 10-15 Worst case scenario specific to benthic ecology receptor impact assessment

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Construction		
Temporary habitat loss / disturbance	Up to 69.1 km^2 of temporary habitat disturbance and loss associated with: • Seabed preparation: – Unexploded Ordnance (UXO) clearance requiring detonation of up to 22 targets over 22 days; – Disturbance over 30.4 km^2 from boulder clearance across the offshore Project, including for the WTG and Offshore Substation Platforms (OSPs), and along the full length of all cables (at a width of 30 m per cable) (this area will also encompass the disturbance from pre-lay grapnel run along the entire length of all cables at a width of 2 m per cable); and – Maximum bedform clearance[8] along the inter-array and interconnector cables at a width of 150 m (inter-array cables = 3.4 km^2, interconnector cables = 2.9 km^2), and bedform clearance along the offshore export cables at a width of 1,000 m (area = 19.2 km^2); – Maximum bedform clearance required for WTG and OSP suction bucket foundation installation over 0.22 km^2. • Offshore export cables:	Largest spatial area and duration of habitat disturbance and loss during construction. The total area of habitat disturbance or loss for the cables has been calculated based on the 50 m widths of seabed disturbance associated with cable burial / installation in addition to areas of bedform clearance. Any seabed disturbance associated with the boulder clearance and pre-lay grapnel run would be located within these areas. It has been assumed that up to two jack-up events will be required per WTG. It has been assumed that the offshore export cables, inter-array cables and interconnector cables will be trenched and buried along the majority of their length and will therefore incur a temporary disturbance. Sections of these cables that are proposed to be protected with rock material are considered under long term impacts.

[8] *Bedforms include sandwave bedforms, bedform fields comprising of sand and gravel, megaripples and rippled scour depressions which are present in different areas across the offshore Project area (see chapter 8: Marine physical and coastal processes for further information).*

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	– Seabed disturbance associated with installation of up to five offshore export cable with a total length of 320 km and a worst case seabed disturbance width of 50 m = 16 km^2; • Inter-array cables: – Seabed disturbance associated with installation of up to 140 inter-array cables, with a total length of 500 km and a worst case seabed disturbance width of 50 m = 25 km^2. • Interconnector cables: – Seabed disturbance associated with installation of up to six interconnector cables with a total length of 150 km and a worst case seabed disturbance width of 50 m = 7.5 km^2; • Landfall: – Maximum of six HDD exit pits (five plus one spare) each of an area of 300 m^2 (totalling 1,800 m^2), at a water depth of approximately 10 - 40 m below Lowest Astronomical Tide (LAT) (approximately at a minimum of 100 m offshore from 0 mLAT). • Jack-up vessels on site at for 125 WTGs and five OSPs, each with a seabed footprint of 270 m2 x 6 jack-up legs = 0.42 km^2; • Anchoring vessel seabed disturbance = 0.03 km^2; • Maximum seabed footprint for ancillary equipment, including mooring systems for Heavy Lift Vessels (HLVs) = 0.00003 km^2; and • Intermittent disturbance over the four year construction period, (with an additional year of seabed preparation activities such as UXO clearance and boulder clearance), lasting approximately 40 months.	10m water depth of HDD exit pit is assumed worst case in the event as that will have the highest potential to affect nearshore benthic habitats that extent to the intertidal such as Kelp and seaweeds associated with bedrock.
Increased suspended sediment	The worst case scenario with regards to this impact is presented in chapter 8: Marine physical and coastal processes.	This covers the largest spatial area of impact associated with seabed clearance activities, WTG, OSP, and cable installation activities (including scour and remedial cable protection

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
concentrations and deposition		measures). The areas of impact associated with each activity is presented separately although in reality these footprints will overlap considerably. Maximum volumes of sediment to be cleared and volumes of rock protection are also provided. The maximum dimensions of WTG and OSP foundations are also given, including maximum drilling parameters.
Increased risk of introduction and spread of INNS	Maximum number of construction vessels during construction at any one time = 30. Up to 101 different vessels will be used across the construction period.	Maximum number of vessels transiting (potentially from waters outside of the UK) to and/or releasing ballast water within the offshore Project area during construction potentially introducing INNS. Another potential pathway for the INNS is the towing of infrastructure to the offshore Project area
Operation and maintenance		
Temporary habitat loss / disturbance	The temporary impact during operation and maintenance will be less than construction as the footprint for all seabed preparatory work and infrastructure installation is captured under construction. However, the worst case scenario has been assessed as the same impact as construction as the footprint of operation and maintenance activities has not been quantified.	See construction justification.
Long term loss or damage to benthic habitats and species	Up to 7.34 km^2 of permanent habitat loss associated with: • WTGs: – Up to 125 WTGs using suction-bucket foundations = 1.25 km^2; • OSPs:	Largest spatial area and duration of habitat disturbance and loss during construction. Conservative assumptions have been made to estimate the scour protection and cable protection requirements for the offshore Project, as detailed in chapter 5: Project description. This area differs from temporary habitat loss / disturbance as it only considered areas where habitats and species will be impacted in the long-term through the

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	– Up to five OSPs with suction-bucket foundations = 0.107 km^2. • Inter-array cables: – Up to 140 inter-array cables, with a maximum cable protection footprint of 2 km^2. • Interconnector cables: – Up to six interconnector cables with a maximum cable protection footprint of 1.98 km^2. • Offshore export cables: – Up to five offshore export cable with a maximum cable protection footprint of 1.87 km^2. • Cable crossings: – Up to 10 total cable crossings across the offshore Project area with five within the offshore ECC (including with the consented Scottish Hydro Electric Transmission Limited (SHET-L) Caithness to Orkney High Voltage Alternating Current (HVAC) Link) and an additional five with the inter-array and interconnector cables. A total area of 0.125 km^2, protected by concrete mattresses, rock placement, grout / cement bags or a Cable Protection System (CPS); • Maximum seabed footprint for ancillary equipment, including mooring systems and monitoring equipment (e.g. wave buoy) = 0.00037 km^2.	installation of infrastructure. Therefore, the area considered is smaller than the area considered for temporary habitat loss / disturbance.
Increased suspended sediment concentrations and associated deposition	The worst case scenario with regards to this impact is presented in chapter 8: Marine physical and coastal processes.	See construction justification.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Colonisation of hard structures	Up to 7.34 km^2 of permanent habitat creation associated with: • WTGs: – Up to 125 WTGs using suction-bucket foundations (including scour protection) = 1.25 km^2; • OSPs: – Up to five OSPs with suction-bucket foundations (including scour protection) =0.107 km^2; • Inter-array cables: – Up to 140 inter-array cables, with a maximum cable protection footprint of 2 km^2; • Interconnector cables: – Up to six interconnector cables with a maximum cable protection footprint of 1.98 km^2; • Offshore export cables: – Up to five offshore export cable with a maximum cable protection footprint of 1.87 km^2; • Maximum seabed footprint for ancillary equipment, including mooring systems and monitoring equipment (e.g. wave buoy) = 0.00037 km^2; and • Up to 10 total cable crossings across the offshore Project area with five within the offshore ECC (including with the consented SHET-L Caithness to Orkney HVAC Link) and an additional five with the inter-array and interconnector cables. A total area of 0.125 km^2, protected by concrete mattresses, rock placement, grout / cement bags or a CPS.	The maximum area of scour protection and cable protection has the greatest potential to result in potential colonisation of benthic species.
Changes in physical processes	The worst case scenario with regards to this impact is presented in chapter 8: Marine physical and coastal processes.	The two WTG OAA layout options have been assessed within the Offshore EIA Report. Maximum cable protection parameters are provided here.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Impact to benthic communities from any thermal load or EMF arising from the cable during operation	• Inter-array cables: – Inter-array HVAC cables (up to 145 kV) with a maximum length of 500 km; – Minimum target burial depth of 1 m; – Up to 20% (100 km) of the inter-array cables will require cable protection at a height of 3 m and a width of 20 m (2 km^2); • Interconnector cables: – Up to six interconnector HVAC cables (up to 420 kV) with a maximum length of 150 km; – Minimum target burial depth of 1 m; – Up to 66% (99 km) of the interconnector cables will require cable protection at a height of 3 m (1.98 km^2); • Offshore export cables: – Up to five offshore export HVAC cables (up to 420 kV) with a maximum length of 320 km; – Minimum target burial depth of 1 m; – Up to 29% (93.5 km) of the offshore export cable routes to require cable protection with a height of 3 m (1.87 km^2); • Up to 10 total cable crossings across the offshore Project area with five within the offshore ECC (including with the consented SHET-L Caithness to Orkney HVAC Link) and an additional five with the inter-array and interconnector cables. A cable protection at a height of 4 m, with a total area of 0.125 km^2; and • Operational life of 30 years.	The maximum length of inter-array, interconnector cables and offshore export cable will result in the greatest potential for EMF effects. The minimum target burial depth represents the worst case scenario as EMF exposure will be minimised by greater burial depths.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Introduction and spread of INNS	The number of vessels during operation and maintenance activities is anticipated to be significantly less than during construction. Up to 7.34 km^2 of long term habitat creation associated with: • WTGS: – Up to 125 WTGs using suction-bucket foundations (including scour protection) = 1.25 km^2; • OSPs: – Up to five OSPs with suction-bucket foundations (including scour protection) = 0.107 km^2; • Inter-array cables: – Inter-array cables, with a maximum cable protection footprint of 2 km^2; • Interconnector cables: – Up to six interconnector cables with a maximum cable protection footprint of 1.98 km^2; • Offshore export cables: – Up to five offshore export cable with a maximum cable protection footprint of 1.87 km$^{2;}$ and • Maximum seabed footprint for ancillary equipment, including mooring systems and monitoring equipment (e.g. wave buoy) = 0.00037 km^2.	Maximum number of vessels transiting (potentially from waters outside of the UK) to and/or releasing ballast water within to the offshore Project area during operation and maintenance potentially introducing INNS. WTG piles and scour protection, and scour protection on the cables will provide novel habitat that can be used as a stepping stone for INNS.
Decommissioning		
Removal of hard substrate during decommissioning	• OSP and WTGs foundations: – Piled foundations will likely be cut below the seabed (typically at least 1 m below the seabed), using diamond wire cutting and abrasive water jet cutting either internally or externally, and the	The worst case scenario for decommissioning will be a clear seabed, where substructures and foundations that extend below the seabed will be cut approximately 1 m below the seabed to allow removal of the substructure. The same applies

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	sections above will be removed. Removal of the entire pile is not considered necessary and would result in disproportionate environmental impacts (see chapter 5: Project description for further details). • Cables (including offshore export cables, inter-array cables and interconnector cables): – If removal is deemed required, this will be done by using a water jet or grapnel tool; – Sections of the cable may likely be left in situ to avoid unnecessarily disturbing the seabed (this would be confirmed through consultation and assessment to ensure the most suitable approach was taken); and – For decommissioning in situ, the cable ends are located and buried at an acceptable depth below the seabed. This is likely to require the use of a Remotely Operated Vehicle (ROV) equipped with suitable trenching and burial equipment and accompanying support vessel. It is assumed that to decommission the cables in situ the cable is already buried along its length and so limited activity is required along the length of the cable. Exposed sections of cable will most likely be cut and removed or subjected to rock placement to ensure they are over trawlable.	for the worst case scenario of the offshore export cables, inter-array cables and the interconnector cables; The cable ends will be buried at an acceptable depth below the seabed and exposed sections of the cable will most likely be cut and removed or subjected to rock placement.
Relevant stakeholders and regulators will be consulted to establish the approach for decommissioning. The seabed will be restored, as far as reasonably practicable, to the condition it was prior to the construction of the offshore Project. Substructures and foundations that extend below the seabed, cut approximately 1 m below the seabed, leaving pile in place. Cables may be left in situ, with exposed sections cut and removed or subjected to rock placement.		

10.5.6 Quantification of impacts

10.5.6.1 Direct Temporary and long term project footprint

The quantification of the worst case direct project footprint on benthic ecology is summarised in Table 10-16. This quantification broadly distinguishes between temporary footprint and long-term footprint as was scoped into the impact assessment. The temporary impacts are considered to be related to direct short term one-off disturbances which will mainly occur during pre-construction and construction activities that are not predicted to fundamentally change the substrate type in the long term and from which a level of recovery can be expected. The long-term footprint is associated with the installed infrastructure itself, particularly where there is a fundamental change to the seabed substrate. In the case of long-term footprint, it is worth noting that this will occur within the boundary of the larger temporary footprint, so there will be physical overlap between the two. It should also be noted that the discussion of long-term impacts has been addressed in the section relating to the operational stage of the project as that is when the long-term impact of the infrastructure occurs, although it is recognised that direct loss of the existing seabed habitat will occur when the infrastructure is installed during construction. When assessing the operational and maintenance stage of the Project the attention is also given to the colonisation of hard structures as was scoped into the EIA. The worst case Project direct footprint outlined in Section 10.5.6 used to quantify the impacts to benthic ecology is summarised in Table 10-16. This quantification distinguishes between temporary and long-term impacts. The proportion of the OAA and offshore ECC and overall project areas that will be directly impacted are presented in Table 10-17.

Table 10-16 Overview of worst case Project footprint

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
OAA Cables	Inter array cables.	23.9	2	Seabed disturbance width = 50 m (encompassing cable installation footprint, boulder clearance and Pre-lay Grapnel Run (PLGR)). Length of cable not requiring bedform clearance = 500 – 22.5 km = 477.5 km. Seabed disturbance (excluding areas requiring bedform clearance) = 477,500 m x 50 m = 23,875,000 m^2.
	Inter array cables - bedform clearance.	3.4	-	It has been assumed that 3% of the inter-array cable corridors will require bedform clearance. The width of the bedform clearance has been estimated based on the maximum seabed footprint of the tools used for the inter-array cables (up to 150 m).
	Interconnectors cables.	6.5	1.98	Seabed disturbance width = 50 m (encompassing cable installation footprint, boulder clearance and PLGR). Length of cable not requiring bedform clearance= 150 – 19.5 km = 130.5 km. Seabed disturbance (excluding areas requiring bedform clearance) = 130,500 x 50 m = 6,525,000 m^2.
	Interconnector cables - bedform clearance.	2.9	-	It has been assumed that 3% of the interconnector cable corridors will require bedform clearance. Total interconnector cable length = 150 km.

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
				Interconnector cable length with expected sandwave occurrence (incl.10% contingency) = 150 km × (0.03 + 0.1) = 19.5 km = 19,500 m. Bedform clearance width = 150 m. Bedform clearance area = 19,500 m × 150m = 2,925,000 m^2.
Offshore ECC Cables	Offshore export cables (excluding bedform clearance areas).	11.2	1.87	Seabed disturbance width = 50 m (encompassing cable installation footprint, boulder clearance and PLGR). Length of cable not requiring bedform clearance = 320 – 96 km = 224 km. Seabed disturbance (excluding areas requiring bedform clearance) = 224,000 m x 50 m = 11,200,000 m^2.
	Offshore ECC -bedform clearance.	19.2	-	Length of cable requiring bedform clearance= 96 km. Bedform clearance width = 1,000 m (i.e. width of offshore ECC covering all 5 cables). Bedform clearance area = (96,000 m / 5) x 1000 m = 19,200,000 m^2.
OSPs and WTGs	Boulder clearance for WTG foundation.	1.3	-	Assumption that all foundation areas will require boulder clearance. Foundation footprint and surroundings would be checked and cleared of boulders to enable jack-ups/equipment to be placed safely as well as to avoid direct interaction with piles and scour protection. Boulders could be densely packed or just a few across the footprint area. Sizes and shapes will vary considerably. Note boulder is anything with diameter >0.5 m.
	Boulder clearance for OSP foundation.	0.1	-	

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
				Based on footprints (including scour protection) provided in chapter 5: Project description the following areas are provided: • 1,253,900 m^2 for WTGs; and • 17,800 x 5= 89,000 m^2 for OSPs. Total = 1,253,900 + 89,000 = 1,342,900 m^2. Note no additional volume added for foundation surrounding area as the above already includes the scour protection area which is highly conservative. Additional conservatism also already included by way of OSP size and number (i.e. largest size and highest number taken which would not occur simultaneously in reality).
	Bedform clearance for WTG + OSP foundations.	0.2	-	Sandwave cross-sectional area plus 5% shape factor = [4 × (3 m × 25 m)/2] × 1.05 = 158 m (from inter- array cables). Assumed one sandwave per WTG foundation for a length of 25 m. [(3 m × 25 m)/2] × 1.05 = 39 m^2. 39 m^2 x 48 m = 1,969 m^3 (equal to diameter of WTG area). 1969 m^3 x 125 = 24,6094 m^3 for total footprint. This value corresponds to 100% of WTG which is expected to be conservative, therefore, no additional contingency added. However, note number is rounded up in chapter 5: Project description given the inherent uncertainty in the value.
	WTG (suction bucket jackets: Total seabed footprint for	-	1.25	Takes the seabed footprint from foundations and adds the scour protection area and rounded up.

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
	Offshore Wind Farm (OWF) + total scour protection).			The scour footprint row already covers area under foundations but excludes actual structure so the calcs here are the scour footprint plus the pile/leg/suction bucket areas depending on applicability and then multiplied by the total number of WTGs.
	OSP jacket foundation (suction bucket jackets: total seabed footprint + scour protection for OWF).	-	0.11	As per chapter 5: Project description.
Cable crossings	Total of 10 crossings across interconnector, inter-array and offshore export cables.	-	0.13	Up to 10 crossings between the inter-array cables and other inter-array cables, the offshore export cables and the interconnector cables have been allowed for, including five within the OAA and five within the offshore ECC (including with the consented SHET-L Caithness to Orkney HVAC Link). The number of crossings may be reduced once the WTG and OSP layout is finalised.
Landfall	HDD exit pits.	0.0018	-	Area of HDD exit pit is as provided in chapter 5: Project description. Area of each pit = 300 m^2, with six HDD exit pits = 1,800 m^2.
	HDD exit pit berm aera (excavated material).	0.003	-	Calculation based on 20 m sidecast width, 3 m height and 25 m length. Therefore footprint per pit is 20 m x 25 m = 500 m^2. Total footprint = 500 m^2 x 6 = 3,000 m^2.
Vessels and ancillary equipment	Jack up vessels.	0.42	-	• 4 – 6 legs per jack-up vessel; • 270 m^2 spudcans; and • Maximum of two jack-up vessels per WTG and two per OSP.

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
				Therefore calculation is 270 m^2 x 6 = 1,020 m^2 seabed footprint per jack-up vessel. Across OAA = 1,020 x ((2x125) + (2x5)) where max number of WTGs is 125 and max number of OSPs is five = 421,200 m^2.
	Anchored cable lay vessels: inter-array cables.	0.02	-	Six-point anchor system with 3 m^2 anchors dropped every 500 m. Cable length = 500 km / 500 m = 1,000 anchor drops. Seabed footprint = 1,000 *(6 x 3 m^2) = 18,000 m^2.
	Anchored cable lay vessels: interconnector cables.	0.005	-	Six-point anchor system with 3 m^2 anchors dropped every 500 m. Cable length = 150 km / 500 m = 300 anchor drops. Seabed footprint = 300 *(6 x 3 m^2) = 5,400 m^2.
	Anchored cable lay vessels: offshore export cables.	0.01152	-	Six-point anchor system with 3 m^2 anchors dropped every 500 m. Cable length = 320 km / 500 m = 640 anchor drops Seabed footprint = 640 *(6 x 3 m^2) = 11,520 m^2.
	Ancillary equipment mooring systems for Heavy Lift Vessels (HLV) (construction).	0.00003	-	As per chapter 5: Project description.
	Ancillary equipment - mooring system for Service	-	0.0002	Quantity = 3 x 4 point-mooring system = 12 in total.

