TotalEnergies E&P North Sea UK Ltd

Culzean Floating Offshore Wind Turbine Pilot Project

Environmental Impact Assessment Report – Chapter 8 - Benthic Ecology

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REV	DATE	DESCRIPTION	ISSUED	CHECKED	APPROVED	CLIENT
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GLOSSARY

TERMINOLOGY	DESCRIPTION
Culzean Floating Offshore Wind Pilot Project (the 'Project')	The entire Development including all offshore components and all project phases from pre-construction to decommissioning.
Environmental Impact Assessment (EIA)	The procedure to predict, minimise, measure and, if necessary, correct and compensate the impacts produced by any human action.
EIA Regulations	The Marine Works (Environmental Impact Assessment) Regulations 2007 requires that certain types of projects with the potential to significantly affect the environment have an environmental impact assessment before a marine licence decision is made.
Habitats Regulations Assessment (HRA)	Under the Habitats Regulations, all competent authorities must consider whether any plan or project could affect a European site before it can be authorised or carried out. This includes considering whether it will have a 'Likely Significant Effect' (LSE) on a European site, and if so, they must carry out an 'appropriate assessment' (AA). This process is known as Habitats Regulations Appraisal (HRA)
Innovation and Targeted Oil and Gas (INTOG)	The Initial Plan Framework Sectoral Marine Plan for Offshore Wind for INTOG encompasses spatial opportunities and a strategic framework for future offshore wind developments within sustainable and suitable locations that will help deliver the wider United Kingdom (UK) and Scottish Government Net Zero targets. The 'IN' component of INTOG consists of small-scale innovative projects of 100 Megawatts (MW) or less. The aim of the 'TOG' component is to supplying renewable electricity directly to oil and gas infrastructure. The Culzean Floating Wind Pilot Project falls under the TOG component of INTOG.
Marine Licence Application ('the Application')	A Marine Licence is granted under the Marine and Coastal Access Act 2009 for projects between 12-200 Nautical Miles (nm) from shore, or the Marine (Scotland) Act 2010 for projects between Mean High-Water Springs (MHWS) out to 12 nm from shore. The application includes HRA-supporting documentation (where required), an application letter, Marine Licence application form and this EIAR.
Maximum Design Scenario (MDS)	The maximum range of design scenarios for all infrastructure.
Net Zero	Refers to a government commitment to ensure the UK reduces its greenhouse gas emissions by 100% from 1990 levels by 2050 and in Scotland, the same target is set for 2045. If met, this would mean the amount of greenhouse gas emissions produced by the UK would be equal to or less than the emissions removed by the UK from the environment.
Project Design Envelope (PDE)	The maximum range of design parameters of all infrastructure assessed as part of the EIA.
Study Area	Receptor specific area used to characterise the baseline.
Project Area	The extent of the immediate area surrounding the floating Wind Turbine Generator (WTG) and cable route as characterised by the extent of the seabed environmental and habitat surveys. Also referred to as the Survey Area where specifically relating to survey activities.
Survey Area	The area surveyed during site-specific surveys. Also referred to as the Project Area.
Floating Wind Turbine Generator (WTG)	Device that converts the kinetic energy of wind into electrical energy. Can be functionally divided into four parts: wind turbine, tower and transition piece, floating foundation, and mooring system.

ACRONYMS AND ABBREVIATIONS

ACRONYM/ ABBREVIATION	DEFINITION
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CMS	Construction Method Statement
CNS	Central North Sea
CNSE	Central North Sea Electrification
CoCP	Code of Construction Practice
DBT	Dibutyltin
DDV	Drop Down Video
DSLP	Development Specification and Layout Plan
DTU	Technical University of Denmark
EBS	Environmental Baseline Survey
eDNA	Environmental Deoxyribonucleic Acid
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPA	Environment Protection Agency
ERL	Effect Range Low
EUNIS	European Nature Information System
EU	European Union
FeAST	Feature Activity Sensitivty Tool
HRA	Habitats Regulations Appraisal
INNS	Invasive Non-Native Species
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
km	Kilometre
LAT	Lowest Astronomical Tide
m	Metre
µg/g	Microgram per gram
MarESA	Marine Evidence-based Sensitivity Assessment

ACRONYM/ ABBREVIATION	DEFINITION
MarLIN	Marine Life Information Network
MASTS	Marine Alliance for Science and Technology Scotland
MBES	Multibeam Echosounder
MBT	Monobutyltin
MCZ	Marine Conservation Zone
MDAC	Methane Derived Authigenic Carbonate
MD-LOT	Marine Directorate – Licensing Operations Team
MDS	Maximum Design Scenario
NCMPA	Nature Conservation Marine Protected Area
NID	Nature Inclusive Design
NMPi	National Marine Plan Interactive
NNS	Northern North Sea
OCP	Organochlorine Pesticides
OEMP	Operational Environmental Management Plan
OSPAR	Oslo – Paris Convention
OTU	Operational Taxonomic Units
PAH	Polycyclic Aromatic Hydrocarbon
PBDE	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyls
PDE	Project Design Envelope
PEMP	Project Environmental Monitoring Programme
PMF	Priority Marine Feature
PSA	Particle Size Analysis
R&D	Research and Development
SAC	Special Area of Conservation
SFF	Scottish Fishermen's Federation
SPA	Special Protected Area
SNH	Scottish Natural Heritage (NatureScot)
SSS	Side Scan Sonar
TBT	Tributyltin
TEPNSUK	Total Energies E&P North Sea UK Ltd
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TOM	Total Organic Matter

ACRONYM/ ABBREVIATION	DEFINITION
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
WTG	Wind Turbine Generator
ZoI	Zone of Influence

8 BENTHIC ECOLOGY

8.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the Benthic Ecology receptors of relevance to the Culzean Floating Offshore Wind Turbine Pilot Project (the 'Project') and assesses the potential impacts from the construction, operation and maintenance and decommissioning of the Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative impacts are also considered while transboundary impacts have been scoped out with the agreement of Scottish Ministers, as described in Section 8.3.

Xodus Group Limited (Xodus) have drafted and carried out the impact assessment. Further competency details of the Project Team including lead authors for each chapter are provided in Chapter 1: Introduction. Table 8-1 provides a list of all the supporting studies which relate to and should be read in conjunction with the Benthic Ecology impact assessment.

Table 8-1 Supporting studies

DETAILS OF STUDY	LOCATIONS OF SUPPORTING STUDY
Habitat Assessment Report – Culzean WT Site Survey June 2nd, 2023. 104728-TOT-OI-SUR-REP-HABASRE	Appendix C: Habitat Assessment Survey Report
Environmental Baseline Survey Report – Culzean WT Site Survey September 1st, 2023. 104728-TOT-OI-SUR-REP-ENVBASRE	Appendix D: Environmental Baseline Survey Report
Environmental DNA Report – Analysis of eDNA samples in water and sediment.	Appendix E: Environmental DNA Report

The impact assessment presented herein draws upon information presented within other impact assessments within this EIAR, including:

- Chapter 7: Marine Physical Processes;
- Chapter 9: Fish and Shellfish Ecology;
- Chapter 10: Marine Mammals and Other Megafauna; and
- Chapter 12: Commercial Fisheries.

Where information is used to inform the impact assessment, reference to the relevant EIAR chapter is given.

An assessment under the Habitats Regulations for Europeans Sites designated for Annex I benthic habitats has also been undertaken for the Project within the Habitats Regulations Appraisal (HRA) Report (Document ID GB-CZN-00-XODUS-000023) submitted alongside the Marine Licence Application ('the Application').