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
	Operated Vessels (SOV) (during operation and maintenance).			Seabed footprint for anchors = 15 m^2.
	Ancillary equipment – mooring system for Crew Transfer Vessels (CTV) (during operation and maintenance).	-	0.0002	Quantity = 3 x 4 point-mooring system = 12 in total. Seabed footprint for anchors = 15 m^2.
	Ancillary equipment – Floating Light Detection and Ranging (LIDAR).	-	0.000002	Seabed footprint = 1 m^2. Quantity = 2.
	Ancillary equipment - wave buoy.	-	0.000002	Seabed footprint = 1 m^2. Quantity = 2.
	Ancillary equipment - seabed frame mounted Acoustic Doppler Current Profiler (ADCP) and suspended sediment monitoring.	-	0.000002	Seabed footprint = 1 m^2. Quantity = 2.
OAA Total Footprint		38.71	5.40	

INFRASTRUCTURE TYPE	INFRASTRUCTURE	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	WORKING/ASSUMPTIONS
Offshore ECC Total Footprint		30.41	1.93	
Total footprint of Project		69.12	7.34	

Table 10-17 Proportion of temporary and long term footprint across OAA and offshore ECC

	TEMPORARY FOOTPRINT (KM^2)	TEMPORARY FOOTPRINT (%)*1	LONG-TERM FOOTPRINT (KM^2)	LONG-TERM FOOTPRINT (%)*2
OAA	38.71	5.89	5.40	0.82
Offshore ECC	30.41	24.3	1.93	1.55
Total for Project	69.12	8.84	7.34	0.94

***1** *OAA area = 657 km^2*
***2** *Offshore ECC area = 125 km^2*

10.5.6.2 Quantification of direct impact to 1170 Annex I reef habitat

As discussed in section 10.4.4.2 and summarised Table 10-6, 39.8 % of the Project area was characterised as having 1170 Annex I reef habitat (it should be noted that this was almost entirely stony reef with only a very small proportion of bedrock in the offshore ECC, close to landfall). As part of the quantification of impact, the area of Annex I reef that would be directly impacted by temporary (construction stage) and long term (operational stage) impacts is shown in Table 10-18 which has been calculated based on the proportion of the impacts in the OAA and offshore ECC respectively calculated in Table 10-17Table 10-17.

Table 10-18 Quantification of direct impact to Reef habitat across offshore Project area

ANNEX I (1107) REEF TYPE	OFFSHORE PROJECT COMPONENT	COVERAGE OFFSHORE PROJECT COMPONENT (KM^2)	PROPORTION OF OFFSHORE PROJECT COMPONENT (%)	TEMPORARY IMPACTED* (KM^2)	TEMPORARY IMPACTED (%)	LONG TERM IMPACTED* (KM2)	LONG TERM IMPACTED (%)
Bedrock reef	OAA	0	0	0	0	0	0
	Offshore ECC	2.6	2.09	0.63	1.99	0.04	0.13
	Total for the offshore Project	2.6	0.33	0.63	0.20	0.04	0.01
Potential stony reef	OAA	29.9	4.6	1.76	0.63	0.25	0.09
	Offshore ECC	12.6	10.1	3.05	9.62	0.19	0.61

ANNEX I (1107) REEF TYPE	OFFSHORE PROJECT COMPONENT	COVERAGE OFFSHORE PROJECT COMPONENT (KM^2)	PROPORTION OF OFFSHORE PROJECT COMPONENT (%)	TEMPORARY IMPACTED* (KM^2)	TEMPORARY IMPACTED (%)	LONG TERM IMPACTED* (KM2)	LONG TERM IMPACTED (%)
	Total for the offshore Project	42.42	5.43	4.81	1.54~~7~~	0.44	0.14
Stony reef (low)	OAA	6.29	0.96	0.37	0.13	0.05	0.02
	Offshore ECC	0.31	0.25	0.08	0.24	0.0048	0.02
	Total for the offshore Project	6.61	0.85	0.45	0.14	0.06	0.02
Stony reef (low to medium)	OAA	116.75	17.77	6.88	2.46	0.96	0.34
	Offshore ECC	8.9	7.14	2.17	6.82	0.14	0.43
	Total for the offshore Project	125.65	16.07	9.04	2.90	1.10	0.35
Stony reef (medium)	OAA	126.91	19.34	7.48	2.67	1.04	0.37
	Offshore ECC	7.37	5.91	1.79	5.65	0.11	0.36

ANNEX I (1107) REEF TYPE	OFFSHORE PROJECT COMPONENT	COVERAGE OFFSHORE PROJECT COMPONENT (KM^2)	PROPORTION OF OFFSHORE PROJECT COMPONENT (%)	TEMPORARY IMPACTED* (KM^2)	TEMPORARY IMPACTED (%)	LONG TERM IMPACTED* (KM2)	LONG TERM IMPACTED (%)
	Total for the offshore Project	134.28	17.17	9.27	2.98	1.16	0.35
Total	OAA	279.82	42.62	16.49	5.89	2.30	0.82
	Offshore ECC	31.74	25.46	7.72	24.32	0.49	1.55
	Total for the offshore Project	311.56	39.85	24.21	7.77	2.79	0.90

** Based on proportion of OAA/ECC temporary and long term impacted (as per Table 10-16).*

10.5.6.3 Quantification of sediment deposition (smothering)

During construction, there will be significant dredging activities which will result in direct deposits of sediment on the seabed. Due to the coarse nature of the sediments in the area, the majority (on average 99.75 %) of disturbed material will not enter suspension but be deposited directly onto the seabed. The detail of this modelling is outlined in chapter 8: Marine physical and coastal processes and SS13: Marine physical and coastal processes supporting study, which have been used to inform this quantification. Selected modelled scenarios outlined in SS13: Marine physical and coastal processes supporting study, have been taken forward with regard to impacts on benthic habitats. These are:

- Bedform clearance and cable installation using Controlled Flow Excavator (CFE); and
- Drilling activities of the WTG/ OSP foundation installation.

As outlined in chapter 8: Marine physical and coastal processes, for bedform clearance using CFE, a disturbance width of 10 m was assumed with potential ejection heights of 5 m, 10 m and 15 m above the seabed. For cable installation by CFE, an ejection height was assumed to be either 1 m, 5 m or 10 m above the seabed. Flow speeds of 0.25 to 1 m/s have been modelled and the range of sediments across the offshore Project area have also been considered.

The full range of theoretical deposition thicknesses and areas under the various modelled scenarios are presented in SS13: Marine physical and coastal processes supporting study. Across all modelled scenarios, the theoretical deposition thicknesses from bedform clearance by CFE ranged from 0.02 m to 8.1 m with corresponding areas ranging from 35.8 km^2 to 0.2 km^2. For cable installation by CFE, the theoretical deposition thickness ranged from 0.02 m to 17.4 m with downstream disturbance distance of 1,000 m to 0.86 m.

The deposition thicknesses and extents vary according to ejection height, flow speed and sediment size, and deposition thickness and area are inversely correlated. A reasonable worst case scenario has been selected in terms of potential smothering impacts on benthic species and habitats. The deposition values which represent the largest area subject to heavy smothering (≥ 0.7 m) have been selected for each activity and the dominant sediment size class has been assumed for the OAA (coarse sand) and the offshore ECC (medium sand).

The theoretical deposition thickness associated with sediment disturbance from OSP and WTG drilling, range from 4.0 m to 0.25 m and covering <1% of the OAA for the installation of all 125 WTGs and all five OSPs. Once again, in order to select the reasonable worst case scenario for smothering impacts on benthic species and habitats, the largest area subject to heavy smothering has been selected.

An overview of the modelling outputs used to quantify the sediment deposition during construction are provided in Table 10-19.

Table 10-19 Overview of modelling outputs to assess benthic impact from sediment deposition

AREA	SCENARIO	DEPOSITION THICKNESS (M)	AREA (KM^2)
OAA	WTG foundation installation (cone shape)	1.78	2.32
	OSP foundation installation (cone shape)	0.7	0.2
	Bedform clearance CFE (coarse sand)*1	0.7	2.3
	Cable installation CFE (coarse sand)*2	0.84	11.61
Offshore ECC	Bedform clearance CFE (medium sand)*3	0.7	2.2
	Cable installation CFE (medium sand)*4	0.75	6.4
Total for OAA	-	-	16.43
Total for offshore ECC	-	-	8.6
Total Project area	-	-	25.03

1Ejection point assumed to be 10 m above seabed, current speed 0.75-m/s (worst case).
2Ejection point assumed to be 10 m above seabed, current speed 0.25 m/s (worst case).
3Ejection point assumed to be 5 m above seabed, current speed 0.5 m/s (worst case).
4Ejection point assumed to be 1 m above seabed, current speed of 1 m/s (worst case).

For bedform clearance using CFE in the OAA, the coarse sand fraction has been considered as this was a dominant size class in the OAA. The deposit thicknesses for coarse sand range from 0.3 m to 3.9 m over an area from 4.6 km^2 to 0.4 m. The ejection height (the position at which the dredged material will be realised above the seabed) is assumed as 10 m above seabed at a flow speed of 0.75 m/s which represents largest area with which a deposit depth is reached that represents heavy smothering of ≥ 0.7m (also note that a 15 m ejection height with 0.5 m/s flow speeds result in the same theoretical deposition values). In this scenario, the deposit thickness is 0.7 m over an area of 2.3 km^2. As such the maximum area considered as being subject to heavy deposition was 2.3 km^2-and this area was taken forward in the impact assessment as the worst case for the OAA.

For bedform clearance in the offshore ECC, the medium sand fraction has been considered as this was a dominant size class in the offshore ECC. The deposition thicknesses for medium sand ranged from 0.1 m to 1.4 m over an area of 9.6 km^2 to 1.1 km^2. The ejection height is assumed to be 5 m above seabed at a flow speed of 0.5 m/s which represents the largest area within which a deposit depth is reached that represents heavy smothering (≥0.7 m). In this scenario, the deposit thickness is 0.7 m depth over an area of 2.2 km^2. An area of 2.2 km^2 was taken forward in the impact assessment as the worst case for the offshore ECC.

For cable trenching using CFE, the model predicted a total distance of deposition downstream of the ejection point rather than an overall impacted area. The area was calculated using distance and cable lengths to calculate an overall expected impacted area from this activity. For the coarse sediments within the OAA, the deposit thicknesses range from 0.21 m to 8.4 m with a downstream dispersion distance of 71.43 m to 1.79 m. The ejection height is assumed as 10 m above seabed at a flow speed of 0.25 m/s which represents the largest area within which a deposit depth is reached that represents heavy smothering. In this scenario in the OAA, the theoretical deposit thickness is 0.84 m with a downstream dispersion distance of 17.86 m. For the offshore ECC, the deposit thicknesses range from 0.08 m to 3 m with a downstream dispersion distance of 200 m to 5 m. The ejection height is assumed as 1 m above seabed at a flow speed of 1 m/s which represents the largest area within which a deposit depth is reached that represents heavy smothering. In this scenario, the theoretical deposit thickness is 0.75 m with a downstream dispersion distance of 20 m. The maximum extent of heavy smothering for inclusion in the impact assessment is calculated as 11.61 km^2 for the OAA and 6.4 km^2 for the offshore ECC, as outlined in Table 10-19.

For WTG foundation installation, a thickness of 1.78 m over a 2.32 km^2 area was taken forward in the assessment as this is considered to represent the largest area that would be subject to heavy smothering during WTG installation (see chapter 8: Marine physical and coastal processes for further sediment modelling details). For OSP foundation installation, a thickness of 0.7 m over a 0.2 km^2 area was taken forward in the assessment. It is worth noting that the modelling outputs represented theoretical extremes in depth based on a cone shaped deposit with a lower area and an extreme area impacted based on an even distribution with a shallower depth. However, the scenario taken forward in the impact assessment is considered to represent a realistic worst case.

10.5.6.4 Quantification of impacts to Annex 1 reef in national context

In order to calculate the impact to 1170 Annex I habitat in the national context, it was assumed that all temporary, long term and smothering impacts in the OAA and offshore ECC would affect reef habitat. This worst case area was used to calculate a proportion of Annex I Reef habitat that would be directly impacted in relation to protected Annex I reef in designated Scottish and UK SAC (

Table 10-20 and Table 10-21). It should be noted that the comparative protected Annex I Reef areas within designated SACs accounted for bedrock, stony and biogenic reefs as these were not differentiated within the corresponding JNCC datasheets (Natural England and JNCC, 2019).

Table 10-20 Worst Case Impacts to 1170 Annex I Reef habitat in Scottish Context

	ANNEX I REEF (KM^2)	TEMPORARILY IMPACTED AREA IN SCOTTISH CONTEXT (%)*[1]	LONG-TERM IMPACT AREA IN SCOTTISH CONTEXT (%)	SMOTHERING AREA (≥0.7 M) IN SCOTTISH CONTEXT (%)
OAA	279.82	0.43	0.06	0.18

	ANNEX I REEF (KM^2)	TEMPORARILY IMPACTED AREA IN SCOTTISH CONTEXT (%)*1	LONG-TERM IMPACT AREA IN SCOTTISH CONTEXT (%)	SMOTHERING AREA (≥0.7 M) IN SCOTTISH CONTEXT (%)
Offshore ECC	31.74	0.34	0.02	0.10
Total	311.56	0.77	0.08	0.28
**1 This is based on total area of 1170 Annex I Reef protected under Scottish SACs – 8,938 km² (Natural England and JNCC, 2019).*				

Table 10-21 Impacts to 1170 Annex I Reef habitat in UK Context

	ANNEX I REEF (KM^2)	TEMPORARILY IMPACTED AREA IN UK CONTEXT (%)*1	LONG-TERM IMPACT AREA IN UK CONTEXT (%)*1	SEDIMENT DEPOSITION AREA (≥0.7M) IN UK CONTEXT (%)
OAA	279.82	0.3	0.04	0.13
Offshore ECC	31.74	0.24	0.01	0.07
Total	311.56	0.53	0.06	0.19
**1 This is based on total area of 1170 Annex I Reef protected under designated UK SACs – 12,940 km² (Natural England and JNCC, 2019).*				

10.6 Assessment of potential effects

10.6.1 Potential effects during construction (including pre-construction)

10.6.1.1 Temporary habitat loss/ disturbance

This section focuses on the direct temporary habitat loss / disturbance resulting from the construction of the offshore Project. Indirect effects associated with this activity, such as increases in suspended sediment concentrations, are covered in section 10.6.1.2. The impacts discussed in this section relate to the direct disturbances associated with pre-construction and construction activities which are expected to be transient and short term, leaving behind seabed which is relatively unchanged in its composition following the temporary disturbance.

Within the OAA and offshore ECC, seabed preparation activities such as bedform clearance and boulder clearance will temporarily disturb existing seabed habitats and communities. In addition, the construction and installation of infrastructure such as the inter-array cables, interconnector cables, anchor placement of installation vessels and jack-up vessel placement as well as the dredging and installation of the export cables will result in temporary habitat loss disturbance. As per Table 10-17, the total combined temporary footprint from all activities within the OAA (38.7 $km^{2)}$ and the offshore ECC (30.4 km^2) is 69.12 km^2. Given that the combined area of the OAA (657 km^2) and the offshore ECC (125 km^2) is 782 km^2, the temporary footprint will disturb 8.8% of the total offshore Project area (5.9% of the OAA and 24% of the offshore ECC) (see section 10.5.6).

It should be noted that this disturbance area accounts for the area that will be directly disturbed temporarily but does not include the indirect seabed disturbance associated with deposited material from the excavation activities which is discussed further in section 10.6.1.2. The potential impacts are discussed below for each of the key habitat types and sensitive species within the temporary disturbance footprint.

An important aspect that has been taken into consideration when determining the significance of the temporary impact is whether the impact is likely to incur a change in biological diversity or community composition that may impact ecosystem function and higher trophic levels including birds, fish and mammals (Scottish Government, 2023).

10.6.1.1.1 Annex I stony and bedrock reef

Within the Project area, habitat resembling Annex I stony reef is present across 279.8 km^2 (~42.6 %) of the OAA and 29.14 km^2 (~23%) of the offshore ECC (see Table 10-18). These areas of reef were delineated as either circalittoral rock or circalittoral mixed sediment with cobbles and boulders interspersed with sand and gravel that resembled 'Low to Medium' stony reef. Along the offshore ECC, there was also an area of bedrock reef closer to shore of 2.6 km^2.

While the stony reef habitats present in the OAA are not protected within a designated site such as an SAC, they are considered to be representative of Annex I reef under the EU Habitats Directive and have potential conservation importance. However, these reef habitats are considered to have a high resilience and recoverability to temporary disturbance and are therefore considered as having medium sensitivity. This habitat supports epifauna which includes octocorals such as dead man's fingers *Alcyonium digitatum* and hydroids such as sea tamarisk, which are listed on the SBL (along with the reef habitat)). The reef habitat provides a foraging area and shelter for a variety of fish species, some of which are also listed as PMF (more details in chapter 11: Fish and shellfish ecology) as well as providing habitat for epifauna such as crustaceans and echinoderms. The cobbles and boulders making up the stony reef habitat were also identified as supporting encrusting species such as the ross worm *Sabellaria spinulosa*. Aggregations of this species were not assessed to comprise biogenic reef but were associated with the geogenic stony reef substrate. The nearshore area of the offshore ECC contains areas of Annex I bedrock reef (SS5: Benthic environmental baseline report). Kelp beds and other macroalgae-dominated bedrock habitats were identified in the nearshore area, extending into the lower intertidal (SS5: Benthic environmental baseline report). The bedrock is predominantly exposed and where covered the surface composition is variable, from veneers of sand and gravel, cobble and boulders to kelp and hydrozoan turfs. As such the bedrock reef is associated with the PMF habitat kelp beds and the corresponding EUNIS habitat 'Kelp and seaweed communities on Atlantic infralittoral rock' (MB121). The impact to kelp beds has been assessed separately.

The temporary disturbance affecting the stony reef habitat will arise from pre-installation preparatory works such as boulder clearance which will essentially displace the larger boulders making up the reef habitat to adjacent areas out with the vicinity of the proposed OSP, WTG, inter-array and interconnector cable areas. In the offshore ECC, there will be potential temporary disturbance to these reef habitats during the bedform clearance and trenching activities for installation of the cables, although it is expected that the bedform clearance is unlikely to directly affect stony reef areas to the same extent as the sediment habitats.

It is noted that some of the features of this receptor such as octocorals have moderate sensitivity to displacement if they are detached from the affected substrate as they have no mechanism to re-attach. However, following these temporary activities, octocorals have been shown to have high recoverability to such disturbance. It is expected that in the short term, the temporary disturbance will result in some direct temporary losses to epifaunal stony reef communities. Such temporary losses could temporarily affect higher trophic levels at a local level by reducing the availability of prey species in these areas until recovery and recolonisation occurs. Encrusting species such as aggregations of *Sabellaria* are known to become completely lost through winter storms only to recolonise within a year where there is high recruitment potential. The *Sabellaria* aggregations are associated with rocky substrate and recovery is expected to be high where this substrate remains. There will be further temporary disturbance to these habitats during the installation of the cables. However, this habitat is considered to have a high recoverability and re-colonisation of these epifaunal communities on rocky substrata can be expected following temporary disturbance.

As mentioned above, the temporary disturbance of the offshore Project will affect an area of 69.1 km^2 (Table 10-16). Based on the Project specific survey data, it has been calculated that there is 279.8 km^2 of reef habitat within the OAA and 31.74 km^2 in the offshore ECC respectively (311.56 km^2 in total). When taking into account the proportionate area of reef affected by temporary disturbance activities across the OAA (5.9% equating to 16.5 km^2) and offshore ECC (24.32% equating to 7.72 km^2), it is predicted that 24.2 km^2 of reef habitat would be temporarily affected (Table 10-18).

As such, the overall proportion of Annex I reef temporarily affected is predicted to be relatively low compared with the total area coverage of this habitat in the project area. Given the relatively low proportion of reef habitat affected compared with unaffected habitat within the OAA and offshore ECC, it is predicted that there would be no significant impact to the ecological function of these reef habitats as a result of the temporary disturbance.

To put this temporary disturbance to Annex I stony reef into the national context, approximately 8,938 km^2 of 1170 Annex I reef is protected in Scottish waters within designated marine SACs (Natural England and JNCC, 2019). If it was assumed as worst case that 100% of all of temporary seabed disturbance in the OAA and offshore ECC was to directly impact reef habitat, the area of reef temporarily affected would be proportionately only 0.77 % of the total area of protected reef in Scotland which is low in national terms (see

Table 10-20 and section 10.5.6).

To put this disturbance of Annex I stony reef into the UK context, approximately 12,939 km^2 of 1170 Annex I reef is protected in UK waters within designated marine SACs. The total area of reef affected by sediment deposits within the offshore Project area is proportionately only 0.53 % of the total area of protected reef in the UK. It should be emphasised that this is worst case and the actual proportion of reef habitat temporarily affected is anticipated to be a much lower number than this (see Table 10-21 and section 10.5.6).

Furthermore, the associated epifaunal communities are predicted to be suitably adapted to the dynamic, energetic environmental conditions present across the project area and are therefore expected to be resilient to temporary disturbance. Overall, the temporary impacts will be localised and limited to the duration of the construction activities with an expected high recoverability following disturbance. With the implementation of embedded mitigation measures, such as micro-siting to avoid sensitive habitats wherever possible and reducing localised temporary habitat loss / disturbance, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of temporary habitat loss/ disturbance during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.1.2 Subtidal sands and gravels habitat

The site-specific survey identified a wide variety of sediment types across the OAA and offshore ECC, ranging from fine sand, gravelly sand and a patchwork of various coarse sand and gravel sediments.

This seabed of the OAA and offshore ECC is characterised by a heterogeneous mosaic sediment habitats which are dominated by sand and gravel sediment fractions.

The environmental survey identified 15 specific biotopes in sedimentary habitats, the majority of which fall within the broad habitat of offshore subtidal sands and gravels which covers a large proportion of the offshore project area which is estimated to be approximately 377 km^2 (57%) of the OAA and 93.27 km^2 (75 %) of the offshore ECC area (see section 10.4.4.2.2). Particle size analysis revealed that the sand and gravel fractions were the most prominent sediment type with a greater sand proportion in the offshore ECC. The most frequently encountered sedimentary biotopes included:

- *Moerella* spp. With venerid bivalves in Atlantic infralittoral gravelly sand (MB3233);
- *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment (MC4214);
- Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand (MC5211);
- Faunal communities of Atlantic circalittoral sand (MC521)/Atlantic offshore circalittoral mixed sediment (MC42); and
- *Lagis koreni* and *Phaxas pellucidus* in Atlantic circalittoral sandy mud.

The assigned EUNIS habitats identified during the survey generally reflected the sand, gravelly sand, mixed and coarse sediments present, although species composition at four stations along the offshore ECC also resembled sandy mud (however, there were no mud habitats identified from PSA analysis). Sand and gravel sediments are the most common subtidal habitat around the coast of the British Isles and are abundant in the offshore waters of Scotland. Offshore subtidal sand and gravel habitats are listed as a PMF.

As part of this assessment, the impacts to the sands and gravels will be discussed collectively and where deemed appropriate, attention is given to specific differences in the sensitivity or ecological effects on a particular biotope. For the OAA, the predominant habitats are the coarse and mixed sediments with low fines which are a feature of the relatively shallow, high energy environment, found across the area, especially on Whiten Head Bank and Stormy Bank where the seabed is at its shallowest. For the offshore ECC, the predominant habitats are characterised by sand with a higher proportion of fines associated with deeper parts of the offshore EEC and in shallower areas, the sediments become similar to those found across the OAA with a highly varied patchwork of sand, gravel and cobbles and boulders in places.

As outlined in Table 10-8, all habitat types listed under subtidal sands and gravels have low sensitivity to abrasion and physical disturbance and also have a medium resistance and medium to high resilience to this temporary disturbance (MarLIN, 2023c). It can therefore be expected that the sensitivity to temporary disturbance resulting from seabed preparation and installation activities will be low. However, as a PMF, the offshore sands and gravels habitat is a conservation priority and may have medium sensitivity to sediment surface disturbance (Marine Scotland, 2023b) while it does have some degree of resilience to temporary habitat loss, is considered to have **medium sensitivity.**

The water depths in the OAA range from approximately 45 m to approximately 100 m while in the offshore ECC, depths range from a maximum of 111.4 m right up to the intertidal area with the deepest parts around midway along the cable route between the shore and the OAA. In the shallower areas, the sediments are more exposed to natural disturbance and storm events and, therefore the faunal communities present can be expected to be relatively robust and resilient to physical disturbances (MarLIN, 2023b,c,e). Indeed the dominant biotopes typical of coarse sands and gravels in the shallower areas of the OAA and offshore ECC are characterised by exposure to currents and sediment movement and are inhabited by robust bivalves such as *Asbjornsenia pygmaea* (previously *Moerella pygmaea*) and *Timoclea ovata*. These habitat types are highly resilient to such disturbances and are expected to recover rapidly following construction activities. In deeper areas, where there is a more stable environment, epifaunal growth is less inhibited and the characterising fauna can include bryozoan and hydroid turfs. These habitats are also tidally swept and exposed to sand scour although this will be variable with decreasing exposure with increasing depth. The epifaunal turf species that characterise this habitat, such as bryozoans and hydroids are resilient to disturbance and recovery is also expected to be high, especially when there is larval recruitment from adjacent areas (MarLIN 2023b,c,e).

In parts of the offshore ECC, especially in deeper areas associated with an increase in the proportion of fine material, a biotope resembling sandy mud was identified which has characteristic species such as the tube worm *Lagis Koreni* and the bivalve *Phaxas pellucidus*. This biotope was not widespread throughout the offshore ECC and was identified from only four grab stations, all positioned at varying points along the offshore ECC. *Lagis koreni* has a strong capacity to resettle, is capable of rapid recolonization through larval recruitment following disturbance events, and reaches former densities within a year (MarLIN, 2023j). However, other species representative of this habitat such as the razor clam *Phaxas pellucidus*, which was also present in the survey samples, may take several years to reach maturity and this can also reflect the overall length of time for the benthic community as a whole to also reach maturity MarLIN, 2023j). It has been reported that muddy sand habitats can have the longer recovery times following disturbance, than mud and clean sand habitats, with medium sensitivity to the removal of substratum and low sensitivity to abrasion or disturbance (MarLIN, 2023b,c,e,j). It is therefore expected that this component of the subtidal sands and gravels may not recover as quickly as the other sediment habitats. However, it can be stated that this habitat type does not appear to be a significantly important component of the overall benthic ecology across the offshore ECC, given its low level of occurrence in the survey area.

As described above, there is approximately 377 km^2 of subtidal sands and gravel habitat across the OAA and 93.27 km^2 across the offshore ECC. Based on temporary habitat loss / disturbance footprint representing 5.9% of the OAA and 24.3% of the offshore ECC (see Table 10-17), it is predicted that 44.92 km^2 of sands and gravel habitat would be temporarily impacted by the construction operations in the OAA and the offshore ECC. The seabed preparation activities and cable trenching will be mainly focussed on sands and gravel habitats, therefore it is assumed that the full footprint of direct temporary disturbance within the offshore ECC can be expected to affect this habitat. The range of sand and gravel habitats found across the OAA are some of the most common subtidal habitats found in Scottish coastal and offshore waters. Due to the predicted high recoverability of this sediment type, and proximity to extensive adjacent areas from which recruitment can occur, any temporary impacts are unlikely to affect the long-term ecological functioning of the seabed ecosystem upon which higher tropic levels of organisms such as fish, marine mammals and seabirds depend. The impact is thus defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of temporary habitat loss/ disturbance during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.1.3 Ocean quahog

Ocean quahog is a low-mobility species and there is a possibility for individuals to be lost or disturbed by construction activities within the OAA. As discussed in Section 10.4.4, juvenile ocean quahog were identified within the offshore Project specific surveys throughout the offshore Project Area although no adult specimens were identified within the OAA (SS5: Benthic environmental baseline report).

Ocean quahog are listed under the OSPAR Convention's List of Threatened and Declining Species and are considered to have high sensitivity to habitat structure changes including disturbance of the surface of the substratum or its removal though extraction (MarLIN, 2023i; Marine Scotland, 2023b). Furthermore, ocean quahog has very low resilience to such disturbances and therefore mortality of individuals in the immediate vicinity of the directly disturbed area can be expected. However, construction activities will be localised, and the proportion of the supporting sands and gravels habitat affected will be small. It is also considered that the large majority of records for ocean quahog across the site were of juvenile specimens with no adults encountered in the OAA and only two adults individuals recorded in the offshore ECC, which suggests that while this area does support ocean quahog populations, the population that is supported may be less important for this species than some other areas of the offshore UK Continental Shelf (UKCS) such as the East of Gannet and Montrose Field NCMPA which is designated for the protection of ocean quahog. Given that there is predicted to be suitable habitat for ocean quahog across the wider area, beyond that directly impacted by construction activities, as well as the localised nature of disturbance, it is not predicted that the ocean quahog will be impacted at a population level. Therefore, the impacts on this receptor are considered to be of a low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of temporary habitat loss/ disturbance during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

Ocean quahog is a low-mobility species and there is a possibility for the species to be lost or disturbed by construction activities within the offshore ECC. As discussed in section 10.4.4, juvenile ocean quahog were identified within the site-specific surveys throughout the offshore Project area with two adult specimens identified within the offshore ECC (SS5: Benthic environmental baseline report).

10.6.1.1.4 Kelp and seaweed communities on Atlantic infralittoral rock

Within the offshore ECC, small areas of kelp and seaweed communities on Atlantic infralittoral rock (MB121) were found within the nearshore region. Kelp beds are a PMF and are listed under 'A3.115-*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock'. In addition, kelp beds are considered to be blue carbon habitats. Kelp beds are typically found within water depths of up to 20 m (MarLIN, 2023h); therefore, the habitat will only be affected by the nearshore parts of the offshore ECC installation activities. Kelp beds are associated with rocky reef which is listed on the Annex I of the Habitats Directive and are a PMF. Kelp beds are considered to have medium sensitivity to disturbance of substratum (MarLIN, 2023h; Marine Scotland, 2023c). The kelp beds were associated with open exposed areas of bedrock close to landfall and are therefore not expected to be directly affected by trenching operations or bedform clearance due to the fact the landfall will be undertaken using HDD. However, the exit point at the seabed using HDD will occur between 10-40 m water depth which could be in the range of kelp and seaweed communities, especially at the shallower end (i.e. 10 m depth). With the implementation of embedded mitigation measures such as micro-siting to avoid sensitive habitats and reducing localised temporary habitat loss / disturbance, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of direct temporary disturbance to kelp beds during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.2 Increased suspended sediment concentrations and sediment deposition

Existing seabed habitats may be temporarily disturbed by the suspension of sediment and deposition during the installation of subsea infrastructure outlined in Table 10-15. These have been subject to modelling studies which are detailed in chapter 8: Marine physical and coastal processes. The outputs of this modelling have been used to inform the impact to benthic receptors (see section 10.5.6).

The seabed preparation, such as bedform clearance, construction and installation of infrastructure such as the inter-array cables, offshore export cables, interconnector cables, rock placement/scour protection and anchor placement of installation vessels will disturb seabed sediments and result in a temporary increase in suspended sediment concentrations. Due to the relatively low fines found across the OAA and offshore ECC, only a very small proportion (0.25%) of the total excavated sediment volume will enter suspension and be distributed in a temporary plume over a range of up to 8 km from the ejection point (see chapter 8: Marine physical and coastal processes for modelling details). The vast majority of the sediment that is excavated (99.75%) will be of larger fractions which will not enter suspension and will instead be deposited in a more localised area. The impact of suspended sediment and the deposition of the bulk coarse sediment within the OAA and offshore ECC are considered here for each benthic receptor. The extent of the impacted area and associated burial depth are dependent on numerous variables which were incorporated to model the potential suspended sediment concentrations, extent and duration of associated plumes and extent and thickness of sediment deposits. The modelling outputs used to quantify the direct sediment deposition is outlined in Table 10-19.

In the case of the suspended sediments, the longest duration and extent of a plume will occur from WTG/OSP foundation installation (drilling two at a time) which will extend to 8 km at a maximum of concentration of 48 mg/l and take 74–hours to reach background levels. The highest suspended sediment concentration is predicted to be from bedform clearance by dredging (190 mg/l) and extends to 8 km but will last only 3.2 hours before returning to background levels. The resettlement of this suspended material may extend beyond the boundary of the OAA; however, the sedimentation of the resettlement of material has been modelled as a maximum of 2 mm and therefore results in a very low level smothering. It is worth noting that the suspended sediment concentrations and associated deposition resulting from the installation of cables has been considered together for all inter-array cables within the OAA and offshore export cables within the offshore ECC.

In the case of sediment deposition, there will be significant dredging activities that will result in direct deposits of sediment on the seabed. Due to the coarse nature of the sediments in the area, the majority (99.75%) of disturbed material will not enter suspension but be deposited directly to seabed. As explained in section 10.5.6.3, during construction, the maximum worst case area of disturbance (≥0.7 m depth) was taken as the basis for the impact assessment for this sediment deposition, which is based on modelling undertaken as part of chapter 8: Marine physical and coastal processes.

Overall, the total area affected by deposition at a minimum burial depth of 0.7 m is 25.03 km^2 (Table 10-19).

In addition, some localised dredging close to the landfall location, including the excavation of HDD exit pits may be required at the cable exit points to ensure the duct ends, and subsea cables end up buried below the seabed. Typical HDD exit pits would be 10 m wide x 30 m long and up to 5 m deep. These pits may be used as plough starter pits allowing access for cable installation. Excavation of the HDD exit pits will occur in a range of 10-40 m below LAT water depth. Using the above pit dimension assumptions, for six pits (5 plus one contingency), the anticipated volume of material moved will be 9,000 m^3 in total. The dredged material would be disposed of or stored beside the HDD exit pits and left as is or backfilled after the operation. The associated berm would be 17 m wide with an HDD exit pit of around 50 m wide which will be localised and relatively small in relation to the other deposits associated with the proposed construction activities. Due to the highly energetic, wave exposed environment close to the landfall, it is expected that sediments will be widely dispersed, and that the berm formed will significantly reduce over time, if not backfill the trenched pit. The excavation of the pits and associated deposition were not subject to dispersal modelling, although the associated seabed impact was included in the overall seabed footprint calculation as part of the direct temporary disturbance (Table 10-16).

10.6.1.2.1 Annex I stony and bedrock reef

Suspended sediment and associated deposition

The mode of impact affecting the benthic ecology from suspended sediment comes from potential clogging of feeding and respiratory structures of benthic invertebrates, especially impact filter feeding species as suspended sediments re-settle to the seabed. The 0.25% of excavated sediment that enters suspension will disperse over a relatively wide area, leaving a very thin veneer (<2 mm) of fine sediment on the seabed. Given that the general area is described as being subject to scouring from currents (SS5: Benthic environmental baseline report), these settled fines are anticipated to be short lived and are not expected to present a significant issue for benthic habitats or organisms present. The significant levels of deposition which would constitute smothering will result from the directly deposited coarser sediment that does not enter suspension and is discussed separately below.

The levels of baseline suspended sediments concentrations were significantly lower (<1mg/l), than the maximum levels predicted to result from construction activities in the OAA (~190mg/l) or offshore ECC (~1,200 mg/l). Despite this, the epifaunal communities of the reef habitats which are characterised by bryozoan and hydroid turfs are predicted to have a low intolerance, high resistance and high resilience to suspended sediments, (MarLIN, 2023a, MarLIN, 2023c). When taking this into consideration the Annex I reef habitats are considered to be of low sensitivity to suspended sediments.

It is recognised that increased suspended sediments and associated siltation can impair filter feeding efficiency in some species, including SBL octocorals and hydroids. However, when considering the very short duration of the sediment in suspension (up to 74 hours) coupled with the minimal siltation depth (<2 mm) the disturbance from suspended sediments is considered both short term and unlikely to disrupt the ecological functioning of the reef. As such the impact resulting from suspended sediment on the reef habitat is defined as being of low magnitude.

Evaluation of significance

Taking the low sensitivity of the receptor and the low magnitude of the impact, the overall effect on reef through suspended sediment is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Minor
Impact significance – NOT SIGNIFICANT		

Sediment deposition

As mentioned above, approximately 99.75% of all excavated sediment material will not enter suspension and will be deposited directly on the seabed, causing smothering of the seabed habitats.

The reef habitats are assessed to have a very low resilience to physical change to another seabed type which could occur through sediment deposition with the complete loss of rocky substratum. Therefore, Annex I reef habitats are assessed to have a very low resilience to habitat change and high sensitivity.

The deposition of sediment has the potential to replace stony reef habitat, smothering the existing epifauna and modifying the substrate from rock to sand thus preventing any recovery and loss of the biotope in the immediate area. The worst case scenario has taken a burial depth of 0.7 m to represent permanent coverage of sediment over reef habitat. As outlined in section 10.5.6.3, the total reef area that may be permanently removed and converted to sandy seabed has been calculated to be 25.03 km^2 (16.43 km^2 in the OAA and 8.6 km^2 in the offshore ECC) which equates to around 8.03 of the reef area across the offshore Project area.

To put this loss of Annex I stony reef into the Scottish context, approximately 8,938 km^2 of 1170 Annex I reef is protected in Scottish waters within designated marine SACs. The total area of reef affected by sediment deposits within the Project area is proportionately only 0.28% of the total area of protected reef.

To put this loss of Annex I stony reef into the UK context, approximately 12,939 km^2 of 1170 Annex I reef is protected in UK waters within designated marine SACs. The total area of reef affected by sediment deposits within the offshore Project area is proportionately only 0.19% of the total area of protected reef.