8.2 Legislation, policy and guidance

The following legislation, policy and guidance are relevant to the assessment of impacts from the Project on Benthic Ecology:

- Legislation:
  - Nature Conservation (Scotland) Act 2004 (as amended)
  - The International Convention for the Control and Management of Ships Ballast Water and Sediments (Ballast Water Management Convention) 2004
  - United Kingdom (UK) Biodiversity Action Plan (UKBAP)
- Policy:
  - Scotland's Biodiversity: a route map to 2020 (Scottish Government, 2015a).
  - Scotland's National Marine Plan (Scottish Government, 2015b). The following policy is relevant to this Benthic 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.
- Guidance:
  - Guidelines for Ecological Impact Assessment in the UK and Ireland (Chartered Institute of Ecology and Environmental Management (CIEEM), 2022);
  - Assessment of the Environmental Impact of Offshore Wind-Farms (Oslo-Paris Convention (OSPAR) Commission, 2008a);
  - OSPAR Assessment of the Environmental Impacts of Cables (OSPAR, 2009a);
  - Background document on Ocean quahog (*Arctica islandica*) (OSPAR, 2009b);
  - Background document on Seapen and burrowing megafauna (OSPAR, 2010);
  - Background document on *Sabellaria spinulosa* reefs (OSPAR, 2013);
  - Defining and Managing Sabellaria spinulosa Reefs (Gubbay, 2007);
  - Identification of the Main Characteristics of Stony Reef Habitats under the Habitats Directive (Irving, 2009);
  - Scottish Natural Heritage (SNH) (now NatureScot) guidance: Guidance on Survey and Monitoring in Relation to Marine Renewable Developments in Scotland – Volume 5: Benthic Habitats (SNH, 2011);
  - Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd, 2012);
  - Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Golding *et al.* 2020);
  - Advances in assessing *Sabellaria spinulosa* reefs for ongoing monitoring (Jenkins *et al.*, 2018);
  - The Status of *Sabellaria spinulosa* Reef off the Moray Firth and Aberdeenshire Coasts and Guidance for Conservation of the Species off the Scottish East Coast (Pearce and Kimber, 2020); and
  - Descriptions of Scottish Priority Marine Features (PMFs) (Tyler-Walters *et al.*, 2016).

8.3 Scoping and consultation

Stakeholder consultation 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 was submitted to Scottish Ministers (Via Marine Directorate – Licensing Operations Team (MD-LOT)), on 14th April 2023, who then circulated the report to relevant consultees. The Scoping Opinion was received on 20th July 2023. Relevant comments from the Scoping Opinion and other consultation specific to Benthic Ecology are provided in Table 8-2, which provides a high-level response on how these comments have been addressed within the EIAR.

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Table 8-2 Summary of consultation responses specific to Benthic Ecology

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT(S)	RESPONSE
Scottish Ministers (via MD-LOT) 5.4.1	The Scottish Ministers are broadly content with the key legislation, policy, and guidance considered in section 7.1.2 of the Scoping Report; however, recommend the Developer to include Pearce and Kimber (2020) in case *Sabellaria* reefs are identified during the surveys.	The Pearce and Kimber (2020) reference has been added to the assessment and consulted for guidance. A reef assessment did not identify any reef habitats in the Project Area, therefore further assessment is not required.
Scottish Ministers (via MD-LOT) 5.4.2	The Scottish Ministers are content with the relevant baseline datasets and the appropriate summary of existing data and baseline characterisation presented within Table 7-1 and section 7.1.5 of the Scoping Report retrospectively.	Noted, no further response required
Scottish Ministers (via MD-LOT) 5.4.3	Section 7.1.10 of the Scoping Report sets out the proposed approach to the impact assessments. The Scottish Ministers are content with the level of detail noted within the approach and support the inclusion of Priority Marine Features (PMF).	Noted, no further response required. PMFs are also considered in Section 8.5.3.5 of Chapter 8: Benthic Ecology.
Scottish Ministers (via MD-LOT) 5.4.4	The Scottish Ministers are content with the embedded mitigation measures presented in Table 7-3 of the Scoping Report. The Scottish Ministers acknowledge the SFF representation regarding Electromagnetic Fields ("EMF") and the request for this to be scoped in to the EIA Report. However, the Scottish Ministers are content for this to be scoped out of the EIA Report. The Scottish Ministers, along with the NatureScot representation, welcome the Developer's intention to support a research proposal that focuses on visualising EMF by providing an EMF recorder around the Proposed Development.	The potential impacts of Electromagnetic Fields (EMF) have been scoped out of this assessment. EMF recorders will be implemented as part of the scientific Research and Development (R&D) programme in conjunction with the Technical University of Denmark (DTU) and the Marine Alliance for Science and Technology for Scotland (MASTS).

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT(S)	RESPONSE
Scottish Ministers (via MD-LOT) **5.4**	Sections 5.4 and 7.1.8 of the Scoping Report outline the cumulative impact approach. The Scottish Ministers are content with this approach. The Scottish Ministers agree that transboundary impacts can be scoped out for further consideration in the EIA Report.	Noted, no further response required. Cumulative impacts for Benthic Ecology are considered in Section 8.11 of Chapter 8: Benthic Ecology.
Scottish Fishermen's Federation (SFF)/ Scottish Ministers (via MD-LOT)	EMF Effects: Both, 7.1 Benthic Ecology, and 7.2 Fish and Shellfish Ecology parts of the report have scoped out the EMF effects on benthic and fish and shellfish ecologies. SFF appreciates the developer's argument which are based on some publication cited in the report; however, we would argue that other studies such as St Abbs Marine Station's show the impact of EMF on brown crab. In addition, the report itself acknowledges lack of proper scientific evidence of EMF effects on marine environment. Therefore, as the development site sits in spawning and nursery ground for some fish as well as pelagic, dredging and demersal fishing ground, we would like to see the EMF effects of the development on marine environment scoped in.	As per the Scoping Responses, MD-LOT (Scottish Ministers) along with the NatureScot representation, are content for EMFs to be scoped out of the EIAR. EMF recorders will be implemented as part of the scientific R&D programme in conjunction with the Technical University of Denmark (DTU) and the Marine Alliance for Science and Technology for Scotland (MASTS), as outlined in Chapter 1: Introduction. Total Energies E&P North Sea UK Ltd (TEPNSUK) are also currently investigating participation in ongoing academic projects as part of the R&D programme, with the potential to provide the Project as a test site for several further environmental monitoring projects.
NatureScot	Benthic interests are considered in section 7.1 (pages 75-92) of the Scoping Report. We have responded to the scoping questions raised within our advice below.	Noted. No further response required.
	Study area: We are content with the proposed development study area as defined in section 7.1.3, which comprises the project area and a buffer of 5 km.	Noted. No further response required.
	Baseline: Section 7.1.2 captures key legislation, policy and guidance, however it should also include Pearce and Kimber (2020)1 in case *Sabellaria* reefs are identified during surveys. There is a knowledge gap regarding the distribution of *Sabellaria* reefs in Scottish waters and whilst there are no known reports of *Sabellaria* in the area to date, it does not preclude their presence.	The Pearce and Kimber (2020) reference has been added to the assessment presented within Chapter 8: Benthic Ecology and consulted for guidance. A reef assessment did not identify any reef habitats in the Project Area, therefore further assessment is not required.