This worst case assessment assumes that all habitat affected by sediment deposition will be reef when in fact the area affected is more likely to be more comprised of sediment habitats which make up the higher proportion of the seabed area. Furthermore, the 0.7 m depth burial is considered here to represent long term habitat change. However due to the currents in the area and known scouring around boulders and hard substrata, it can be expected that the sediment would clear over time to some degree. Estimates of sediment clearance from 30 cm smothering on circalittoral rock in similar conditions have been predicted to clear over a period of one year (MarLIN 2023). Therefore, it is reasonable to assume that within four years the deposited sediment of around 1 m could potentially clear, re-exposing the rocky substrate to allow recolonisation, which in itself could take several years. For the purposes of this assessment, it is considered that the impact is long term, although the proportion of the area affected is low. It should also be noted that the coarse and medium sands sediments that are deposited will be similar in nature to the matrix of sediments that exist across the area that make up the patchwork of coarse and mixed sediment habitats. As such the benthic ecology as a whole is not expected to be significantly compromised. With the implementation of embedded mitigation measures, such as micro-siting to avoid sensitive habitats and reducing localised habitat loss, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of long term loss of Annex I reef through sediment deposition is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.2.2 Subtidal sands and gravels habitat

The site-specific survey identified a wide variety of sediment biotopes across the OAA and offshore ECC ranging from fine sand, gravelly sand and generally circalittoral mixed and coarse sediments. Which are dominated by sand and gravel sediment fractions.

As previously discussed in Section 10.6.2.2.2, the environmental survey identified 15 specific biotopes within the sedimentary habitats, which have been considered to fall broadly within the EUNIS habitat classification offshore subtidal sands and gravels. These cover a large proportion of the offshore Project area, estimated to be approximately 377 km^2 (57%) of the OAA and 93.27 km^2 (75 %) of the offshore ECC area. Particle size analysis revealed that the sand and gravel fractions were the most prominent sediment type with a greater sand proportion in the offshore ECC.

Subtidal sand and gravel habitats were identified throughout the OAA and offshore ECC in areas that were not delineated as reef areas. The assigned EUNIS habitats identified during the survey generally reflect the sand, gravelly sand, mixed and coarse sediments. Sand and gravel sediments are the most common subtidal habitat around the coast of the British Isles and are abundant in the offshore waters of Scotland.

Suspended sediment and associated deposition

Addition of fine material will alter the character of this habitat by covering it with a layer of dissimilar sediment and will reduce suitability for the species associated with this feature and the mobile infaunal communities which dominate these habitats can be expected to be able to burrow through light smothering caused by the settled re-suspended material. There are expected to be energetic costs associated with re-opening burrows, for instance, and can be considered to have a medium resistance to changes in the suspended sediment levels and associated siltation (MarLIN, 2023 b,c,d,e,f,g,h,k). The resilience to suspended sediment and associated light siltation is regarded as high.

As such, even though offshore subtidal sand and gravel habitats are listed as a PMF and therefore of conservation value, the habitat is considered to be of low sensitivity to suspended sediments and associated deposition.

While it is recognised that the increased suspended sediments and associated siltation can impair filter feeding efficiency in some species, it is expected that resilience to this pressure is high (MarLIN, 2023). Furthermore, the very short duration of the sediment in suspension (up to 74 hours) coupled with the very minimal siltation depth (<2 mm), the disturbance from suspended sediments is considered both short term and unlikely to disrupt the ecological functioning of the offshore subtidal sands and gravel habitats. Therefore, the impact resulting from suspended sediment on subtidal sand and gravel habitat is defined as being of low magnitude.

As such, these habitats and associated benthic communities are expected to have a low intolerance to suspended sediments and low sensitivity (MarLIN, 2023).

While it is recognised that the increased suspended sediments and associated deposition of fines can impair filter feeding efficiency in some species, it is expected that resilience to this pressure is high (MarLIN, 2023). Furthermore, the very short duration of the sediment in suspension (up to 74 hours) coupled with the very minimal depth (<2 mm), the disturbance from suspended sediments is considered both short term and unlikely to disrupt the ecological functioning of the offshore subtidal sands and gravel habitats. Therefore, the impact resulting from suspended sediment on subtidal sand and gravel habitat is defined as being of low magnitude.

Evaluation of significance

Taking the low sensitivity of the receptor and the low magnitude of the impact, the overall effect of suspended sediment and associated deposition on subtidal sands and gravel habitat in the offshore ECC is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Minor
Impact significance – NOT SIGNIFICANT		

Sediment deposition

It is recognised that the variety of sands and gravel biotopes present are characterised by different sediment fraction sizes ranging from fine sands to coarse gravels along with the associated faunal communities. As part of this assessment, the impacts to the sands and gravels will be discussed collectively and where deemed appropriate, attention will be given to specific differences in the sensitivity or ecological effects on a particular biotope. For the OAA, the predominant habitats are the coarse and mixed sediments with low fines which are a feature of the relatively shallow, high energy environment, found across the area, especially at the Whiten Head and Stormy Banks where the seabed is at its shallowest. As outlined in Table 10-8, all habitat types listed under subtidal sands and gravels have a medium sensitivity to heavy smothering.

There is a total of approximately 467 km^2 subtidal sands and gravel habitat across the offshore Project area (377 km^2 in the OAA and 90.3 km^2 in the offshore ECC) of which up to 25.03 km^2 (see section 10.5.6.3) which could be subject to sediment deposition to a depth of ≥0.7 m which is the depth at which heavy smothering has been determined for the risk assessment. It is therefore considered that there is likelihood that smothering will cause potential mortality of some organisms through burial, particularly sessile species with no means to migrate through the sediment such as bryozoans, hydroids and soft corals. Nonetheless, the extensive undisturbed adjacent areas close by are expected to be able to support recruitment and allow faunal recovery of these sediments. While there is the possibility that the sediment type shifts from what was previously there and there could be some localised change to the benthic composition, particularly during recovery phase, the sands and gravels will essentially be replaced with more sand and gravel, so the level of disturbance in the long term is not expected to incur a fundamental shift in benthic ecology. Given the relatively localised areas affected compared with the extensive adjacent undisturbed areas, the resulting sediment deposition on subtidal sand and gravel habitats in the offshore ECC is not expected to significantly impact the overall ecological functioning of the affected seabed habitats. With the implementation of embedded mitigation measures, such as micro-siting to avoid sensitive habitats and reducing localised habitat loss, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of sediment deposition on subtidal sands and gravel habitat in the OAA is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance – NOT SIGNIFICANT

10.6.1.2.3 Ocean quahog

Ocean quahog is a low-mobility species and there is a possibility for the species to be affected by suspended sediments, the associated deposition of fines and the direct deposition of coarser material. Juvenile ocean quahog were identified by the site-specific surveys throughout the offshore Project area and two adult specimens were identified within the offshore ECC (SS5: Benthic environmental baseline report).

Suspended sediment and associated deposition

Ocean quahog have a high degree of resilience to increased suspended sediments and light deposition and are not predicted to be sensitive to this disturbance (MarLIN, 2023i). Furthermore, ocean quahog is considered to have no sensitivity to low siltation changes (Marine Scotland, 2023b). Due to the temporary nature of the construction works, low siltation can be expected. While it is considered that this species is listed under the OSPAR Convention's List of Threatened and Declining Species and a PMF, the receptor considered to have low sensitivity.

They have been recorded to be able to burrow to the surface from depths of up to 41 cm in sandy sediment types with no effect on growth or population structure (MarLIN, 2023i). It is therefore considered that the suspended sediments and smothering to a depth of <2 mm will be of negligible consequence to ocean quahog populations. Therefore, it is not predicted that ocean quahog will be impacted at a population level and overall, the associated impacts on this receptor are considered to be of a low magnitude.

Evaluation of significance

Taking the low sensitivity of the receptor and the low magnitude of the impact, the overall effect of suspended sediment and associated deposition on ocean quahog is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Minor

Impact significance – NOT SIGNIFICANT

Sediment deposition

As discussed above, ocean quahog is considered to have a resilience to sediment deposition and a deposit of 30 cm of material is predicted to have no negative effects on this species (MarLIN, 2023i). However, in the case of deposition to ≥0.7 m, this is potentially to be beyond the capacity of ocean quahog to be able to bury out of and thus the level of deposition could represent direct mortality. As well as being listed under the OSPAR Convention's List of Threatened and Declining Species, they and are considered to have high sensitivity to this disturbance.

Ocean quahog is considered to have low resilience to such disturbances and therefore mortality of individuals in the immediate vicinity of the directly disturbed area can be expected. However, the impacts of direct deposition will be localised, and the relative proportion of the supporting sands and gravels habitat affected will be small compared with the undisturbed surrounding supporting habitat. It is also considered that the large majority of records for ocean quahog across the site were of juvenile specimens and no adults were encountered in the OAA, with only two in the offshore ECC, which suggests that the population that is supported may be less important for this species than some other areas of the offshore UKCS such as the East of Gannet and Montrose Field NCMPA which is designated for the protection of ocean quahog. Given that there is predicted to be suitable habitat for ocean quahog across the wider area beyond what is directly disturbed by sediment burial to 0.7 m, it is not predicted that the ocean quahog will be impacted at a population level. Therefore, the associated impacts from sediment deposits on this receptor are considered to be of a low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of increase in suspended sediment concentrations and associated deposition during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.2.4 Kelp and seaweed communities on Atlantic infralittoral rock

Within the offshore ECC, areas of kelp and seaweed communities on Atlantic infralittoral rock (MB121) were found within the nearshore region. Kelp beds are a PMF and are listed under 'A3.115-*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock'. The kelp beds are associated with open exposed areas of bedrock close to landfall and are therefore not expected to be directly affected by trenching operations or bedform clearance although it is possible that suspended sediments and deposits from cable installation could extend into the nearshore area where kelp occurs. This is most likely with the deposits associated with the directional drilling and the HDD exit pits excavation. In addition, kelp beds are considered to be blue carbon habitats. Kelp beds are typically found within water depths of up to 20 m (MarLIN, 2023h) therefore, the habitat will only be affected by the nearshore offshore ECC installation activities.

Kelp beds are associated with rocky reef which is listed on the Annex I of the Habitats Directive and are a PMF. MarLIN (2023) explains that smothering by sediment of around 30 cm material during a discrete event is unlikely to damage kelp plants but can affect gametophyte survival, holdfast communities and the epiphytic community at the base of the stipe thus interfering with zoospore settlement and could inhibit growth. As such the resistance to heavy smothering pressure and siltation is considered to be medium, however, due to the resilience of the habitat being high, the overall sensitivity is considered to be low sensitivity.

Suspended sediments

It should be considered that kelp beds on circalittoral rock are affected by water clarity and have a medium sensitivity to changes in suspended solids, which would be a feature of excavation activities. Increased suspended sediments could increase water turbidity and reduce light availability which has the potential to affect photosynthetic activity and productivity of kelp plants. However, the temporary plume of suspended sediments is expected to disperse and return to normal conditions within a 74-hour period (most likely much less in the exposed rock outcrops near landfall). Kelp are resilient to these temporary changes in suspended sediments and unlikely to be affected by a short-term plume of suspended material and have therefore been considered as having low sensitivity to this pressure. When considering the very short duration of the sediment in suspension (up to 74 hours) coupled with the very minimal siltation depth (<2 mm), the disturbance from suspended sediments is considered both short term and unlikely to disrupt the ecological functioning of the kelp habitat. As such, the impact resulting from suspended sediment on kelp habitat is defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of increased suspended sediment on kelp beds during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Minor
Impact significance – NOT SIGNIFICANT		

Sediment deposition

While sediment resuspension and siltation are not considered significant with regard to impacts on kelp, this habitat has no resistance, very low resilience and high sensitivity to physical change to another seabed type (MarLIN, 2023h). In the case of sediment deposition, the sand deposited has the potential to completely cover the kelp, transforming the circalittoral bedrock habitat to a sediment one, fundamentally changing the seabed with the consequence of losing the kelp habitat. Kelp beds have a low sensitivity to smothering of up to 30 cm (considered as heavy smothering under MarLIN, 2023h). However, in the case of deposition relating to excavation activities in the offshore ECC, the burial depth could be several metres, which would represent a complete change to the habitat. It is not defined as to exactly what sediment burial depth would constitute a permanent shift in habitat type but for the purposes of this assessment, around 0.7 m is taken which is significantly higher than 30 cm. At this depth, an area of 8.6 km^2 could be impacted which, if was directed over kelp beds would theoretically cover over 100% of the 2.6 km^2 of associated bedrock habitat in the offshore ECC. It will be important therefore to ensure that ejection points are selected where possible to avoid bedrock areas due to this sensitivity. It should be born in mind that these nearshore bedrock habitats are highly dynamic and wave exposed and therefore in reality it can be expected that any deposited sediment would clear over time and that extreme burial scenarios of multiple metres depth is largely theoretical. With the implementation of embedded mitigation measures such as micro-siting to avoid sensitive habitats and reducing localised habitat loss, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of sediment deposition on Kelp beds during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.1.3 Increased risk of introduction and spread of INNS

There is potential for marine Invasive Non-Native Species (INNS) to be introduced or transferred by construction vessels, particularly for vessels working within an international market. This can happen through biofouling (e.g. attachment of organisms to boat hulls) or discharge of ballast water. Another potential pathway for the INNS is the towing of infrastructure to the offshore Project area introducing or transferring marine INNS.

INNS can have a detrimental effect on benthic ecology through predation on existing wildlife or outcompeting for prey and habitat. This can result in biodiversity changes in the existing habitats present in the benthic ecology study area. Depending on the INNS species introduced, this could potentially lead to complete loss of certain species and may result in new habitats forming (e.g. reef-forming species). It is worth noting that a non-native polychaete, *Goniadella gracilis* was identified at 23 different grab sample locations across the offshore Project area, with a total of 80 individuals (SS5: Benthic environmental baseline report). The species is not considered to be a threat to biodiversity or the ecological function of the benthic communities in the offshore Project area and therefore not considered to be invasive.

There will be approximately 30 vessels present on site at any one time during construction. Up to 101 different vessels will be used across the construction period. The vessels likely to be used, but not limited to, include construction support vessels, rock dump vessels, installation jack-up rigs, heavy lift vessels, cable laying vessels, and supply vessels.

In this section, the discussion of impacts to the habitats of the OAA and offshore ECC are combined wherever they are deemed to occur across both as it considered that the pressures and risk will be similar between these areas.

10.6.1.3.1 Annex I stony and bedrock reef

Within the OAA and offshore ECC, habitat resembling Annex I stony reef is present across approximately 312 km^2. These areas of reef were delineated as either circalittoral rock or circalittoral mixed sediment with cobbles and boulders interspersed with sand and gravel. Bedrock reefs were also present in the nearshore area, extending to approximately 2.6 km^2.

There is a species of colonial sea squirt, known as the carpet sea squirt (*Didemnum vexillum),* which is native to Asia that is invasive in the UK and can outcompete and smother native biological communities on rocky substrates. This species can form extensive mats over the substrata it colonises, binding boulders and cobbles and altering the host habitat (Griffith *et al.*, 2009). While this invasive species is limited to sheltered rocky locations in the UK, based on some reports from the USA where this species has been recorded in more exposed offshore locations (Lengyel *et al.*, 2009), it is deemed possible that *the carpet sea squirt* could colonize more exposed locations within the UK such as that in the Project area and potentially pose a threat. In addition to this species, another INNS considered to be of high impact within Scotland, is the leathery sea quirt *(Styela clava)*, with Scottish records mainly form the west coast. Other notable medium/low or unknown impact INNS include Japanese Kelp (*Undaria pinnatifida*), bryozoan *Schzoporella japonica* and Japanese wireweed *(Sargassum muticum)* (Marine Scotland, 2023c). Overall, the carpet sea squirt and leathery sea squirt are expected to pose the greatest threat to reef biodiversity, with consideration also for seaweed species such as the Japanese kelp in shallower areas.

When considering that the stony and bedrock reefs are Annex I habitats and a conservation priority and also possibly vulnerable to such an invasive species, this receptor is considered to have high sensitivity.

Furthermore, the UK reports of this carpet sea squirt are restricted to sheltered rocky shore areas where there is continuously high vessel traffic in confined areas such as in marinas. The offshore Project area will be subject to vessel activity for a temporary period only, during construction over a large area of open water where the reefs are fully tidally exposed and as such the threat is expected to be restricted.

The main risk identified is the invasive sea squirt species mentioned above, which has been recorded in Scottish waters. Once details are known post consent and following contractor procurement, an INNS risk assessment will be undertaken which will allow for finalisation of the outline INNS management plan that has been submitted with the application and for the Project to understand any INNS monitoring requirements. With the implementation of embedded mitigation measures for INNS impacts through the INNS management plan, the impact is assessed as being of negligible magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of INNS on stony and bedrock reefs during construction is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

10.6.1.3.2 Kelp and seaweed communities on Atlantic infralittoral rock

Within the offshore ECC, areas of kelp and seaweed communities on Atlantic infralittoral rock (MB121) were found within the nearshore region. Kelp beds are a PMF and are listed under 'A3.115-*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock'. The kelp beds are associated with open exposed areas of bedrock close to landfall. UK kelp habitats have a high sensitivity to INNS and are particularly vulnerable to the introduction of the invasive Japanese kelp *(Undaria pinnatifida*) which is native to the northwest Pacific. This species has been reported to outcompete native UK kelp species resulting in a significant decrease in abundance (MarLIN, 2023h). The main mechanism for the introduction of Japanese kelp is through hull fouling, and also potentially through ballast water transport, and therefore the introduction of this species would be associated with vessel presence in the area. It should be born in mind that any vessel presence in the vicinity will be limited in duration, thus reducing the risk of introduction of NNS to kelp habitats.

It is recognised that any impacts could affect the long-term functioning of the kelp populations. As mentioned above, once details are known post consent and following contractor procurement, an INNS risk assessment will be undertaken which will allow for finalisation of the outline INNS management plan that has been submitted with the application and for the offshore Project to understand any INNS monitoring requirements and embedded mitigation for INNS impacts through INNS management plan, the impact is defined as being of negligible magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of INNS on Kelp beds during construction is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

10.6.1.3.3 Subtidal sands and gravels

Offshore subtidal sand and gravel habitats were identified throughout the OAA and offshore ECC in areas that were not delineated as reef areas. The assigned EUNIS habitats identified during the survey generally reflect the sand, gravelly sand, mixed and coarse sediments. Sand and gravel sediments are the most common subtidal habitat around the coast of the British Isles and are abundant in the offshore waters of Scotland. Offshore subtidal sand and gravel habitats are listed as a PMF.

The sediments characterising this biotope are likely to be too mobile or otherwise unsuitable for most of the recorded INNS currently recorded in the UK. However, colonisation or establishment of INNS would likely change the biotope classification(s) and characterising species may be prey items for invasive mobile species. As such, the biotopes associated with this benthic habitat, such as *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand and *Moerella spp* with venerid bivalves in infralittoral gravelly sand, are considered to have a high sensitivity to INNS. In particular, two species may be of concern including the slipper limpet *Crepidula fornicata* which has been recorded to smother bivalves and alter seabed habitat and the colonial ascidian *Didemnum vexillum* which may have the potential to colonize and smother offshore gravel habitat and alter habitat and outcompete other species for space. Therefore, the introduction and establishment of INNS to the offshore Project area could result in long-term changes to the native biotopes.

Once details are known post consent and following contractor procurement, an INNS risk assessment will be undertaken which will allow for finalisation of the outline INNS management plan that has been submitted with the application and for the offshore Project to understand any INNS monitoring requirements, the impact is defined as being of negligible magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of INNS on subtidal sands and gravel habitat during construction is considered to be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

10.6.1.3.4 Ocean quahog

Ocean quahog are protected under the OSPAR Convention's List of Threatened and Declining Species. No evidence suggests that ocean quahog populations are particularly sensitive to the introduction of INNS (MarLIN, 2023i; Marine Scotland, 2023c). Therefore, ocean quahog are considered to have a **high sensitivity** to INNS.

Any impacts could affect the long-term functioning of the ocean quahog populations. Nonetheless, based on the localised workings of the vessels and the temporary nature of the activities and embedded mitigation for INNS impacts, such as the INNS management plan and the routine removal of marine growth, the impact is defined as being of **negligible** magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of INNS on ocean quahog during construction is considered to be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

10.6.2 Potential effects during operation and maintenance

10.6.2.1 Temporary habitat loss/ disturbance

Temporary habitat loss and disturbance will also occur during the operation and maintenance stage as a result of seabed disturbance associated with the requirement for jack-up vessel placement during major replacement activities and cable repair or replacement activities. This temporary disturbance would occur intermittently over the 30-year operation and maintenance stage. However, the spatial extent would be highly localised and is not expected to exceed the effects assessed for the construction stage. Therefore, the sensitivity and magnitude ratings for temporary habitat loss and disturbance during the construction stage is also considered applicable to the operation and maintenance stage.

Overall, the temporary disturbance in the OAA and offshore ECC during operations is considered to be low magnitude to be not significant.

Evaluation of significance

Taking the high sensitivity of the receptors and the low magnitude of the impact, the overall effect of temporary habitat loss/ disturbance during operation is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.2.2 Long term loss or damage to benthic habitats and species

Existing seabed habitats and communities may be changed in the long term due to the introduction of the infrastructure outlined in Table 10-15. Within the OAA and offshore ECC, the presence of the installed infrastructure on the seabed will represent a long-term/permanent introduction of additional hard substrate and the long-term loss of the natural sediment beneath. As per Table 10-16, the total combined long-term footprint from all activities within the offshore Project area is 7.34 km^2 (comprising 5.40 km^2 in the OAA and 1.93 km^2 in the offshore ECC). Given the combined area of the offshore Project area is approximately 782 km^2, the long-term footprint will only disturb 0.94% of the combined OAA and offshore ECC area (see Table 10-17).

An important aspect of determining the significance of the long-term impact is whether the impact is likely to incur a change in biological diversity or community composition that may impact ecosystem function to other receptors such as birds, fish and mammals (Scottish Government, 2023).

10.6.2.2.1 Annex I Stony and bedrock reef

As explained in Section 10.6.1.1.1 habitat resembling Annex I stony reef is present across 279.8 km^2 of the OAA and 29.14 km^2 of the offshore ECC respectively. These areas of reef were delineated as either circalittoral rock or circalittoral mixed sediment with cobbles and boulders interspersed with sand and gravel that resembled 'low to medium' stony reef. Along the offshore ECC, there was also an area of bedrock reef closer to shore of 2.6 km^2.

This habitat supports epifauna which includes octocorals such as dead man's fingers (*Alcyonium digitatum*) and hydroids such as sea tamarisk, which are listed on the SBL (along with the reef habitat)). The reef habitat provides a foraging area and shelter for a variety of fish species, some of which are also listed as PMF (more details in chapter 11: Fish and shellfish ecology) as well as providing habitat for epifauna such as crustaceans and echinoderms. The cobbles and boulders making up the stony reef habitat were also identified as supporting encrusting species such as the ross worm *Sabellaria spinulosa*. Aggregations of this species were not assessed to comprise biogenic reef but were associated with the geogenic stony reef substrate. The nearshore area of the offshore ECC contains areas of Annex I bedrock reef (SS5: Benthic environmental baseline report). Kelp beds and other macroalgae-dominated bedrock habitats were identified in the nearshore area, extending into the lower intertidal (SS5: Benthic environmental baseline report). The bedrock is predominantly exposed and where covered the surface composition is variable, from veneers of sand and gravel, cobble and boulders to kelp and hydrozoan turfs. As such the bedrock reef is associated with the PMF habitat kelp beds and the corresponding EUNIS habitat 'kelp and seaweed communities on Atlantic infralittoral rock' (MB121). The impact to kelp beds has been assessed separately.

The long-term disturbance in the OAA and offshore ECC affecting the stony reef habitat will arise from installation of the export, inter-array and interconnector cables, suction bucket jackets associated with the WTGs and OSPs, and the associated rock placement. The direct placement of infrastructure and protective material on the rocky habitats will replace the existing habitat in the immediate vicinity with direct mortality of all affected surfaces and replace the existing boulders and cobble substrate with anthropogenic artificial substrate.

As mentioned above, the long-term disturbance of the Project will affect an area of 7.34 km^2. Based on the Project specific survey data, it has been calculated that there is 279.8 km^2 of reef habitat within the OAA and 31.74 km^2 in the offshore ECC respectively (Table 10-18). When taking into account the proportionate area affected by long term disturbance activities across the OAA (0.82% equating to 2.3 km^2) and offshore ECC (1.5% equating to 0.49 km^2), it is predicted that up to 2.79 km^2 of reef habitat would be impacted in the long term (Table 10-18). The long-term colonisation of the introduced hard substrate is assessed in Section 10.6.2.3.

To put this long-term loss of Annex I reef into the national context, approximately 8,938 km^2 of 1170 Annex I reef is protected in Scottish waters within designated marine SACs. If it was assumed as worst case that 100% of all of the long-term seabed disturbance in the OAA and offshore ECC was to directly impact reef habitat, the area of reef affected would be proportionately only 0.08% of the total area of protected reef in Scotland which is very low in national terms.

To put this long-term loss of Annex I stony reef into the UK context, approximately 12,939 km^2 of 1170 Annex I reef is protected in UK waters within designated marine SACs. The total area of reef affected by sediment deposits within the offshore Project area is proportionately only 0.06 % of the total area of protected reef in the UK.

The epifaunal communities within the OAA and offshore ECC are expected to be well adapted to the dynamic, energetic environmental conditions present. Therefore, it is predicted that recolonisation of the introduced substrate by a similar epifaunal community and will occur throughout the operational stage of the offshore Project area. The recovery of this long-term direct impact and the recolonisation of structures is discussed in section 10.6.2.3.

It is recognised that one of the aspects influencing the benthic biodiversity across the stony reef areas is the heterogenous nature of the of seabed habitats that range from cobble and pebbles interspersed with sands and gravels. However, it is also worth noting that the high level of patchiness of the stony reef/sediment areas and high proportion of sand and gravel reduces the overall 'reefiness' of the seabed. The stony reef present across the OAA are relatively low lying and are therefore expected to be subjected to natural seabed scouring which can limit the suitability of the substrate for less tolerant flora and fauna. As explained in section 10.4.4.4, the Annex I reef in the offshore Project area was similar to the lower lying rocky areas of the Solan Bank Reef SAC that were subject to scour and had a more impoverished biodiversity. Moreover, there was no evidence that the rich epifaunal assemblages reported from surveys in the Solan Bank Reef SAC were present in the OAA or offshore ECC. Despite this, it is also considered that Annex I habitat ('medium' and 'low to medium' resemblance) will be directly lost in the long term. As such the sensitivity is considered to be of high sensitivity.

When the subsea infrastructure is installed, the small-scale patchy variation of seabed habitats present will be reduced in the immediate vicinity and replaced in the long term. However, the more elevated relief from the seabed presented by the new infrastructure may create new habitat for colonisation by a wider variety of benthic species (this is discussed further in section 10.6.2.3).

Given the relatively low proportion of reef habitat affected compared with unaffected habitat within the OAA, it is predicted that there would be no significant impact to the ecological function of these reef habitats as a result of the long-term disturbance. Overall, the long-term impacts will be localised and limited in spatial extent. Furthermore, there will be new habitat created by the new infrastructure and introduced rock and infrastructure which is discussed further in section 10.6.2.3. Where possible, rock protection will match up as much as possible with the existing hard substrate, in terms of size, shape and type of rock/materials used in order to minimise habitat alteration. With the implementation of embedded mitigation measures, such as micro-siting to avoid sensitive habitats wherever possible and reducing localised long-term habitat loss, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of long-term loss or damage to benthic habitats and species during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance – NOT SIGNIFICANT

10.6.2.2.2 Sands and gravels habitat

The site-specific survey identified a wide variety of sediment biotopes across the OAA and offshore ECC ranging from fine sand, gravelly sand and circalittoral mixed and coarse sediments. This seabed of the OAA and offshore ECC is characterised by a heterogeneous mosaic sediment habitats which are dominated by sand and gravel sediment fractions.

The environmental survey identified 15 specific sediment habitats, the majority of which fall within the broad habitat of offshore subtidal sands and gravels which covers a large proportion of the offshore project area which is estimated to be approximately 377 km^2 (57%) of the OAA and 93.27 km^2 (75%) of the offshore ECC area. Particle size analysis revealed that the sand and gravel fractions were the most prominent sediment type with a greater sand proportion in the offshore ECC. The most frequently encountered sedimentary biotopes included:

- *Moerella* spp. With venerid bivalves in Atlantic infralittoral gravelly sand (MB3233);
- *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment (MC4214);

- Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand (MC5211);
- Faunal communities of Atlantic circalittoral sand (MC521)/Atlantic offshore circalittoral mixed sediment (MC42); and
- *Lagis koreni* and *Phaxas pellucidus* in Atlantic circalittoral sandy mud.

The assigned EUNIS habitats identified during the survey generally reflected the sand, gravelly sand, mixed and coarse sediments present, although species composition at four stations along the offshore ECC also resembled sandy mud (however, there were no mud habitats identified from PSA analysis). Sand and gravel sediments are the most common subtidal habitat around the coast of the British Isles and are abundant in the offshore waters of Scotland. Offshore subtidal sand and gravel habitats are listed as a PMF.

As part of this assessment, the impacts to the sands and gravels will be discussed collectively and where deemed appropriate, attention is given to specific differences in the sensitivity or ecological effects on a particular biotope. For the OAA, the predominant habitats are the coarse and mixed sediments with low fines which are a feature of the relatively shallow, high-energy environment, found across the area, especially on Whiten Head Bank and Stormy Bank where the seabed is at its shallowest. For the offshore ECC, the predominant habitats are characterised by sand with a higher proportion of fines associated with deeper parts of the offshore EEC and in shallower areas, the sediments become similar to those found across the OAA with a highly varied patchwork of sand, gravel and cobbles and boulders in places. As outlined in Table 10-8, all habitat types listed under subtidal sands and gravels have no resistance and very low resilience to habitat change and are therefore considered to have a high sensitivity.

The introduction of the hard substrata and supporting rock along areas of the inter-array cables and interconnector cables will essentially result in the long-term loss of the sediment habitats in the immediate vicinity with no possibility of future recovery. These sediment habitats will essentially be lost.

As described above, there is approximately 377 km^2 of subtidal sands and gravel habitat across the OAA and 93 km^2 across the offshore ECC. It is predicted that 4.54 km^2 of sands and gravel habitat would be impacted long term by the construction operations in the OAA and the offshore ECC. The range of sand and gravel habitats found across the OAA are some of the most common subtidal habitats found in Scottish coastal and offshore waters.

Furthermore, the proportion of long-term loss of this habitat is small compared with the amount of sand and gravels habitats not directly impacted. Where possible, rock protection will match up as much as possible with the existing substrate, in terms of size, shape and type of rock/materials used in order to minimise habitat alteration. With the implementation of embedded mitigation measures, such as micro-siting to avoid sensitive habitats and reducing localised long-term habitat loss, the impact is defined as being of low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of long-term loss or damage to benthic habitats and species during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.2.2.3 Ocean quahog

Ocean quahog is a low-mobility species and there is a likelihood for the species to be lost through infrastructure installation activities within the OAA and offshore ECC. Juvenile ocean quahog were identified within the offshore Project specific surveys throughout the offshore Project area although no adult specimens were identified within the OAA and only two adult specimens were recorded in the offshore ECC (SS5: Benthic environmental baseline report).

Ocean quahog are listed under the OSPAR Convention's List of Threatened and Declining Species and are considered to have high sensitivity to physical change to another substrate type (MarLIN, 2023i; Marine Scotland, 2023b). Furthermore, ocean quahog has very low resilience to such disturbances and therefore mortality of individuals in the immediate vicinity of the directly disturbed area can be expected. The stressor specific impact on the life stages of this species of conservation importance comes from the long-term placement of infrastructure that will ultimately remove the available seabed sediments available for larval (spat) settlement and any potential recovery within the directly affected area for this species (Scottish Government, 2023).

However, the long-term impacts of infrastructure installation will be localised, and the proportion of the supporting sands and gravels habitat affected will be small. It is also considered that the large majority of records for ocean quahog across the site were of juvenile specimens and with only two adults encountered which suggests that while this area does support ocean quahog populations, the population that is supported may be less important for this species than some other areas of the offshore UKCS such as the East of Gannet and Montrose Field NCMPA which is designated for the protection of ocean quahog. Given that there is predicted to be suitable habitat for ocean quahog across the wider area beyond what is lost, it is not predicted that the ocean quahog will be impacted at a population level. Therefore, the associated long-term impacts on this receptor are considered to be of a low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of long-term loss or damage to benthic habitats and species during construction is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.2.2.4 Kelp and seaweed communities on Atlantic infralittoral rock

Within the offshore ECC, discrete areas of kelp and seaweed communities on Atlantic infralittoral rock (MB121) were found within the nearshore region. Kelp beds are typically found within water depths of up to 20 m (MarLIN, 2023h); therefore, the habitat will only be affected by the nearshore offshore ECC installation activities related to cable installation and the associated rock protection. Kelp beds are a PMF and are listed under 'A3.115-*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock'. In addition, kelp beds are considered to be blue carbon habitats. They are widely distributed along the UK coast, and therefore only an extremely small proportion of this habitat will be impacted by offshore export cable installation activities. Kelp beds are listed on the Annex I of the Habitats Directive and a are a PMF. Kelp beds are considered to have high sensitivity to changes in habitat type (MarLIN, 2023h).

It has been considered that the exit point at the seabed using HDD will occur between 10-40 m water depth which could be in the range of kelp and seaweed communities, especially at the shallower end (i.e. 10 m depth) and that in these locations, protection material may be required which could affect the substrates present in the long term. However, based on the highly localised spatial extent of the nearshore activities, and that directional drilling will be utilised for cable landfall it is not expected that direct impacts on kelp beds will be significant. Kelp is widely distributed along the UK coast, including the Caithness coast wherever suitable conditions occur. Therefore, only an extremely small proportion of this habitat will be temporarily impacted, if any by offshore export cable operation and maintenance activities.

Based on the highly localised spatial extent of the nearshore activities, any impacts are unlikely to affect long-term functioning of the wider kelp bed habitat. With the implementation of embedded mitigation measures such as micro-siting to avoid sensitive habitats and reducing localised long-term habitat loss, the impact is defined as being of negligible magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect of long-term loss or damage to kelp and seaweed communities during operation is considered to be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

10.6.2.3 Colonisation of hard structures

Subsea infrastructure from OWFs can provide potential new novel hard structures that can provide novel hard substrate for colonisation by epilithic species. The introduction of hard infrastructure may alter previously soft sediment habitat areas which can attract new species with a preference for hard substrates are expected to colonise the installed structures, typically increasing the habitat complexity biodiversity of the area.

As per section 10.6.2.2, the long-term footprint of the offshore Project is 7.34 km^2, present for the duration of the operation and maintenance stage (30 years). The presence of up to 125 WTG and five OSP foundations will introduce new hard structures, with the potential for encrusting epifauna typical of local bedrock and cobbles including hydroids, bryozoans, and tunicates to colonise. As these will extend to the sea surface, a zonation of encrusting flora and fauna are expected to colonise the vertical extent of the structures in the water column from the sublittoral to the littoral. However, the lack of structural complexity on the WTG and OSP structures makes it unlikely that highly diverse communities will develop, however, all biofouling represents additional food supply within the local ecosystem. It is not anticipated that the long-term provision of novel hard substrate will result in the impact propagating up the food chain (see chapter 11: Fish and shellfish ecology).

To reduce the footprint of the cable protection, the cables associated with the offshore Project will be buried where possible and cable protection will only be required where sufficient burial depth is not achieved or where there are cable crossings. It is important to note that the sediments across the offshore Project area are heterogeneous. There is a mixture of sandy, coarse and mixed sediments with large patches of rocky substrate, much of which is classified as potential reef (40% of the total offshore Project area). Therefore, a substantial change in the benthic community is not expected. Langhamer, (2012) explained that the new benthic habitats resulting from the introduction of renewable structures including scour protection, can compensate for habitat loss. It can be expected that introduced protective rock will be colonised with similar species associated with the existing stony reef habitats, with recruitment from nearby unaffected sites. Therefore, the introduced rock could therefore be considered to provide surrogate substrate and ecosystem complexity that could possibly even have positive effects on productivity and diversity through colonising organisms as well as providing shelter from predation. It is recognised that there is some uncertainty about how much of a positive effect on biodiversity there may be. The ScotMER working group considered that new infrastructure such as WTG may be associated with increased biodiversity (Scottish Government, 2023). Bearing in mind that that the infrastructure will provide a higher relief substrate with potentially lowered sediment scouring and the added reduction in fishing pressure, there may be potentially a net increase in faunal biodiversity and biomass in the vicinity of the installed infrastructure. It should also be mentioned that enrichment of organic material in the surrounding seabed sediments may also play a part in ecological effects of the increase in marine growth on the structures which may have a localised effect on the infauna communities present. However, this effect is expected to me a very localised with low consequence to the overall ecological function of the surrounding habitats.

The benthic receptors across the offshore Project area are broadly considered to be of **medium sensitivity**. The introduction of hard structures represents a minor shift away from the existing baseline conditions. Based on this, the impact is defined as being of **low magnitude**. Any impacts are unlikely to affect the long-term functioning of the baseline benthic receptors.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of colonisation of hard structures during operation is considered to be **minor** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance – NOT SIGNIFICANT

10.6.2.4 Increased suspended sediment concentrations and sediment deposition

The increase in suspended sediment and sediment deposition during operation and maintenance will be lower to that during construction, although it is acknowledged, as with the temporary impacts, that where the target cable burial depth is not achieved, or in areas where cables are exposed, further cable protection may be required as part of maintenance activities during operation. Cable repair, reburial or replacement activities (in addition to other major maintenance activities) may also result in increases in suspended sediment concentrations. The installation of this additional protection is likely to incur a further temporary increase in suspended sediment concentrations, although this will not exceed what is already discussed as a worst case in section 10.6.1.5.