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT(S)	RESPONSE
	Table 7-1 captures the relevant baseline datasets, with Section 7.1.5 presenting an appropriate summary of existing data and baseline characterisation.	Noted. No further response required.
	Priority Marine Features (PMFs): We support the inclusion of Priority Marine Features (PMFs)2 and Annex I habitats.	Noted. No further response required. Annex I Habitats are considered in Section 8.5.3.3 and PMFs are considered in Section 8.5.3.5 of Chapter 8: Benthic Ecology.
	Blue carbon: We welcome the consideration of blue carbon storage in section 7.1.5 and we are content that the potential for significant effects to blue carbon storage have been scoped out for further assessment.	Noted. As agreed, Blue Carbon Storage has been scoped out of the EIA. No further response required.
	Key impact pathways to consider: We are content with the potential impacts scoped in as per Table 7-4 of the Scoping Report.	Noted. In line with Table 7-4 of the Scoping Report, the following impacts have been scoped in for further consideration in Chapter 8: Benthic Ecology: • Long term habitat loss; • Temporary habitat loss or disturbance; • Increased suspended sediment concentrations and associated deposition; • Disturbance of contaminated sediments; • Removal of artificial hard substrate during decommissioning; and • Colonisation of hard structures.
	Approach to impact assessment: The proposed assessment approach is set out in section 7.1.10 and we are content with this as detailed. We welcome the assessment of potential impacts on PMFs and Annex I habitats.	Noted. No further response required. Annex I Habitats are considered in Section 8.5.3.3 and PMFs are considered in Section 8.5.3.5 of Chapter 8: Benthic Ecology.
	Cumulative impacts: We are content with the approach to the cumulative impact approach, as outlined in section 5.4 and 7.1.8.	Noted. No further response required. Cumulative impacts for Benthic Ecology are considered in Section 8.11 of Chapter 8: Benthic Ecology.

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT(S)	RESPONSE
	Mitigation and monitoring: The embedded mitigation measures are discussed in Table 7-3 and we note that whilst not mentioned in this chapter, the marine physical processes section states that requirements for scour protection will be included in the Construction Method Statement. Thus, we are content with what is proposed.	Noted. The requirements for and the impacts of scour protection are also included in Chapter 8: Benthic Ecology.
	Additionally, we agree that effects from Electromagnetic Fields (EMF) are scoped out and welcome the intention to support a research proposal which focuses on visualising EMF that will provide an EMF recorder around the Culzean floating wind pilot project, as discussed in section 1.3 (project overview). This will help increase our collective knowledge.	EMF recorders will be implemented as part of the scientific R&D programme in conjunction with the Technical University of Denmark (DTU) and the Marine Alliance for Science and Technology for Scotland (MASTS), as outlined in Chapter 1: Introduction. Total Energies E&P North Sea UK Ltd (TEPNSUK) are also currently investigating participation in ongoing academic projects as part of the R&D programme, with the potential to provide the Project as a test site for several further environmental monitoring projects.
	Transboundary impacts: We agree that transboundary impacts are scoped out from further consideration in the EIAR.	Noted. As agreed, transboundary impacts on Benthic Ecology receptors have been scoped out of the Environmental Impact Assessment (EIA).

In line with the Scoping Opinion, aspects relevant to Benthic Ecology but scoped out of further assessment in this EIAR include:

- Increased risk of introduction and spread of Invasive and Non-Native Species (INNS) (all Project phases);
- Impacts to habitats or species as a result of pollution or accidental discharge (all Project phases);
- Hydrodynamic changes leading to scour around subsea infrastructure during construction, operation and maintenance (Note: this is assessed in Chapter 8: Marine Physical Processes); and
- Impact of cable thermal load or EMF on benthic ecology during operation and maintenance.

It should, however, be re-iterated that the Project will utilise the pilot project to implement a scientific R&D programme in conjunction with the DTU and MASTS. This programme will provide knowledge and experience covering the themes of Environmental Deoxyribonucleic Acid (eDNA)-based monitoring development, biodiversity and ecosystem indicators and active acoustics and optics monitoring development including EMF monitoring.

8.4 Study Area

The Benthic Ecology Study Area is defined as a buffer of 5 kilometre (km) around the Wind Turbine Generator (WTG) (Figure 8-1). Direct impacts are only likely to be felt within the immediate vicinity of seabed activities, whereas the Benthic Ecology Study Area is defined as the area that will be directly impacted by the offshore infrastructure and the adjacent areas that may be affected by indirect impacts, such as sediment suspension and resettlement, which will not extend beyond the buffer zone, in line with the Study Area for Chapter 7: Marine Physical Processes.

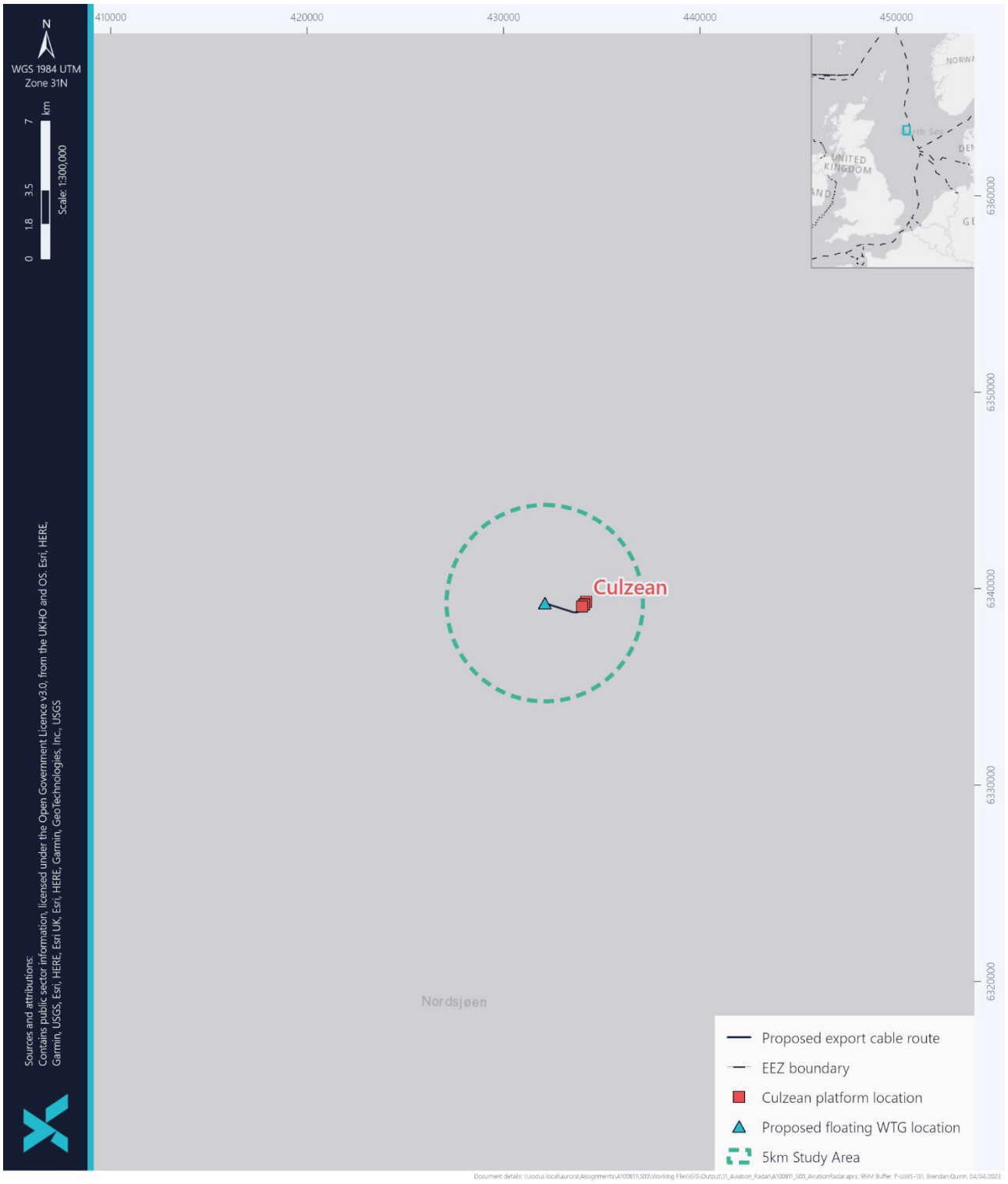

Figure 8-1 Benthic Ecology Study Area

8.5 Baseline Environment

The purpose of this section is to provide a description of the marine Benthic Ecology in the vicinity of the Project. A discussion of the key sensitivities and potential ecological impacts arising from the Project during the construction, operation and maintenance, and decommissioning phases has been carried out and the findings are presented.

8.5.1 Data sources

The existing data sets and literature with relevant coverage to the Project, which have been used to inform the baseline characterisation for Benthic Ecology are outlined in Table 8-3.

Table 8-3 Summary of key datasets and reports

TITLE	SOURCE	YEAR	AUTHOR
Culzean Platform Site Survey	Survey report	2013	Gardline
Culzean Export Pipeline Route Surveys	Survey report	2014	Gardline
Annex I Submarine structures made by leaking gas	https://hub.jncc.gov.uk/assets/b47ebc16-7b74-4a69-bd4b-7e29c0584d59	2018	Joint Nature Conservation Committee (JNCC)
Annex I Reefs in UK offshore waters (public)	https://hub.jncc.gov.uk/assets/992dfef7-3267-43db-b351-5927bf0621d4	2022	JNCC
Feature Activity Sensitivity Tool (FEAST)	http://www.marine.scotland.gov.uk/FEAST/	2013	Marine Scotland
Spatial data relating to Benthic Ecology on National Marine Plan Interactive (NMPi)	https://marinescotland.atkinsgeospatial.com/nmpi/	2023	Marine Scotland
Special Area of Conservation (SAC)	https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas/international-designations/european-sites/special-areas-conservation-sacs	2020	NatureScot
Nature Conservation Marine Protected Area (NCMPA)	https://marine.gov.scot/maps/844	2020	Marine Scotland
Habitat Assessment Report – Culzean WT Site Survey June 2nd, 2023. 104728-TOT-OI-SUR-REP-HABASRE	Appendix C: Habitat Assessment Survey Report (2023	2023a	Ocean Infinity
Environmental Baseline Survey Report – Culzean WT Site Survey September 1st, 2023. 104728-TOT-OI-SUR-REP-ENVBASRE	Appendix D: Environmental Baseline Survey Report (2023)	2023b	Ocean Infinity

TITLE	SOURCE	YEAR	AUTHOR
List of threatened and/or declining species and habitats	https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats	2008b	OSPAR
Species distribution modelling of marine benthos. A North Sea case study.	https://www.int-res.com/abstracts/meps/v442/p71-86/	2011	Reiss *et al.*
Special Protected Area (SPA)	https://data.gov.uk/dataset/549cfe11-819d-4b0c-9479-9c70135fe9cf/special-protection-area-scotland	2020	Scottish Government
Scottish PMF	https://marine.gov.scot/sma/content/descriptions-scottish-priority-marine-features-pmfs	2016	Tyler-Walters *et al.*

8.5.2 Project site-specific surveys

An environmental baseline and habitat assessment survey was completed in 2023 in the Project Area. This included geophysical survey (Multibeam Echosounder (MBES) and Side-Scan Sonar (SSS)) as well as environmental sampling. The environmental and benthic sampling consisted of:

- Drop Down Video (DDV) for identifying epifauna and habitat;
- Grab sampling for faunal taxonomy, biomass, Particle Size Analysis (PSA) and contaminants;
- Grab sampling for eDNA; and
- Water sampling for contaminants and eDNA.

An overview of sampling stations in relation to the Culzean Project Area Is provided in Figure 8-2.

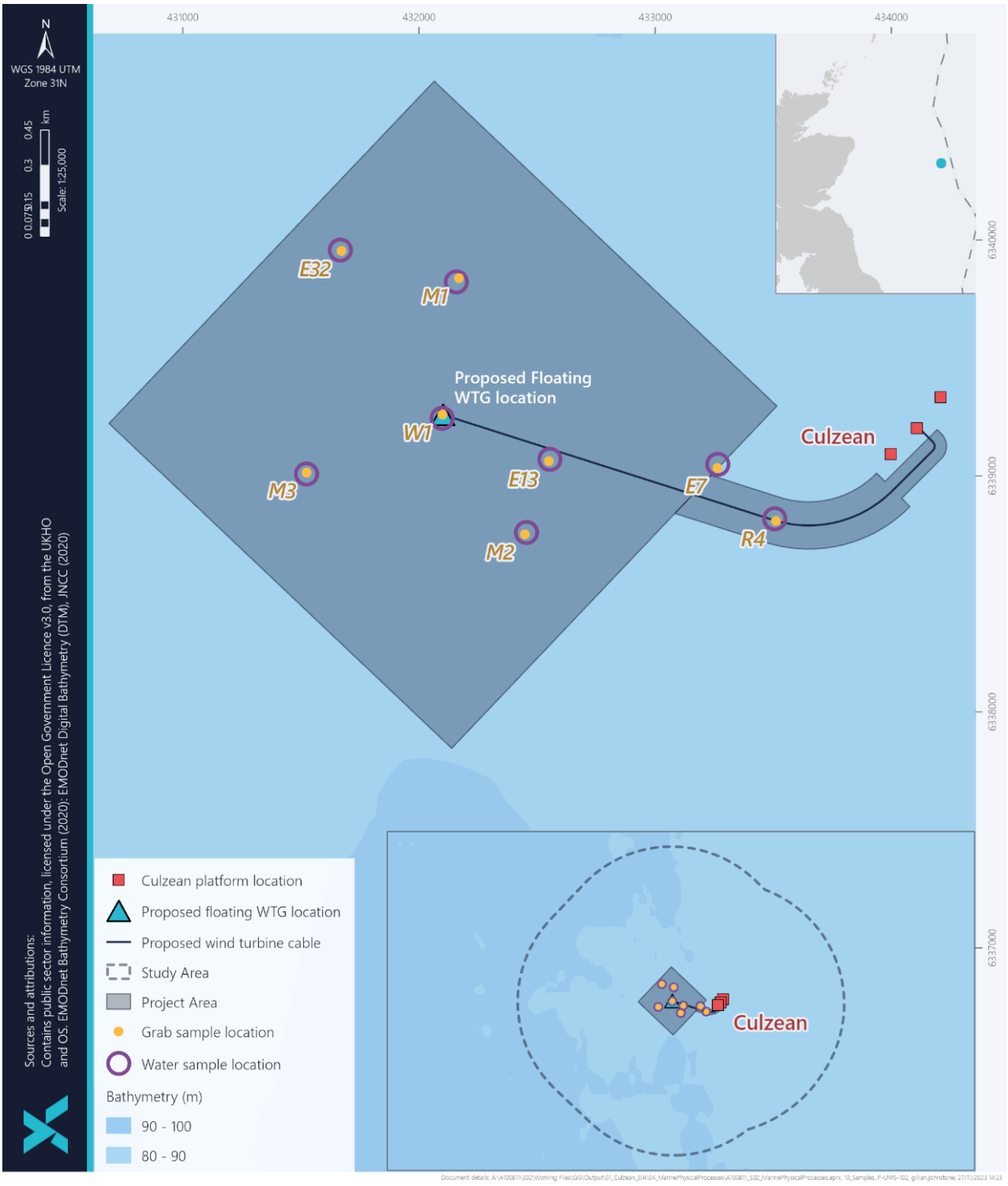

Figure 8-2 Environmental (benthic, sediment and water) sampling locations across the Project Area (Appendix C; Appendix D)

8.5.3 Existing baseline

8.5.3.1 Introduction

A review of literature and available data sources, augmented by Project site-specific surveys (Appendix C; Appendix D) has been undertaken to describe the current baseline environment for Benthic Ecology. The findings of this research are presented below to provide an understanding of the offshore Project environment and inform the EIA process.