Evaluation of significance

Taking the high sensitivity of the receptors as a whole across the offshore ECC and OAA and the negligible magnitude of the impact, the overall effect of the release of sediment contaminants during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

10.6.2.5 Changes in physical processes

Chapter 8: Marine physical and coastal processes concluded that there would not be a significant change in physical processes within the offshore Project area. Overall, the influence of the WTGs and OSPs on the local tidal regime, wave parameters and sediment accretion and erosion is minimal. This is reflected in the lack of change in sediment transport post-construction. It was considered that the excavation pits and associated berm formed at the HDD exit points close to the at the landfall location may have some effect on hydrodynamic and coastal processes, thus affecting subtidal ecology in the nearshore and in the intertidal area which could potentially have a high sensitivity to such changes. However, the impact was assessed to be of negligible magnitude and not significant. Therefore, this minimum change is not anticipated to affect the benthic receptors within the offshore study area.

Evaluation of significance

Taking the high sensitivity of the receptor and the negligible magnitude of the impact, the overall effect changes of physical processes during operation is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

10.6.2.6 Impact to benthic communities from any thermal load or EMF arising from the cable during operation

10.6.2.6.1 EMF

EMFs have the potential to alter the behaviour of marine organisms that are able to detect electric (E-fields, measured in volts per metre (V/m)) or magnetic (B-field, measured in micro Tesla (μT)) components of the fields. The B-field penetrates most materials, and therefore, is emitted into the marine environment, thus resulting in an associated induced Electric (iE)-field. The direct E-fields are blocked by the use of conductive sheathing within the cable, and hence are not considered further. When relative motion is present between B-fields and a conductive medium (e.g. sea water), iE-fields are produced. Earth has its own natural Geomagnetic Field (GMF) with associated B and iE-fields which species rely on for navigation (Gill and Desender, 2020; Winklhofer, 2009). The natural iE-fields result from sea water interacting with the natural GMF, due to relative motion caused by the Earth's rotation, and tidal currents (Gill and Desender, 2020).

Up to 140, 145 kV inter-array HVAC cables (500 km), six 420 kV interconnector HVAC cables (150 km) and five 420 kV offshore export cables (320 km) will be installed as part of the offshore Project. All cables will either be buried to a target depth of 1-3 m or covered by cable protection to a height of 3 m. Although the burial of cables and other protective measures such as cable protection are not considered to be effective ways to mitigate the extent of magnetic fields in the marine environment, it does separate the most sensitive species from the source of the emissions, thereby reducing the maximum field strength likely to be encountered (e.g. at the seabed) (Copping *et al.*, 2020). In addition, design parameters and installation methods are expected to conform to industry standard specifications which includes shielding technology to reduce the direct emission of EMFs.

A Project specific modelling study undertaken by a cable manufacturing contractor (currently confidential) was undertaken to inform the assessment of EMF effects, focussing on B-fields from the inter-array cables and offshore export cables. 66 kV inter-array cables at 691 A and 275 kV offshore export cables at 972 A were modelled. It is acknowledged that these voltages are less than those being proposed for the offshore Project. However, it is important to note that potential B-fields are proportional to cable current, and a higher voltage results in a smaller current. Therefore, modelling B-fields for these lower currents represents the worst case.

The results of the EMF study are shown in Table 10-22 at 0, 1, 2 and 3 m burial depths (where cable protection of up to 3 m can be treated the same as burial depth). The B-fields rapidly dissipate when assuming 1 -3 m burial or cable protection. Furthermore, the approximate natural geomagnetic field at the offshore Project area is 50 μT, and in all cases, the B-fields are less than this at 1 m burial or protection depth.

Table 10-22 Magnetic (B) fields at various burial depths for the inter-array and offshore export cables

COMPONENT	BURIAL DEPTH (M)			
	0	1	2	3
Inter-array cable B-fields	348 μT	9.3 μT	2.8 μT	1.3 μT
Offshore export cables	507 μT	18 μT	5.7 μT	2.7 μT

The results above are also similar to the modelling conducted by Normandeau *et al.* (2011) on a range of subsea cable designs, including HVAC cables ranging from 35 – 132 kV with 1 – 600 MW. Normandeau *et al.* (2011) showed that the average B-fields for the modelled HVAC cables (when assuming 1 m cable burial), were 7.85 μT at the seabed directly above the cable (i.e. horizontal distance from the cable = 0).

Although the effects of EMFs on benthic communities are not well understood, recent studies suggest that benthic communities growing along cables route are similar to those in nearby baseline areas, and where species are not found this is likely due to the physical presence of the cable and surface properties, rather than an EMF effect (Copping and Hemery, 2020). Information on the effects of EMF on fish and shellfish species is presented within chapter 11: Fish and shellfish ecology.

The burrowing activity of the polychaete *Hediste diversicolor* was enhanced in the presence of EMF up to 1 mT, although no avoidance or attraction behaviour to EMF was shown (Jakubowska, 2019). Enhanced sediment reworking activity observed in response to exposure to EMF might be profitable for the ecosystem in terms of sediment oxygenation and stimulation of cycling of nutrients.

Benthic receptors are considered to have a moderate vulnerability to EMF effects. Therefore, the receptors are assessed to have a medium sensitivity. EMF will be continuous and emitted throughout the life cycle of the offshore Project (i.e. long term). However, based on the local spatial extent of this impact, and the widespread distribution of the benthic communities, it is defined as being of low magnitude.

Evaluation of significance

Taking the medium sensitivity of the receptor and the low magnitude of the impact, the overall effect of EMF during operation is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance – NOT SIGNIFICANT

10.6.2.6.2 Thermal load

Cables have the potential to emit heat into the surrounding environment as when electric energy is transported, a certain amount dissipates as heat energy (OSPAR Commission, 2009). Therefore, there is the potential that the buried inter-array cables within the OAA and the offshore export cables within the offshore ECC have the potential to emit heat energy (or thermal emissions) into the surrounding sediment.

A substantial increase in sediment temperature can potentially alter the physical and chemical properties of the substratum such as the oxygen concentration. These changes can have knock on effects (or indirect impacts) that lead to alterations in the microorganism communities (Rhoads and Boyer, 1982; OSPAR Commission, 2008).

Although there has been limited research into the impacts of thermal loading as it relates to subsea cables, based on available evidence, the benthic receptors are considered to be of high sensitivity, based on the value of the presence of ocean quahog, and the impact is defined as being of low magnitude.

Any impacts are therefore unlikely to affect the long-term functioning of the other benthic receptors within the benthic ecology study area. Therefore, the overall effect to benthic ecology receptors is considered to be minor and not significant.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of thermal load during operation is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance – NOT SIGNIFICANT

10.6.2.7 Introduction and spread of INNS

The risk of potential introduction of INNS from vessels during operation and maintenance are expected to be lower than that during construction. As such these effects are assessed as a worst case in section 10.6.1.3. This section focuses on the potential stepping-stone effect of the installed infrastructure present within the offshore Project area during the operational stage as highlighted by the ScotMER Receptor group (Scottish Government, 2023).

As per section 10.5.6.1, the long-term footprint of the Project is 7.34 km^2, present for the duration of the offshore Project (30 years). In addition, the presence of up to 125 WTG and five OSP foundation structures could act as a stepping-stone for INNS with pelagic larvae that move passively under the influence of currents, such as barnacles, bivalves and algae. There is some evidence that introduced structures in UK offshore waters provide new or unique opportunities for INNS which could facilitate their introduction (De Mesel *et al.*, 2015; Kerckhof *et al.*, 2010).

As described previously in section 10.6.1.3, INNS can have a detrimental effect on the benthic ecology of an area through predation on existing wildlife or outcompeting for prey and habitat, with resultant changes to localised biodiversity (Inger *et al.*, 2009).

With the implementation of embedded mitigation measures for INNS impacts through the INNS management plan, which will include periodic inspections and clearance of marine growth from the infrastructure, the impact is considered to be of negligible magnitude.

Evaluation of significance

Taking the high sensitivity of the receptors and the negligible magnitude of the impact, the overall effect of thermal load during operation is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

10.6.3 Potential effects during decommissioning

In the absence of detailed information regarding decommissioning works, the impacts during the decommissioning of the offshore Project are considered analogous with, or likely less than, those of the construction stage.

10.6.3.1 Removal of hard structures during decommissioning

The worst case scenario for decommissioning will be a clear seabed, where substructures and foundations that extend below the seabed will be cut approximately 1 m below the seabed to allow removal of the substructure. The same applies for the worst case scenario of the offshore export cables, inter-array cables and the interconnector cables; a clear seabed where some materials may be left *in situ*. The cable ends will be buried at an acceptable depth below the seabed and exposed sections of the cable will most likely be cut and removed or subjected to rock placement.

A Decommissioning Programme will be developed and approved pre-construction to address the principal decommissioning measures for the offshore Project, this will be written in accordance with applicable guidance and will detail the management, environmental management and schedule for decommissioning. Prior to the commencement of any decommissioning works, the Decommissioning Programme will be reviewed and revised as required in accordance with the industry practice at that time. The decommissioning activities are expected to take a similar duration as the construction programme.

Given the nature of the decommissioning activities and the worst case being full removal of the offshore infrastructure (see Table 10-15), which will largely be a reversal of the installation process, the impacts during decommissioning are expected to be similar in extent or less than those assessed for the construction stage. The removal of the hard structures will also result in the reduction in the long-term footprint calculated for the operational stage, although it can be expected that the majority of the rock protection will remain *in situ*.

The removal of the infrastructure will essentially result in loss of the artificial hard structures such as the WTG foundations, which will have been colonised by sessile epifauna which themselves will have provided an ecological function, providing food and shelter to other species such as fish. With the removal of these three-dimensional structures and associated colonised surfaces will be replaced with a return to a more open expanse of seabed substrates similar to what was present pre-construction. As there is expected to be little or no impacts to the physical processes at the seabed from the offshore Project area, the surrounding seabed out-with the immediate long term project footprint is expected to remain relatively intact, allowing for the potential of recruitment and recolonisation of the seabed left behind from the undisturbed areas. It is noted that this recovery period will follow the temporary disturbance associated with the physical removal of the infrastructure.

Therefore, the magnitude of impacts assigned to benthic and intertidal ecology receptors during the construction stage is also applicable to the decommissioning stage. It is also assumed that the receptor sensitivities will not materially change over the lifetime of the offshore Project. Therefore, the temporary decommissioning effects are not expected to exceed those assessed for construction. While all benthic receptors are considered to be of high sensitivity, and the impact is defined as being of low magnitude.

Any impacts are therefore unlikely to affect the long-term functioning of the other benthic receptors within the benthic ecology study area. Therefore, the overall effect to benthic ecology receptors from decommissioning is considered to be minor and not significant.

Evaluation of significance

Taking the high sensitivity of the receptors and the negligible magnitude of the impact, the overall effect of decommissioning operations is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.6.4 Summary of potential effects

A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the offshore Project is provided in Table 10-23.

No significant effects on benthic and intertidal ecology receptors were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in section 10.5.4 are not considered necessary.

Table 10-23 Summary of potential effects

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction						
Temporary habitat loss/ disturbance	Stony and bedrock reef	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Sands and gravels	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Ocean quahog	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Kelp and seaweed communities	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increased suspended sediment	Stony and bedrock reef	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
concentrations and associated deposition	Sands and gravels	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Ocean quahog	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Kelp and seaweed communities	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Sediment Deposition	Stony and bedrock reef	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Sands and gravels	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Ocean quahog	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
	Kelp and seaweed communities	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increased risk of introduction and spread of INNS	Stony and bedrock reef	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Sands and gravels	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Ocean quahog	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Kelp and seaweed communities	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Operation and maintenance						
Temporary habitat loss/ disturbance	All benthic receptors discussed collectively	High (highest sensitivity of all receptors)	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long-term loss or damage to benthic habitats and species	Stony and bedrock reef	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Sands and gravels	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Ocean quahog	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	Kelp and seaweed communities	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Colonisation of hard structures	All benthic receptors discussed collectively	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increased suspended sediment concentrations and associated deposition	All benthic receptors discussed collectively	High (Highest sensitivity of all receptors))	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Changes in physical processes	All benthic receptors discussed collectively	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Impact to benthic communities from any thermal load or EMF arising from the cable during operation	All benthic receptors discussed collectively	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Introduction and spread of INNS	All benthic receptors discussed collectively	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Decommissioning						
Removal of hard substrate during decommissioning	All benthic receptors discussed collectively	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

10.7 Assessment of cumulative effects

10.7.1 Introduction

Potential impacts from the offshore Project have the potential to interact with those from other developments, plans and activities, resulting in cumulative impacts on benthic ecology receptors. The general approach to the cumulative effects assessment is described in chapter 7: EIA methodology and further detail is provided below.

The list of relevant developments for inclusion within the cumulative effects assessment is outlined in Table 10-24. This has been informed by a screening exercise, undertaken to identify relevant developments for consideration within the cumulative effects assessments for each EIA topic, based on defined Zones of Influence (ZoI).

Developments within 20 km (and 50 m for intertidal) of the offshore Project are considered for the cumulative effects assessment for benthic ecology. A 20-km ZoI was initially applied to inform the cumulative development list to try and capture overlapping maximum excursion extents. Modelling undertaken within chapter 8: Marine physical and coastal processes has shown that the maximum lateral excursion of suspended sediments would be 20 km buffer around the OAA and 30 km from the offshore ECC. The developments within these buffer areas are listed in Table 10-24.

Table 10-24 List of developments considered for the benthic ecology cumulative impact assessment

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[9]
West of Orkney	OWF export cable	West of Orkney Windfarm – transmission connection to the Flotta Hydrogen Hub	0	0[10]	Pre-application	Low
Pentland Firth	OWF	Pentland Floating Offshore Wind Farm (PFOWF)[11]	20	2	Consented	Medium
Pentland Firth (Caithness to Warebeth)	Subsea power cable	SHET-L Orkney-Caithness Interconnector Project	22	0	Consented	Medium
Murkle Bay, Caithness to Rackwick Bay, Orkney	Power distribution cable	Pentland Firth East (3) Cable Replacement	26	11	Under construction	High

The following impacts have been taken forward for the cumulative assessment:

[9] *Confidence ratings have been applied to each cumulative development where: 'Low' = pre-application or application, 'Medium' = consented and 'High' = under construction or operational.*

[10] *Note that there is not a direct overlap between the offshore Project and the West of Orkney Windfarm – transmission connection to the Flotta Hydrogen Hub. This development will be a cable corridor in a different location to the offshore Project.*

[11] *Pentland Floating Offshore Wind Farm (PFOWF) will incorporate the currently consented Pentland Floating Offshore Wind Demonstrator turbine, and hence PFOWF only has been considered. The PFOWF Section 36 Consent and Marine Licence was granted for 10 years. However, the cumulative effects assessment has been based on the Project Design Envelope, as specified within the EIA, and therefore, an operational life of up to 30 years for the PFOWF has been considered. Since consent was granted in June 2023, PFOWF have submitted a Screening Report to MD-LOT with the intention to request a variation to the Section 36 Consent. This variation will incorporate refinements to the Project Design Envelope and to extend the operational life to 25 years.*

- Construction and decommissioning:
  - Temporary habitat loss/disturbance;
  - Long-term loss or damage to benthic habitats;
  - Increase in suspended sediment concentration and sediment deposition;
  - Increase risk and introduction and spread of INNS; and
- Operation and maintenance:
  - Temporary habitat loss/disturbance;
  - Increase in suspended sediment concentration and sediment deposition;
  - Colonisation of hard structures;
  - Impact to benthic communities from any thermal load or EMF; and
  - Introduction and spread of INNS.

10.7.2 Cumulative construction effects

The types of developments considered within the cumulative effects assessment are those within 20 km of the offshore Project and include: West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub, the SHET-L Caithness to Orkney HVAC Link, the PFOWF and the Pentland Firth East (3) Cable Replacement. There will be temporary seabed disturbance during the construction of these three developments. The replacement works for the Pentland Firth East (3) Cable replacement are anticipated to be complete by August 2023, and therefore will not overlap with the offshore Project construction stage. The construction timelines for the West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub are unknown, however, an overlap with the construction of the offshore Project cannot be ruled out. The SHET-L Caithness to Orkney HVAC Link is expected to be installed by 2027, which may overlap with offshore Project construction timeline.

10.7.2.1 Temporary habitat loss/disturbance

As described above for the offshore Project alone, the most sensitive benthic habitats and species to temporary habitat loss has high sensitivity.

For the West of Orkney Windfarm transmission connection it is anticipated that up to five offshore export cables may be installed to Hoy, with a length of up to 340 km each. For the SHET-L Caithness to Orkney HVAC Link, it is anticipated that up to 1 km^2 of temporary habitat loss and disturbance may result from the seabed preparation and cable installation activities (Scottish and Southern Electricity (SSE), 2019). It is expected that for both of these cable installation developments, any temporary disturbance will be highly localised with some recovery of the seabed once the installation activities are completed. Furthermore, it likely that the temporal overlap in the construction activities of these developments and the offshore Project will be limited.

The PFOWF will be in its operation and maintenance stage during the offshore Project construction. Therefore, any temporary habitat loss during the operation and maintenance stage is expected to be highly localised.

Overall, the temporary habitat loss of the cumulative developments will not substantially increase that which is associated with the offshore Project. Therefore, the impact remains as being at a low magnitude for all receptors. Therefore, the overall effect is assessed to be minor and not significant in EIA terms.

10.7.2.2 Increase in suspended sediment concentration and sediment deposition

As described above for the offshore Project alone, the most sensitive benthic habitats and species to increase in suspended sediment concentration and sediment deposition has high sensitivity.

The West of Orkney Windfarm – transmission connection to the Flotta Hydrogen Hub, PFOWF and SHET-L Caithness to Orkney HVAC Link developments all have the potential to cause a localised increase in suspended sediment concentration and sediment deposition.

The PFOWF EIA concluded that the majority of the disturbed sediment during trenching would be deposited within the 500 m of the disturbance (Highland Wind Limited, 2022). Only a small proportion would enter into suspension (discussed below). The SHET-L Caithness to Orkney HVAC Link development suggests that sediments disturbed by trenching activities are likely to re-settle within the immediate vicinity of the trench, less than 10 m either side, for sand or coarser sediments (SSEN, 2019). The scale of deposition associated with Project construction activities is somewhat greater (section 10.6.1.2). However, this is considered to be minimal overall in the context of the whole offshore Project area. In combination with these two other developments, the scale of deposition and change to seabed levels is unlikely to be noticeable in the context of the wider environment.

Suspended sediment concentration was assessed in the PFOWF EIA. Only the silt fraction (less than 5% of the sediment fraction) was assumed to contribute to the formation of a plume. The maximum sediment plume extent was estimated to be 3.3 km on a flood tide, with a duration of 4.7-hours. On an ebb tide, the plume is expected to have an extent of around 2.4 km and a duration of less than 4 hours. The PFOWF EIA suggested that a similar plume development could occur with the SHET-L Caithness to Orkney HVAC Link development. In both cases the plume would disperse with the tidal and wave currents in the nearshore area within a few hours and certainly within a tidal cycle (Highland Wind Limited, 2022). These extents and timescales are relatively consistent with what is discussed in chapter 8: Marine physical and coastal processes. For the offshore Project alone, albeit slightly reduced. Most importantly, the timelines associated with these two other developments indicates that they will be installed by 2027. Therefore, the opportunity for overlap in sediment plumes associated with all these activities is highly unlikely.