The depth at the Project Area ranges from approximately 87 m – 91 m below Lowest Astronomical Tide (LAT). Throughout the site, the seabed is mostly homogenous with limited localised variation in sedimentary characteristics. Variation across the site was typically associated with anthropogenic infrastructure. Other sources of bathymetric variation included depressions, faunal burrows, cobbles and shell gravel (Appendix D).

The key features of Benthic Ecology which are likely to require consideration within the EIA are:

- Broad habitat type, species composition (Section 8.5.3.2);
- Annex I habitats (Section 8.5.3.3);
- OSPAR threatened and/or declining species and habitat (Section 8.5.3.4);
- PMFs (Section 8.5.3.5);
- Protected Areas (Section 8.5.3.6); and
- International Union for the Conservation of Nature (IUCN) Red List Species (Section 8.5.3.7).

8.5.3.2 Habitat type, species composition

The benthic habitat type that underlies the Project Area is broadly classified under the European Nature Information System (EUNIS) as 'Deep Circalittoral Sand' (EUNIS habitat code A5.27 (MD5) (Marine Scotland, 2023). Detailed survey work during the Environmental Baseline Survey (EBS) and habitat assessment survey identified one EUNIS habitat type in the Project Area as well as three habitat complexes and one artificial habitat. The identified habitats are listed in Table 8-4. These habitats were identified using a combination of geophysical and environmental survey work.

Table 8-4 EUNIS Habitats in the Project Area (Appendix C; Appendix D)

HABITAT CLASSIFICATION	EUNIS CODE	SAMPLE STATION(S)
Faunal communities in Atlantic offshore circalittoral sand	MD521	E7
Faunal communities in Atlantic offshore circalittoral sand/ Seapens and burrowing megafauna in Atlantic circalittoral fine mud	MD521 / MC6216	M1, M2, E13 and R4
Faunal communities in Atlantic offshore circalittoral sand / *Brissopsis lyrifera* and *Amphiura chiajei* in Atlantic circalittoral mud	MD521 / MC6218	E32
Faunal communities in Atlantic offshore circalittoral sand/ *Gracilechinus acutus norvegicus* assemblage on Atlantic upper bathyal sand	MD521/ ME5213	M3, W1
Constructed, industrial and other artificial habitats	J (V. 2012) *	N/A

A map of habitat types around the Project Area is provided in Figure 8-3. Most of the Project Area is covered by the MD521 EUNIS habitat ('Faunal communities in Atlantic offshore circalittoral sand') (Appendix D). Little data is available on circalittoral sand habitats; however they are typically more stable than their shallower counterparts (European Environment Agency, 2022). They are characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

The various habitat complexes in the Project Area support a diverse array of benthic fauna. Seabed imagery from the EBS (Appendix D) identified a range of notable taxa including: seapens (*Pennatula phosphorea*, *Virgularia mirabilis*) sea urchins (*Gracilechinus acutus*, *Brissopsis lyrifera)* and likely a species of heart urchin (*Echinocardium chordatum)*. Drop down camera surveys also identified rare occurrences of *Ophiurida*, *Caridea*, *Crangon sp.*, *Naticidae*, *Hyalinoecia tubicola*, *Polynoidae*, *Scaphopoda* and *Pecten maximus*. Several of these species were identified in previous survey work in the area, particularly seapen species (*P. phosphorea* and *V. mirabilis*) (Gardline, 2013). However other species commonly identified in the EBS Appendix D had not previously been identified in the area (e.g. *Brissopsis lyifera*) suggesting a potential shift in ecological conditions in the last decade.

As part of the survey work detailed in Appendix C and Appendix D, eDNA samples were recovered and analysed by Nature Metrics (Appendix E). For invertebrates, 33 Operational Taxonomic Units (OTUs) were identified across water and sediment samples in the area. The analysis also identified eight vertebrate OTUs and five fish OTUs. The eDNA analysis did not identify any invasive species in the Project Area.

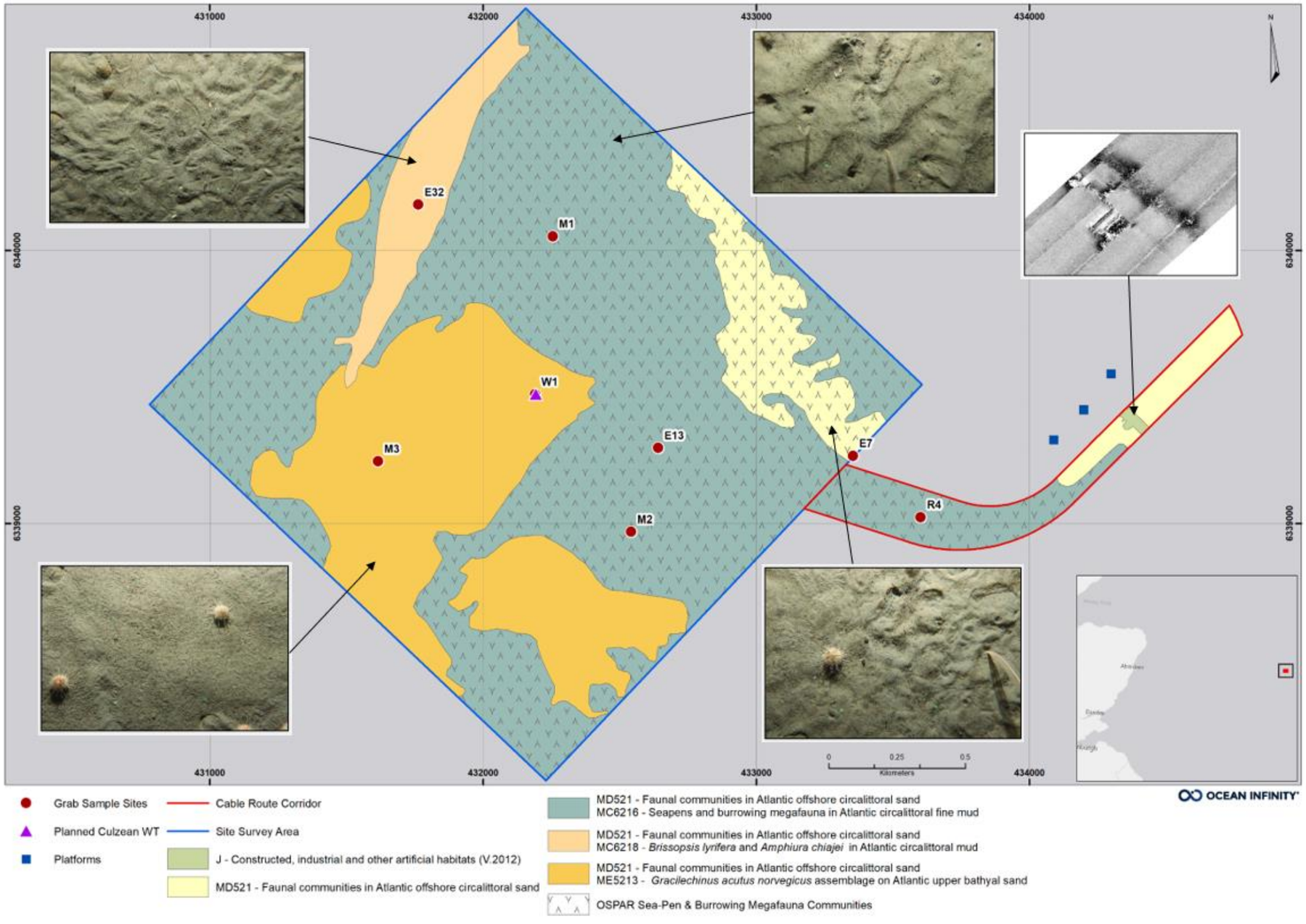

Figure 8-3 EUNIS Habitat Types Within Project Area

The majority of the site area and the western section of the route cable corridor are classified as habitat complex MD521/MC6216 - *Faunal communities on Atlantic offshore circalittoral sand / Seapens and burrowing megafauna* in Atlantic circalittoral fine mud. The habitat complex MD521/MC6216 matches the qualifying descriptors of the OSPAR habitat 'Sea-Pen & Burrowing Megafauna Communities'.

The western and central sections of the site area are characterised by a frequent occurrence of *G. acutus* and classified as habitat complex MD521/ME5213 - *Faunal communities on Atlantic offshore circalittoral sand / G. acutus norvegicus* assemblage on Atlantic upper bathyal sand.

The furrows interpreted in the northernmost sections extend into the central sections of the site area and show a species composition similar to MD521/MC6218 -*Faunal communities on Atlantic offshore circalittoral sand / Brissopsis lyrifera* and *Amphiura chiajei* in Atlantic circalittoral mud.

8.5.3.3 Annex I Habitats

Annex I habitats are defined as habitats which require the designation of SAC under the European Union (EU) Habitats Directive. Throughout the North Sea, three Annex I marine habitats occur regularly. These are:

- Reefs (defined as hard substrata (biogenic and rocky (or geogenic)) on the sea floor which can be formed in several different ways;
- Sandbanks (which are slightly covered by seawater all the time)); and
- Submarine structures made by leaking gases (e.g. Pockmarks).

Reefs are variable in form and in the communities that they support. Two main types of reef can be recognised: those where animal and plant communities develop on rock or boulders and cobbles (geogenic), and those where structure is created by the animals themselves (biogenic) (JNCC, 2022). The distinction between what defines a Reef is not precise and is generally referred to as "reefiness" (Gubbay, 2007). This is particularly relevant in the case of the tube-building polychaete (*Sabellaria spinulosa)* and areas of cobbles and boulders (stony reef).

Previous survey work identified cobbles and boulders in the wider Culzean area (Gardline, 2013). These substrata can form the basis of the Annex I 'stony reef' habitat. Rocky reefs are extremely variable, both in structure and in the communities they support. A wide range of topographical reef forms meet the EU definition of this habitat type. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles (JNCC, 2022). Reefs are characterised by communities of attached algae and invertebrates, usually associated with a range of mobile animals, including invertebrates and fish. The specific communities that occur vary according to a number of factors (JNCC, 2022). However, the densities of cobbles and boulders identified during the Culzean platform survey were not indicative of the habitat (Gardline, 2013).

As previous survey work was not specific to the Project Area, further project specific survey work was undertaken (Appendix C; Appendix D). Criteria outlined in Gubbay (2007) and Irving (2009) are used to assess potential 'reefiness'. However, the survey did not identify any areas within the Project Area that were likely to support either stony or biogenic reefs, therefore further assessment using Gubbay (2007) and Irving (2009) was not required. Whilst previous survey work identified cobbles and boulders that could potentially support 'Annex I 'stony reefs in the wider Culzean Field (Gardline, 2013), the most up to date survey work suggests that it the Project Area is unlikely to support any Annex I Reef Habitats.

The depth and bathymetry in the Culzean area means that no Annex I 'Sandbanks' habitats are likely to be present in the Project Area. This has been confirmed by geophysical survey work in the area (Gardline, 2013; Appendix C; Appendix D).

The recent Ocean Infinity surveys in the Project Area did not identify any pockmarks (active or otherwise) or Methane Derived Authigenic Carbonate (MDAC) structures (Appendix C; Appendix D), both of which are considered features of the Annex I habitat 'Submarine structures made by leaking gases'. Furthermore, no evidence of the Annex I habitat '*submarine structures made by leaking gases*' was identified in the vicinity of the Culzean platform (Gardline, 2013) or in recent project specific survey work (Appendix C; Appendix D). However, it is noteworthy that MDAC structures were identified at multiple stations from the Gardline (2014) report, around approximately 4 km west of the Culzean platform. Despite the presence of MDAC structures in the Gardline (2014) survey, Annex I '*Submarine structures made by leaking gases*' are not considered to be present in the Project Area.

Overall, survey work suggests that it is unlikely that any Annex I habitats will be present in the Project Area. Previous survey work has however identified potential 'Submarine structures made by leaking gases' in the wider Culzean area. No other Annex I habitats are thought to be present in the Project Area.

Effects on Annex I Habitats as qualifying features of European Protected Sites have also been considered by the Habitats Regulations Assessment (HRA) process. The screening process, undertaken in consultation with NatureScot and MD-LOT, concluded there was no potential for LSE on these features and therefore no further assessment was required under the HRA process.

8.5.3.4 OSPAR threatened and/or declining features.

The OSPAR Convention is a legislative instrument used for the protection of the marine environment in the North East Atlantic, including the North Sea. The OSPAR convention includes a list identifying all species and habitats that are in need of protection. These features are listed as threatened and/or declining (OSPAR, 2008b).

One of the habitats listed on the OPSAR threatened and/or declining list is '*Seapens and burrowing megafauna*', a habitat present throughout the North Sea which was added to the OSPAR list in 2003 (OSPAR, 2010). The habitat is also a constituent of the PMF habitat 'Burrowed Mud' (see PMF information embedded in Section 8.5.3). The habitat consists of plains fine mud which are heavily bioturbated by burrowing megafauna with burrows and mounds. Whilst there is limited quantifiable data on the extent of this habitat, it is thought to be sensitive to any pressures involving the physical disturbance of the seabed. A review of the habitats status in 2022 concluded that the habitat are still likely to be threatened and/or declining (OSPAR, 2010). The habitat also qualifies for ecological significance, as it can provide nursery areas for a range of fish including hake *Merluccius merluccius*. The 'mosaic' of disturbance patches created by megafaunal activity may be a factor acting to promote species diversity in the macrofaunal community. However, no single member of this biotope complex is known to be a 'keystone' species whose activity is essential to the maintenance of community structure (OSPAR, 2010).

The burrowing crustacea present typically include Norway lobster (*Nephrops norvegicus; 'Nephrops')*, which is frequently recorded from surface observations although grab sampling may fail to sample this species (Hill *et al.* 2023). Indeed, some forms of sampling may also fail to indicate seapens as characterising species. The burrowing anemone (*Cerianthus lloydii)* and the ubiquitous epibenthic scavengers (*Asterias rubens*, *Pagurus bernhardus* and *Liocarcinus depurator)* are present in low numbers in this biotope whilst the brittlestars (*Ophiura*

albida and *Ophiura ophiura)* are sometimes present but are much more common in slightly coarser sediments (Hill *et al.* 2023). Low numbers of the anemone (*Pachycerianthus multiplicatus)* may also be found, and this species, which is scarce in the UK, appears to be restricted to this habitat (JNCC, 2024). The infauna may contain significant populations of the polychaetes Pholoe spp., Glycera spp., Nephtys spp., spionids, *Pectinaria belgica* and *Terebellides stroemii*, the bivalves *Nucula sulcata, Varicorbula gibba* and *Thyasira flexuosa*, and the echinoderm *Brissopsis lyrifera*. The biotope may include a range of the component fauna (Hill *et al.* 2023).

Recent survey work identified numerous examples of the OSPAR threatened and declining habitat '*Seapens and burrowing megafauna*' (Figure 8-4). These habitats were identified at stations R4, E7, E13, M2 and M1 (see Figure 8-2 for reference). The stations where the habitat was identified are predominantly located along the export cable route and to the east of the proposed WTG location. This habitat has also been identified in previous survey work around the Culzean platform (Gardline, 2013). These results suggest that the Project Area supports the habitat at relatively high densities. The OSPAR threatened and/or declining habitat is likely to be present across the Project Area.