The PFOWF assumes 0.4% of their export cable will require external protection. Within the corresponding array area, 1% of the development area will be occupied by the placement of hard substrate. As the development is floating and relatively small in scale, the impact on the seabed is comparatively limited. In the PFOWF cumulative assessment, the identified a region of overlap between the windfarm and the SHET-L Caithness to Orkney HVAC Link development of approximately a 500 m section off the coast (depending on final HDD pop out locations). Therefore, the area of overlap is very small and the requirement for cable protection measures within that area from both developments is unlikely. The PFOWF EIA concluded there was no cumulative impact. These two developments reach landfall approximately 2 km southeast from the Project's Greeny Geo offshore ECC landfall location therefore will not overlap directly with the offshore Project area at this point.

The SHET-L Caithness to Orkney HVAC Link development will cross the Project offshore ECC further offshore thereby necessitating the use of rock protection at the crossing (as it assumed that the SHET-L Caithness to Orkney HVAC Link development will be installed first). The offshore Project area is mostly covered in mixed sediments which are generally more coarse in nature. The overall scale of seabed lost due to rock placement is minimal in the context of the wider region. With regards to other construction impacts, these will be temporary in nature and so the seabed is expected to recover from this temporary disturbance relatively rapidly.

Overall, the scale of the other two developments is small in comparison to the offshore Project. Therefore, the impacts associated with the other developments are not likely to add considerably to the impact of the offshore Project alone. The cumulative impact remains consistent with the assessment for the offshore Project alone. Therefore, the impact remains as being at a low magnitude for all receptors and the overall effect is assessed to be minor for all receptors and not significant in EIA terms.

10.7.2.3 Increase risk and introduction and spread of INNS

As described for the offshore Project alone, the most sensitive benthic habitats and species from the introduction and spread of INNS has high sensitivity.

As there is potential for the construction periods of the developments mentioned above to overlap with the offshore Project's construction period, there is the potential for a temporary increase in the number of vessels in the area that have the potential to introduce INNS. It is, however, assumed that all vessels will adhere to embedded mitigation industry standards, including the Ballast Water Management Convention (2004), and will undertake an INNS risk assessment/ management plan that will indicate whether there is a risk of INNS. Therefore, the impact remains as being of a negligible magnitude. As such, the overall cumulative effects are assessed to be negligible and not significant in EIA terms.

10.7.3 Cumulative operation and maintenance effects

10.7.3.1 Temporary habitat loss/disturbance

As described above for the offshore Project alone, the most sensitive benthic habitats and species to temporary habitat loss has high sensitivity.

The types of developments considered within the cumulative effects assessment are those within 20 km of the offshore Project and include: West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub, the SHET-L Caithness to Orkney HVAC Link, the PFOWF and the Pentland Firth East (3) Cable Replacement. There will be temporary seabed disturbance during any maintenance work undertaken at these developments during their operational lifetimes. However, it is anticipated that any to temporary habitat loss/ disturbance will be significantly less than that occurring during construction. It is also unlikely that all cumulative developments will require maintenance works simultaneously.

Overall, the temporary habitat loss of the cumulative developments will not substantially increase that which is associated with the offshore Project. Therefore, the impact remains as being at a low magnitude for all receptors. Therefore, the overall effect is assessed to be minor for all receptors and not significant in EIA terms.

10.7.3.2 Long-term loss or damage to benthic habitats

As described above for the offshore Project alone, the most sensitive benthic habitats and species to long term habitat loss has high sensitivity.

The types of developments considered within the cumulative impact assessment are those within 20 km of the OAA and within 30 km of the offshore ECC and include: the West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub, the SHET-L Caithness to Orkney HVAC Link, the PFOWF and the Pentland Firth East (3) Cable Replacement. There will be long term habitat loss associated with the introduction of hard substrate associated with these developments which will have a cumulative effect. There is limited information available for the West of Orkney Windfarm transmission connection. However, it is anticipated that up to five offshore export cables may be installed, with a length of up to 340 km to Hoy. For the SHET-L Caithness to Orkney HVAC Link, it is anticipated that up to 1.03 km^2 of long term habitat loss and disturbance may occur (SSEN, 2019). Overall, the habitat loss of the cumulative developments will not substantially increase that which is associated with the offshore Project. Therefore, the impact remains as being at a low magnitude for all receptors. Therefore, the overall effect is assessed to be minor for all receptors and not significant in EIA terms.

10.7.3.3 Increase in suspended sediment concentration and sediment deposition

As described above for the offshore Project alone, the most sensitive benthic habitats and species to increase in suspended sediment concentration and sediment deposition has medium sensitivity.

The West of Orkney Windfarm – transmission connection to the Flotta Hydrogen Hub, PFOWF and SHET-L Caithness to Orkney HVAC Link developments all have the potential to cause a localised increase in suspended sediment concentration and sediment deposition during maintenance activities. However, it is anticipated that any to temporary habitat loss/ disturbance will be significantly less than construction. It is also unlikely that all cumulative developments will require maintenance works simultaneously.

Overall, the scale of the other two developments is small in comparison to the offshore Project. Therefore, the impacts associated with the other developments are not likely to add considerably to the impact of the offshore Project alone. Therefore, the cumulative impact remains consistent with the assessment for the offshore Project alone. Therefore, the impact remains as being at a low magnitude for all receptors and the overall effect is assessed to be minor for all receptors and not significant in EIA terms.

10.7.3.4 Colonisation of hard structures

As described above for the offshore Project alone, the most sensitive benthic habitats and species to impacts from the introduction of hard structures has medium sensitivity.

The potential areas for the colonisation of hard structures will be localised to discrete areas around the WTGs, OSPs, scour protection and cable protection associated with the inter-array cables, interconnector cables and offshore export cables. Therefore, only the SHET-L Caithness to Orkney HVAC Link, the PFOWF and the West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub have been considered as having the potential to act cumulatively with the offshore Project.

Hard substrate will be introduced in areas of cable protection. However, as noted in the Marine Environmental Appraisal (MEA) for this development, the offshore areas of the cable installation corridor for the SHET-L Caithness to Orkney HVAC Link are located in areas with rocky substrates, and thus, any potential reef effect would be minimal (SSEN, 2019). The long term seabed footprint associated with the PFOWF extends to a total of 0.22 km^2. As the

PFOWF will also include up to 7 WTGs, 63 mooring lines and 7 dynamic cables in the water column that may become fouled (although anti-fouling paint will be used to minimise this), there is the potential that this development could be colonised (Highland Wind Limited, 2022). As described previously, details on the West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub are limited. However, it would be expected that some hard substrate may be required for cable protection, which could result in the colonisation of these structures.

Overall, the potential colonisation of hard substructures effects of the cumulative developments will be highly localised and are not expected to substantially increase that which is associated with the offshore Project. Therefore, the impact remains as being at a low magnitude for all receptors. Therefore, the overall effect is assessed to be minor for all benthic ecology receptors and not significant in EIA terms.

10.7.3.5 Impact to benthic communities from any thermal load or EMF

As described above for the offshore Project alone, the most sensitive benthic habitats and species to thermal load and/or EMF has high sensitivity.

The range of thermal load and EMF from subsea cables is very localised, therefore, only the SHET-L Caithness to Orkney HVAC Link, the PFOWF, the West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub and the Pentland Firth East (3) Cable replacement have been considered as having the potential to act cumulatively with the offshore Project. The SHET-L Caithness to Orkney HVAC Link, the PFOWF and the Pentland Firth East (3) Cable replacement state commitments to burying cables to a sufficient depth where possible or, where burial is not possible, cable protection measures will be applied to reduce the effects of EMF (SSEN, 2019; Highland Wind Limited, 2022; SSEN, 2022). PFOWF will also consist of suspended cables in the water column. However, the EMF effects associated with these cables are also anticipated to be highly localised.

The offshore Project may have to cross the SHET-L Caithness to Orkney HVAC Link. The crossing will be in line with industry best practice to reduce any potential damage and in accordance with a crossing agreement, sought between SHET-L and OWPL. Proximity agreements will also be developed, if required, and these will seek agreement on how close construction activities can occur to existing infrastructure. Any cumulative thermal load or EMF levels are anticipated to be highly localised. Proximity agreements will be in place, and therefore, the cables will not be close enough to cause cumulative thermal load or EMF effects, with the exception of the point of crossing, where the cables will be protected. Therefore, the impact is still considered to be low magnitude, making the overall effect minor for all benthic ecology receptors and not significant in EIA terms.

10.7.3.6 Introduction and spread of INNS

As described for the offshore Project alone, the most sensitive benthic habitats and species from the introduction and spread of INNS has high sensitivity.

The types of developments considered within the cumulative effects assessment are those within 20 km of the offshore Project and include: West of Orkney Windfarm transmission connection to the Flotta Hydrogen Hub, the SHET-L Caithness to Orkney HVAC Link, the PFOWF and the Pentland Firth East (3) Cable Replacement. There is potential for the maintenance periods of the developments to overlap with maintenance activities for the offshore Project, which will result in a temporary increase in vessel in the area. However, the number of vessels will be significantly less than those during construction. It is however, assumed that all vessels will adhere to embedded mitigation industry standards, including the Ballast Water Management Convention (2004), and will undertake an INNS risk assessment/ management plan that will indicate whether there is a risk of INNS. Therefore, the impact remains as being of a negligible magnitude. As such, the overall cumulative effects are assessed to be negligible and not significant in EIA terms.

10.7.4 Cumulative decommissioning effects

There is limited information on the decommissioning of the offshore Project and that of other developments. However, the cumulative effects are expected to be less than or equal to the construction stage. Furthermore, decommissioning of multiple other developments would not be expected to occur at the same time as the decommissioning stage of the offshore Project.

A Decommissioning Programme will be developed pre-construction to address the principal decommissioning measures for the offshore Project and will be written in accordance with applicable guidance. The Decommissioning Programme will detail the environmental management, and schedule for decommissioning and will be reviewed and updated throughout the lifetime of the offshore Project to account for changing best practices.

10.7.5 Summary of cumulative effects

A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning stages of the offshore Project is provided in Table 10-25.

Table 10-25 Summary of assessment of cumulative effects

POTENTIAL IMPACT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning						
Temporary habitat loss/disturbance	All receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increase in suspended sediment concentration and sediment deposition	All receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increase risk and introduction and spread of INNS	All receptors	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Temporary habitat loss/disturbance	All receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL IMPACT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long-term loss or damage to benthic habitats	All receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Increase in suspended sediment concentration and sediment deposition	All receptors	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Colonisation of hard structures	All receptors	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Impact to benthic communities from any thermal load or EMF	All receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Introduction and spread of INNS	All receptors	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

10.8 Inter-related effects

Inter-related effects are the potential effects of multiple impacts, effecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different stages of the offshore Project (i.e. interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a receptor within an offshore Project stage. The potential inter-related effects for benthic ecology receptors are described below.

10.8.1 Inter-related effects between offshore Project stages

All offshore Project stages have the potential to impact various benthic and intertidal ecology receptors. Impacts relating to EMF and thermal load, colonisation of hard substructure, changes in physical processes will only occur during the operation and maintenance stage. Therefore, there will be no combined effect with the construction or decommissioning stages.

Temporary and long term habitat loss/disturbance, and increases in suspended sediment and associated deposition during operation and maintenance may occur in the same areas as construction and decommissioning (e.g. WTG and OSP foundations (and associated scour protection) will be located in areas disturbed by bedform clearance). However, the majority of habitat disturbance/ loss and/or sediment disturbance during the construction stage will be temporary and localised, with a recovery of the seabed once construction activities have ceased. Therefore, there is considered to be a limited potential for an interaction between the habitat loss/ disturbance and / or sediment disturbance during the construction, operation and maintenance and decommissioning stages to result in a greater effect than when each stage is assessed in isolation.

10.8.2 Inter-related effects within an offshore Project stage

During the operation and maintenance stage, the spatial extent associated with temporary and long term habitat loss and disturbance, EMF and thermal load, and colonisation of hard structures will be similar and receptors may be affected by these impacts simultaneously. However, considering the highly localised extent of these effects, the combined effect of these impacts during the operation and maintenance stage is not expected to result in a greater effect than the assessment of these impacts in isolation.

10.9 Whole Project assessment

The onshore Project is summarised in chapter 5: Project description and a summary of the effects of the onshore Project is provided in chapter 21: Onshore EIA summary. These onshore aspects of the Project have been considered in relation to the impacts assessed in section 10.5.6. The findings are presented below.

The onshore Project will undertake HDD operations above MHWS, with an HDD exit point offshore. The impacts from the HDD exit point on benthic ecology receptors have been assessed in full in section 10.5.6. It is not anticipated that there will be any additional impacts from the onshore Project on benthic ecology receptors as all other activities from the onshore Project are fully terrestrial.

10.10 Ecosystem effects

Benthic habitats and species play and important role within the food chain, largely occupying the lower trophic levels of primary producers and primary consumers and form prey or feeding habitats for fish and shellfish species. Benthic habitats also influence the abundance and distribution of key prey species, being fish and shellfish, with species such as sandeel having close association with specific substrates and herring utilising specific habitats for spawning. A holistic approach has been undertaken in the identification of impacts to consider any potential impacts that may occur at an ecosystem scale and particularly across trophic levels (e.g. impacts on prey species affecting their availability for predators). Changes in the availability or distribution of benthic habitats and species could have cascading effect on other species within the ecosystem and may indirectly affect those species that feed on them (predator species including piscivorous fish, marine mammals and birds).

The impacts discussed in this chapter may indirectly affect fish and shellfish receptors, which may in turn indirectly affect high trophic levels such as marine mammals and seabirds. As assessed in section 10.6, no significant impact on benthic and intertidal ecology have been concluded. Indirect effects to fish and shellfish species related to changes in availability or distribution of prey has been assessed within chapter 11: Fish and shellfish ecology and subsequently the effect of changes on fish prey for marine mammals and offshore ornithology is assessed in chapter 12: Marine mammals and megafauna and chapter 13: Offshore and intertidal ornithology, respectively. Marine mammals and megafauna, as largely generalist feeders, highly mobile and wide ranging were considered to be of low sensitivity to changes in prey availability. A number of offshore bird species (kittiwakes, Arctic terns, guillemots, razorbills, puffins, fulmars and gannets) are considered to be of medium sensitivity to indirect effects to prey species. No significant impacts have been concluded within these assessments either.

10.11 Transboundary effects

Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

There is no potential for transboundary impacts upon benthic ecology receptors due to construction, operation and maintenance and decommissioning of the offshore Project. The impacts on benthic receptors are localised and will not affect other EEA states. Therefore, transboundary effects for benthic and intertidal ecology receptors do not need to be considered further.

10.12 Summary of mitigation and monitoring

No secondary mitigation, over and above the embedded mitigation measures proposed in section 10.5.4, is either required or proposed in relation to the potential effects of the offshore Project on benthic and intertidal ecology as no adverse significant impacts are predicted.

The EIA predicts that areas of temporary seabed disturbance during construction activities will recover, especially given the dynamic environment within the offshore Project area. However, OWPL will monitor the recovery of sensitive seabed habitats and communities post-construction. The approach to monitoring will be determined in discussion with NatureScot and other relevant stakeholders during the post-consent stage but is expected to involve grab sampling and seabed photography in both disturbed and undisturbed areas, using methods compatible with those used in the benthic baseline survey.

Furthermore, if the INNS risk assessment indicates the requirement for INNS monitoring, appropriate monitoring will be agreed with Marine Directorate.

The monitoring details will be included within the Project Environmental Monitoring Plan (PEMP) that will be subject to approval as part of the discharge of consent conditions.

10.13 References

ABPmer (2008). Atlas of UK Marine Renewable Energy Resources. Available online at: https://marine.gov.scot/data/atlas-uk-marine-renewable-energy-resources-2008-abpmer [Accessed 08/08/2023].

Copping, A. E. and Hemery, L. G. (2020). State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES). Available online at: https://tethys.pnnl.gov/publications/state-of-the-science-2020 [Accessed 08/08/2023].

De Mesel, I., Kerckhof, F., Norro, A., Rumes, B. and Degraer, S. (2015). Succession and seasonal dynamics of the epifauna community on offshore wind farm foundations and their role as stepping stones for non-indigenous species. *Hydrobiologia*, 756, pp.37-50.

Department for Business, Energy and Industrial Strategy (BEIS) (now DESNZ) (2022). UK OESEA4. Available online at: https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-4-oesea4 [Accessed 08/08/2023].

Department of Energy and Climate Change (now DESNZ) (2004). Synthesis of Information on Benthos of Area SEA 5. Available online at: https://www.gov.uk/government/publications/strategic-environmental-assessment-5-supporting-documents [Accessed 08/08/2023].

Eno, N.C., Clark, R.A., and Sanderson, W. G. (1997). Non-native marine species in British waters: a review and directory. Peterborough: JNCC. Available online at: https://data.jncc.gov.uk/data/1684dd5e-36e3-4969-852f-4541c82240eb/non-native-species-review-directory.pdf [Accessed 08/08/2023].

European Marine Observation and Data Network (EMODnet) (2021). EMODnet broad-scale seabed habitat map for Europe (EUSeaMap). Available online at: https://emodnet.ec.europa.eu/en/seabed-habitats [Accessed 08/08/2023].

Gill, A.B. and Desender, M. (2020). 2020 State of the Science Report, Chapter 5: Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices. Available online at: https://www.osti.gov/servlets/purl/1633088 [Accessed 08/08/2023].

Golding. N., Albrecht. J., and McBreen. F. (2020). Refining criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656, JNCC, Peterborough, ISSN 0963-8091. Available online at: https://data.jncc.gov.uk/data/4b60f435-727b-4a91-aa85-9c0f99b2c596/JNCC-Report-656-FINAL-WEB.pdf [Accessed 08/08/2023].

Griffith, K., Mowat, S., Holt, R.H., Ramsay, K., Bishop, J.D., Lambert, G. and Jenkins, S.R., (2009). First records in Great Britain of the invasive colonial ascidian *Didemnum vexillum* Kott, 2002. Aquatic Invasions, 4(4), pp.581-590.

Highland Wind Limited (2022). Pentland Floating Offshore Wind Farm: Environmental Impact Assessment Report. Available online at: https://marine.gov.scot/ml/pentland-floating-offshore-wind-farm [Accessed 08/08/2023].

Hughes, S.L., Hindson, J., Berx, B., Gallego, A. and Turrell, W.R. (2018) Scottish Ocean Climate Status Report 2016. Scottish Marine and Freshwater Science Vol 9 No 4, 167pp. DOI: 10.7489/12086-1. Available online at: https://data.marine.gov.scot/dataset/scottish-ocean-climate-status-report-2016 [Accessed 08/08/2023].

Inger, R., Attrill, M.J., Bearhop, S., Broderick, A.C., James Grecian, W., Hodgson, D.J., Mills, C., Sheehan, E., Votier, S.C., Witt, M.J. and Godley, B.J. (2009). Marine renewable energy: potential benefits to biodiversity? An urgent call for research. Journal of applied ecology, 46(6), pp.1145-1153.