Figure 8-4 Example of Seapen and Burrowing Megafauna Community in the Project Area (Appendix D)

Another feature that is listed as threatened and/or declining in the North Sea is the ocean quahog (OPSAR, 2008b; OSPAR, 2009b). Ocean quahog is a species of bivalve mollusc that can live for up to 400 years. Ocean quahog typically inhabits areas dominated by sands and gravels. This is supported by surveys at the Culzean platform, where a total of 190 juveniles were identified across the Survey Area, with a maximum of seventeen individuals recorded at any one station (Gardline, 2013). No adult specimens were identified. Furthermore, five different species distribution

models for ocean quahog reported that the species is likely to occur in the region of the North Sea overlapping the Project (Reiss *et al.* 2011). Whilst no individuals were identified during the most recent site-specific survey work (Appendix C; Appendix D), previous surveys at the Culzean platform (Gardline. 2013) did identify four juveniles in the area. Whilst this suggests that ocean quahog may be sparsely distributed within the Project Area and the wider Study Area, it is unlikely that the area is of particular conservation importance for the species.

No other habitats or species listed as threatened and/or declining according to the OSPAR List were identified in the Project Area.

8.5.3.5 Priority Marine Features

PMFs are a range of species and habitats that have been identified as being of conservation importance in Scotland (Tyler-Walters *et al.*, 2016). The habitat '*Seapens and burrowing megafauna*' is a constituent of the PMF 'Burrowed mud' habitat' and the species ocean quahog is also listed as a PMF species in Scottish Waters. As discussed in Section 8.5.3.4 on OSPAR threatened and/or declining habitats, these features have been identified in the vicinity of the Project Area. Beyond these features, a sandy ray (*Leucoraja circularis)* was also identified at sampling station E32 (Appendix D). This species is similarly listed as a PMF, however only one occurrence was noted during survey work. It is an offshore species typically found on sandy or muddy seabeds to the north-west of Scotland. As discussed in the previous section, four juvenile ocean quahog were identified in survey work around the Culzean platform (Gardline, 2013). As well as being listed on the OSPAR list of threatened and/or declining species, ocean quahog are also listed as a PMF (Tyler-Walters *et al.*, 2016)

The only other PMF feature that has been recorded in the vicinity of the Project Area is the habitat '*Offshore subtidal sands and gravels*'. An occurrence of the broadscale habitat has been identified approximately 5 km southeast of the Project Area at the outer extent of the Study Area (Marine Scotland, 2023). These 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 (Marine Scotland, 2016). These habitats typically comprise communities of tube building polychaetes, burrowing brittlestars, polychaetes and bivalves. The presence of mud habitats in the Project Area may also be indicative of the PMF habitat 'Offshore deep-sea muds', for which the East of Gannet and Montrose NCMPA is designated (JNCC, 2021) (see subsequent Section 8.5.3.6 on protected areas for further information).

No other PMF features have been identified in the vicinity of the Project Area.

8.5.3.6 Protected areas

The nearest protected site is the East of Gannet and Montrose Fields NCMPA, located approximately 18 km to the west of the Culzean platform (Figure 8-3). The area is designated for the presence of the PMF habitat 'Offshore deep-sea muds' and ocean quahog aggregations (JNCC, 2021). Given the designation of the NCMPA, the presence of mud habitats in the Project Area may suggest the presence of the PMF habitat 'Offshore deep-sea muds.

The closest SAC is the Scanner Pockmark SAC, located approximately 132 km north of the proposed development, whilst the closest Marine Conservation Zone (MCZ) is the Fulmar MCZ, located approximately 65 km south of the Culzean Development (Marine Scotland, 2023). Given their respective distances, no protected sites or areas designated for the protection of benthic features are expected to be impacted from the proposed operations.

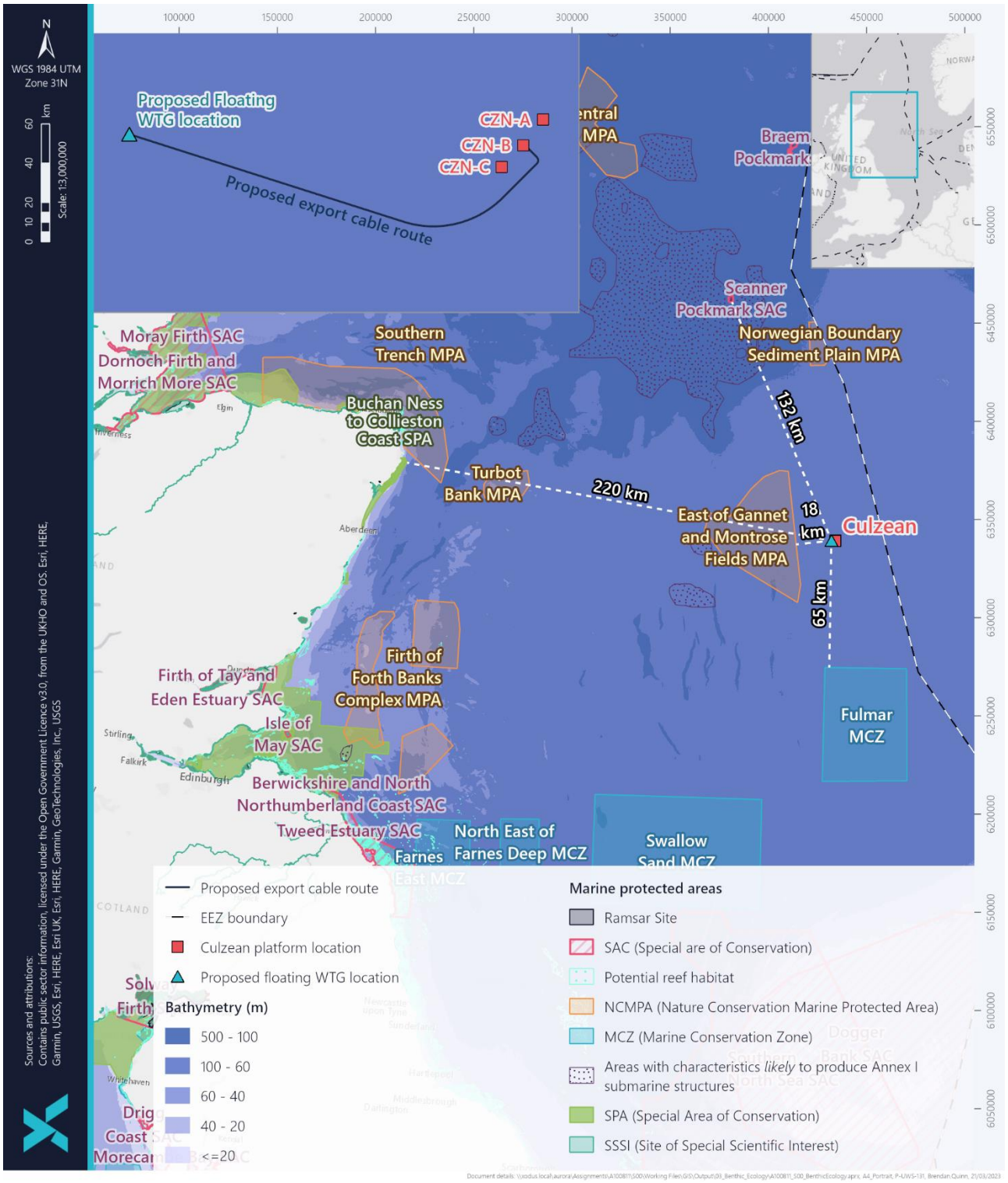

Figure 8-5 Protected Areas and proximity to the Project

8.5.3.7 IUCN Red List species

During eDNA analysis of the collected water and sediment samples, no species listed as vulnerable, endangered or critically endangered on the IUCN red list were identified in the Project Area (Appendix E). However, during drop

down camera work, *L. circularis* (also a PMF) was identified at sampling station E32 (Appendix D). The species is considered threatened on the IUCN Red List (IUCN, 2023). No other species listed on the IUCN Red List were identified in the Project Area.