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. JNCC Report No. 432. Available online at: https://data.jncc.gov.uk/data/21693da5-7f59-47ec-b0c1-a3a5ce5e3139/JNCC-Report-432-FINAL-WEB.pdf [Accessed 08/08/2023].

Jakubowska, M., Urban-Malinga, B., Otremba, Z. and Andrulewicz, E. (2019). Effect of low frequency electromagnetic field on the behaviour and bioenergetics of the polychaete *Hediste diversicolor*. Marine environmental research, 150, p.104766. doi: 10.1016/j.marenvres.2019.104766.

Joint Nature Conservation Committee (JNCC) and Department for Environment, Food and Rural Affairs (DEFRA) (On behalf of the Four Countries' Biodiversity Group). UK Post-2010 Biodiversity Framework. July 2012. Available online at: https://data.jncc.gov.uk/data/587024ff-864f-4d1d-a669-f38cb448abdc/UK-Post2010-Biodiversity-Framework-2012.pdf [Accessed 08/08/2023].

JNCC (2017). North-West Orkney MPA. Available online at: North-West Orkney MPA | JNCC – Adviser to Government on Nature Conservation [Accessed 08/08/2023].

JNCC (2023). Solan Bank Reef SAC. Available online at: https://sac.jncc.gov.uk/site/UK0030386 [Accessed 08/08/2023].

Kerckhof, F., B. Rumes, T. J. Jacques, S. Degraer & A. Norro, (2010). Early development of the subtidal marine biofouling on a concrete offshore windmill foundation on the Thornton Bank (Southern North Sea): first monitoring results. International Journal of the Society for Underwater Technology 29: 137–149.

Langhamer, O. (2012). Artificial reef effect in relation to offshore renewable energy conversion: state of the art (review article). The Scientific World Journal. doi:10.1100/2012/386713.

Lengyel, N. L., Collie, J. S., and Valentine, P. C. (2009). The invasivecolonial ascidian *Didemnum vexillum* on Georges Bank–ecological effectsand genetic identification. Aquat. Invasions 4, 143-152. doi: 10.3391/ai.2009.

Marine Scotland (2023a). Scotland's National Marine Plan Interactive (NMPi). Available online at: Marine Scotland – National Marine Plan Interactive (atkinsgeospatial.com) [Accessed 08/08/2023].

Marine Scotland (2023b). Feature Activity Sensitivity Tool. Available online at http://www.marine.scotland.gov.uk/FEAST [Accessed 08/08/2023].

Marine Scotland (2023c). The Marine Scotland Assessment of Non Native Species. Available at: https://marine.gov.scot/sma/assessment/non-native-species [Accessed 08/08/2023].

MarLIN (2023). The Marine Life Information Network. Available online at: https://www.marlin.ac.uk/ [Accessed 08/08/2023].

MarLIN (2023a). *Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock or mixed substrata. Available online at: https://www.marlin.ac.uk/habitats/detail/267 [Accessed 08/08/2023].

MarLIN (2023b). *Moerella spp*. with venerid bivalves in infralittoral gravelly sand. Available online at: https://www.marlin.ac.uk/habitats/detail/1111 [Accessed 08/08/2023].

MarLIN (2023c). *Flustra foliacea* and *Haliclona (Haliclona) oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata. Available online at: https://www.marlin.ac.uk/habitats/detail/248 [Accessed 08/08/2023].

MarLIN (2023d). *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand. Available online at: https://www.marlin.ac.uk/habitats/detail/1133 [Accessed 08/08/2023].

MarLIN (2023e). *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand. Available online at: https://www.marlin.ac.uk/habitats/detail/1131 [Accessed 08/08/2023].

MarLIN (2023f). *Branchiostoma lanceolatum* in Atlantic circalittoral coarse sand with shell gravel. Available online at: https://www.marlin.ac.uk/habitats/detail/244 [Accessed 08/08/2023].

MarLIN (2023g). *Hesionura elongata* and *Microphthalmus similis* with other interstitial polychaetes in infralittoral mobile coarse sand. Available online at: https://www.marlin.ac.uk/habitats/detail/379 [Accessed 08/08/2023].

MarLIN (2023h). *Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock. Available online at: https://www.marlin.ac.uk/habitats/detail/171#policy_legislation [Accessed 08/08/2023].

MarLIN (2023i). Icelandic cyprine (*Arctica islandica*). Available online at: https://www.marlin.ac.uk/species/detail/1519 [Accessed 08/08/2023].

MarLIN (2023j). A bristleworm (*Lagis koreni).* Available online at: https://www.marlin.ac.uk/species/detail/1834 [Accessed 08/08/2023].

Millar, H., O'Hara Murray, R., Gallego, A., Gormley, K. & Kent, F. (2019). Connectivity of selected Priority Marine Features within and outwith the Scottish MPA network. Scottish Natural Heritage Research Report No. 1048. Available online at: https://www.nature.scot/doc/naturescot-research-report-1048-connectivity-selected-priority-marine-features-within-and-outwith [Accessed 08/08/2023].

Moore, P.J. and Smale, D.A. (2020) Impacts of climate change on shallow and shelf subtidal habitats relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 272–292.

Natural England and JNCC (2019). Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas. September 2019. Available online at: https://data.jncc.gov.uk/data/3c9f030c-5fa0-4ee4-9868-1debedb4b47f/NE-JNCC-advice-key-sensitivities-habitats-MPAs-offshore-windfarm-cabling.pdf [Accessed 08/08/2023].

NatureScot (2023). Sitelink. Available online at: https://sitelink.nature.scot/map [Accessed 08/08/2023].

Normandeau, A., Exponent, T. Tricas, and A. Gill (2011). Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

Ocean Infinity (2023a). Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 1 – OAA Results Report.

Ocean Infinity (2023b). Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 2a – Export Cable Corridor (ECC) Results Report (Whiten Head Bank to Crosskirk).

Ocean Infinity (2023c). Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 2b – ECC Results Report (Stormy Bank to Crosskirk).

Orkney's Biodiversity Steering Group (2018). The Orkney Local Biodiversity Action Plan: A plan for action to conserve Orkney's Biodiversity. Version 1.3: A targeted action plan for 2018 – 2022. August 2018. Available online at: https://www.orkney.gov.uk/Files/Planning/Biodiversity/Orkney%20Local%20Biodiversity%20Action%20Plan%202018%20to%202022.pdf [Accessed 08/08/2023].

Orkney Islands Council (OIC) (2020). Orkney Islands Marine Region: State of the Environment Assessment. A baseline assessment of the Orkney Islands Marine Region. Available online at: https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/20210107-OIC-Report-V9-screen%20v2.pdf [Accessed 08/08/2023].

OIC (2022). Orkney Islands Regional Marine Plan: Consultation Draft. Available online at: https://www.orkney.gov.uk/Service-Directory/D/orkney-islands-regional-marine-plan.htm [Accessed 08/08/2023].

OSPAR Commission (2008). Background document on potential problems associated with power cables other than those for oil and gas activities. London.

OSPAR Commission (2009). Background Document for Ocean Quahog *Arctica islandica*. Available online at: https://www.ospar.org/site/assets/files/1505/p00407_ocean_quahog.pdf [Accessed 08/08/2023].

Offshore Wind Power Limited (OWPL) (2022). West of Orkney Wind Farm Scoping Report. Available online at: https://marine.gov.scot/data/scoping-request-offshore-wind-power-limited-west-orkney [Accessed 08/08/2023].

Offshore Wind Power Limited (OWPL) (2023). Outline Biodiversity Enhancement Plan. OWPL document number WO1-WOW-CON-EV-RP-0011.

Reiss, H., Cunze, S., König, K., Neumann, H. and Kröncke, I. (2011). Species distribution modelling of marine benthos: a North Sea case study. Marine Ecology Progress Series, 442, pp.71-86.

Rhoads DC, Boyer LF. (1982) The Effects of Marine Benthos on Physical Properties of Sediments. A Successional Perspective. In: McCall PL, Tevesz MJS, editors. Anim. Relations Biog. Alter. Sediments, Springer US; 1982, p. 3–43.

Scottish Government (2015a). Scotland's National Marine Plan. Available online at: https://www.gov.scot/publications/scotlands-national-marine-plan/ [Accessed 08/08/2023].

Scottish Government (2015b). Scotland's Biodiversity: a Route Map to 2020. Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2015/06/scotlands-biodiversity-route-map-2020/documents/00480289-pdf/00480289-pdf/govscot%3Adocument/00480289.pdf [Accessed 08/08/2023].

Scottish Government (2016). Pilot Pentland Firth and Orkney Waters Marine Spatial Plan, July 2016. Available online at: Pilot Pentland Firth and Orkney Waters Marine Spatial Plan – gov.scot (www.gov.scot) [Accessed 08/08/2023].

Scottish Government (2019). The National Island's Plan. Available online at: https://www.gov.scot/publications/national-plan-scotlands-islands/documents/ [Accessed 08/08/2023].

Scottish Government (2020). Sectoral Marine Plan for Offshore Wind Energy. Available online at: https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy/ [Accessed 08/08/2023].

Scottish Government, (2023) Benthic Species ScotMER Receptor Group - Evidence map (updated January 2023). Available online at: https://www.gov.scot/publications/benthic-species-specialist-receptor-group/[Accessed 08/08/2023].

Scottish and Southern Electricity Networks (SSEN) (2019). Scottish & Southern Electricity Networks Transmissions: Orkney. Available online at: https://www.ssen-transmission.co.uk/projects/project-map/orkney/ [Accessed 08/08/2023].

Scottish and Southern Electricity Networks Transmission (SSEN) (2022). Pentland Firth East (3) Cable Replacement – Marine Licence Application. Environmental Supporting Information. Available online at: https://marine.gov.scot/sites/default/files/environmental_supporting_information_final.pdf [Accessed 09/08/2023].

Shucksmith, R., Shelmerdine, R. L., & Shucksmith, R. (2019). Biological analyses of seabed imagery from within and around Marine Protected Areas in Orkney, Shetland, Inner Sound, and Islay and Jura in 2019. https://doi.org/10.7489/12364-1.

Simon-Nutbrown, C., Hollingsworth, P.M., Fernandes, T.F., Kamphausen, L., Baxter, J.M. and Burdett, H.L., 2020. Species distribution modeling predicts significant declines in coralline algae populations under projected climate change with implications for conservation policy. Frontiers in Marine Science, p.758.

Smale D.A., Wernberg T., Yunnie A.L.E., Vance T. (2015). The rise of *Laminaria ochroleuca* in the Western English Channel (UK) and preliminary comparisons with its competitor and assemblage dominant *Laminaria hyperborea*. Marine Ecology 36, pp 1033–1044.

Spectrum (2023). Volume 1 – West of Orkney Windfarm Nearshore Geophysical Survey Results and Charts Report.

Stocker, T., Dahe, Q., Plattner, G-K. *et al*. (eds). (2013) Climate Change 2013: Working Group 1 (WG1) Contribution to the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5), Cambridge University Press.

Thorburn, J.A., Wright, P.J., Lavender, E., Dodd, J., Neat, F., Martin, J.G.A., Lynam, C., James, M. (2021). Seasonal and ontogenetic variation in depth use by a critically endangered benthic elasmobranch and its implications for spatial management. Frontiers in Marine Science, 8: 656368. https://doi.org/10.3389/fmars.2021.656368

Tyler-Walters, H., James B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. & Crawford-Avis, O.T. (2016). Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406. Available online at: https://www.nature.scot/sites/default/files/Publication%202016%20-%20SNH%20Commissioned%20Report%20406%20-%20Descriptions%20of%20Scottish%20Priority%20Marine%20Features%20%28PMFs%29.pdf [Accessed 08/08/2023].

Whomersley, P., Wilson, C., Clements, A., Brown, C., Long, D., Leslie, A. and Limpenny, D. (2010). Understanding the marine environment – seabed habitat investigations of submarine structures in the mid Irish Sea and Solan Bank Area of Search (AoS). JNCC report No. 430.

Wilding, T. A., Hughes, D. J. and Black, K. D. (2005). The benthic environment of the North and West of Scotland and the Northern and Western Isles: sources of information and overview. Report 1 to METOC.

Winklhofer, M. (2009). The physics of geomagnetic-field transduction in animals. IEEE Transactions on magnetics, 45(12), pp.5259-5265.

Wort, E., Flintham, H., Good, E., Bakker, J., Craig, H. & Egeter. B. (2022). Review of DNA-based marine benthic monitoring protocols. JNCC Report No. 705, JNCC, Peterborough, ISSN 0963-8091.

10.14 Abbreviations

ACRONYM	DEFINITION
μT	micro Tesla
ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy and Industrial Strategy
BGS	British Geological Survey
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFE	Controlled Flow Excavator
CMS	Construction Method Statement
CPS	Cable Protection System
CTD	Conductivity, Temperature, and Depth
DBT	Dibutyltin
DDV	Drop Down Video
DEFRA	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DNA	Deoxyribonucleic Acid
DSLP	Development Specification And Layout Plan

ACRONYM	DEFINITION
DVV	Dual Van Veen
EBS	Environmental Baseline Survey
ECC	Offshore Export Cable Corridor
eDNA	Environmental DNA
EEA	European Economic Area
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMODnet	European Marine Observation and Data Network
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EU	European Union
EUNIS	European Nature Information System
FeAST	Feature Activity Sensitivity Tool
GEN	General Policy
GIS	Geographic Information Systems
GMF	Geomagnetic Field
HDD	Horizontal Directional Drilling
HG	Hamon Grab

ACRONYM	DEFINITION
HLV	Heavy Lift Vessels
HRA	Habitats Regulation Appraisal
HVAC	High Voltage Alternating Current
iE	Induced Electric
INNS	Invasive Non-Native Species
IUCN	International Union for Conservation of Nature and Natural Resources
JNCC	Joint Nature Conservation Committee
km	Kilometres
kV	Kilovolts
LIDAR	Light Detection and Ranging
LSE	Likely Significant Effect
m	Metres
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	The Marine Life Information Network
MBES	Multibeam Echo Sounder
MBT	Monobutyltin
MD-LOT	Marine Directorate - Licensing Operations Team
MEA	Marine Environmental Appraisal
MESH	Mapping European Seabed Habitat

ACRONYM	DEFINITION
MHWS	Mean High-Water Springs
mLAT	Metres Below Lowest Astronomical Tide
MPCP	Marine Pollution Contingency Plan
MS-LOT	Marine Scotland - Licensing Operations Team
MSS	Marine Scotland Science
MW	Megawatt
NBN	National Biodiversity Network
NCMPA	Nature Conservation Marine Protected Area
NMPi	National Marine Plan Interactive
NPF4	National Planning Framework 4
OAA	Option Agreement Area
OESEA4	UK Offshore Energy Strategic Environmental Assessment 4
OIC	Orkney Island Council
OP	Outline Plan
OSPAR Convention	Convention for the Protection of the Marine Environment of the North East Atlantic
OSPs	Offshore Substation Platform
OWF	Offshore Wind Farm
OWPL	Offshore Wind Power Limited
PAH	Polycyclic Aromatic Hydrocarbon

ACRONYM	DEFINITION
PCB	Polychlorinated Biphenyls
PEMP	Project Environmental Monitoring Plan
PFOWF	Pentland Floating Offshore Wind Farm
PLGR	Pre-lay Grapnel Run
PMF	Priority Marine Features
PSA	Particle Size Analysis
RIAA	Report to Inform the Appropriate Assessment
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SBL	Scottish Biodiversity List
SBP	Sub-Bottom Profiler
ScotMER	Scottish Marine Energy Research
SEA	Strategic Environmental Assessment
SHET-L	Scottish Hydro Electric Transmission Limited
SOV	Service Operated Vessels
SS	Supporting Study
SSEN	Scottish and Southern Electricity Networks Transmission
SSS	Side Scan Sonar
SSSI	Site of Special Scientific Interest

ACRONYM	DEFINITION
TBT	Tributyltin
THC	The Highland Council
UAV	Unmanned Aerial Vehicle
UHRS	Ultra-High Resolution Seismic
UK	United Kingdom
UKBAP	UK Biodiversity Action Plan
UKCS	UK Continental Shelf
USB	Universal Serial Bus
UVA	Unmanned Aerial Vehicle
UXO	Unexploded Ordnance
V/m	volts per metre
VRM	Vector Ruggedness Measure
WMS	Web Map Services
WTG	Wind Turbine Generator
ZoI	Zones of Influence

10.15 Glossary

TERM	DEFINITION
Arthropod	An invertebrate phylum from which all individuals possess an exoskeleton with a cuticle made of chitin and possesses a segmented body and paired segmented legs (marine examples include crabs, lobsters, shrimps and amphipods).
B-Field	The magnetic field around a magnetic material or a moving electric charge, such as the voltage of proposed export cables, within which the force of magnetism acts.
Bryozoan	Phylum of (predominantly) marine invertebrates which are permanently attached to the seabed forming colonies and reproduce by budding (sometimes known as moss animals).
Colonial	A collective life form which comprise associations of individual organisms. Marine Colonial animals are typically attached to the seabed and include corals and bryozoans.
Contaminant	A substance within the sediment in which excess levels of the substance could result in adverse impacts on species or habitats (e.g., toxicity or pollution).
Circalittoral	The region of the seabed that is below the depth at which marine plants/algae are typically found and is dominated by animals (i.e. below the photic zone).
Geophysical Survey	A broad term covering the suite of (typically acoustic) detection methods used to map the physical properties of the seabed (in this case). Examples include sonar, echosounders and seismic airguns.
Hydrocarbon	A compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas.
Invasive	An introduced organism that can become overpopulated, outcompete and/or prey upon native species causing adverse ecological impacts.
Infralittoral	A region of shallow water seabed which is at a depth that marine plants/algae can grow (i.e. within the photic zone) but excludes the intertidal area.
Littoral	The intertidal area of a shoreline.
Mollusc	Large phyla of invertebrate animals that include (amongst others) gastropods (e.g. snails, limpets), bivalves (e.g. clams, mussels) and cephalopods (e.g. octopus, squid). A large proportion of benthic molluscs are bivalves.
Octocorallia	Soft corals. Colonial organisms, with numerous tiny polyps embedded in a soft matrix that forms the visible structure of the colony. Common species in UK include dead mans fingers (*Alcyonium digitatum*).

TERM	DEFINITION
Organotins	Concerned with or being an organic compound with one or more tin atoms in its molecules.
Phylum	A principal taxonomic category that ranks above class and below kingdom.
Polychaete	Taxonomic class of (mainly) marine segmented worms from the Phylum Annelida.
Recruitment	Recruitment is a key ecological process in which individuals are added to population. For marine organisms with a dispersive phase, recruitment relies on the supply of planktonic larvae and their ability to settle and survive.
Rugosity	The measurement of a small scale variation of amplitude in the height of the (seabed) surface. Used in this case to help refine the delineation of likely reef habitat from non-reef habitat.
Sandwave	Sedimentary structure that forms across from tidal currents.
Substratum	The layer of layer of rock or sediment beneath the sea surface of sea (i.e. the seabed surface).
Suspended sediment	Sediment transported by a fluid that it is fine enough for turbulent eddies to outweigh settling of the particles.