Overall, the benthic baseline environment in the vicinity of the Project Area is typical for the Central North Sea (CNS) and consists of several broad habitat types and associated benthic communities. The area supports several features of conservation importance, including; potential Annex I 'Submarine structures made by leaking gases', the OSPAR threatened and/or declining and PMF 'Seapens and burrowing megafauna' habitat, the OSPAR threatened and/or declining and PMF ocean quahog, the PMF and IUCN Red List threatened sandy ray and the PMF habitat 'Offshore subtidal sands and gravels'. All of these features are known to occur throughout the wider North Sea.

8.5.4 Future Baseline

In the absence of the Project, the future Benthic Ecology environment at the Offshore Site is likely to primarily experience changes associated with the effects of climate change. Climate change is leading to increasing 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; 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).

Characteristic benthic receptors identified in the Project Area such as the 'Seapens and burrowing megafauna' habitat typically show moderate sensitivity to changes in temperatures (Hill *et al.*, 2023). Several of these species are known to occur in the Mediterranean, suggesting a wide thermal range. Therefore, the most likely impact relating to the future baseline would be a shift in pressure from fish species. Shifts in the timing of spawning, hatching and migration, where the mismatch between the timing of fish spawning and algal blooms may have an effect on the recruitment of winter-spring hatching fish larvae (e.g. sandeel, cod, and sole) that prey on plankton (Wright, *et al.*, 2020). Further details on the impact of climate change to fish and shellfish species are provided in Chapter 9: Fish and Shellfish Ecology.

It should be noted that climate change effects are difficult to predict, and there is limited confidence in interpreting evidence on the level of contribution of climate change to the observed changes in Benthic Ecology. Complex relationships between anthropogenic impacts and natural variation, as well as the difficulty in predicting future impacts of the rapidly changing climate on benthic receptors means that an accurate future benthic baseline for the Benthic Ecology Study Area cannot be provided.

8.5.5 Summary and Key Issues

Table 8-5 Summary and key issues for Benthic Ecology

SUMMARY AND KEY ISSUES	PROJECT AREA
	Environmental survey work identified the presence of the following EUNIS habitats within the Project Area: • Faunal communities in Atlantic offshore circalittoral sand (MD521); • Faunal communities in Atlantic offshore circalittoral sand / Seapens and burrowing megafauna in Atlantic circalittoral fine mud (MD521 / MC6216); • Faunal communities in Atlantic offshore circalittoral sand / *Brissopsis lyrifera* and *Amphiura chiajei* in Atlantic circalittoral mud (MD521 / MC6218); • Faunal communities in Atlantic offshore circalittoral sand / *Gracilechinus acutus norvegicus* assemblage on Atlantic upper bathyal sand (MD521/ ME5213); and • Constructed, industrial and other artificial habitats J (V. 2012) *.
	Environmental survey work (Appendix D) identified multiple examples of the OSPAR threatened and/or declining and PMF habitat 'Seapens and burrowing megafauna.
	Environmental survey work (Appendix D) identified multiple juvenile specimens of the OSPAR threatened and/or declining and PMF Ocean quahog species.
	Drop down camera work identified a single occurrence of the sandy ray, which is listed as threatened on the IUCN Red List and as PMF species. Due to the species only being identified on one occurrence, it is not thought to be abundant in the Project Area. Given the low abundance and scale of the Project, this species has not been considered further in this chapter.
	Previous survey work identified the presence of MDAC structures 4 km from the Project Area. Whilst these sites are associated with Annex I 'submarine structures made by leaking gases', the presence of the Annex I habitat was not recorded. Due to the distance from the Project and lack of classification as an Annex I habitat, this habitat has not been considered further as part of this chapter.

** Note: The individual habitats listed here are assessed as a whole within this EIA. Subtidal sediments encompass the primary biotope Atlantic Offshore Circalittoral sand (MD521) which also incorporates the muddy sand habitat complexes. While these habitats do contain patches that may be constituted as mud, for the purpose of the assessment they have not been considered separately, given the similarity of the sensitivity of these habitats. This habitat also incorporates the OSAPAR threatened and Declining habitat 'Offshore sands and Gravels' as well as elements of the Scottish PMF 'Burrowed Mud'.*

8.5.6 Data Gaps and Uncertainties

TEPSNUK 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 Project Area. This data has been supplemented with publicly available data on the wider area where required. As such, it is not considered that there are any data limitations or uncertainties for Benthic Ecology.

8.6 Key Parameters for Assessment

As detailed in Chapter 4: Project Description, this assessment considers a Project Design Envelope (PDE), which encompasses a Maximum Design Scenario (MDS) or a worst-case scenario. The MDS scenario represents, for any given receptor and potential impact on that receptor that would result in the greatest potential for change.

Given that the MDS is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that development of any alternative options within the design parameters will give rise to no worse effects than assessed in this impact assessment. Table 8-7 presents the worst-case scenario for potential impacts on Benthic Ecology during construction, operation and maintenance and decommissioning.

8.6.1 Quantification of Impacts

In relation to Benthic receptors, the main impacts associated with the project are any activities which will involve an interaction with the seabed. These are quantified in Table 8-6.

Table 8-6 Quantification of Seabed Impacts

INFRASTRUCTURE	QUANTITY	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	ASSUMPTIONS
Catenary Mooring Lines	3	0.0147	N/A	There will be three initial catenary mooring lines used as part of the Project. Installation of the mooring lines will involve connecting them to the anchors. Therefore, there will be no temporary impacts associated with installation. Within the MDS, each mooring line is 600 metres (m), with a maximum of 490 m in contact with the seabed following installation. The lines may be subject to a maximum of 10 m lateral movement (5 m in either direction). 3 Catenary mooring lines temporary footprint: [3 x 490 m x 10 m = 14,700 m^2 = **0.0147 km^2**].
Additional Semi Taut Mooring System	3	0.0033	N/A	Approximately one year into the Project, TEPNSUK plan to install either a taut or semi-taught mooring system. The MDS for this will be a semi-taut mooring system (which would be the additional option with the highest seabed impact). This will involve 3 mooring lines, each with a length of 610 m. Of this approximately 110 m will be in contact with the seabed. The lines may be subject to a maximum of 10 m lateral movement (5 m in either direction). The footprint has therefore been calculated based on this assumption: 3 Semi-taut mooring lines temporary footprint: [3 x 110 m x 10 m = 3,330 m^2 = 0.0033 km^2] Total mooring line temporary footprint: [0.0147 km^2 + 0.0033 km^2 = **0.018 km^2**]
Anchors	6	0.00411	0.00042	Each mooring line will have an associated anchor. Six drag anchors have been assumed to assess the worst-case scenario. Each anchor is approximately 11.2 m long and 11.2 m at its widest point (worst-case of 125m^2 per anchor). The anchors will be secured in place by dragging them across the seabed. A maximum worst-case drag length of 50 m has been assumed. Drag anchors temporary footprint [6 x 125 m^2 = 750 m^2 = 0.00075 km^2] Post-installation drag temporary footprint [6 x 11.2 m x 50 m = 3,360 m^2 = 0.00336 km^2] Total anchor seabed temporary footprint: [0.00075 km^2 + 0.00336 km^2 = **0.00411 km^2**]

INFRASTRUCTURE	QUANTITY	TEMPORARY SEABED FOOTPRINT (KM^2)	LONG TERM SEABED FOOTPRINT (KM^2)	ASSUMPTIONS
				The anchors will penetrate approximately 10 m to 15 m into the seabed. Post-installation, there may be a requirement for up to 70 m2 of rock to be deposited as a form of scour protection at each anchor site. The maximum long-term footprint from anchoring would therefore be equivalent to: **Total long-term impact footprint (Anchor scour):** [6 x 70 m^2 = 420 m^2= **0.00042 km^2**]
Export Cable	1	0.03	0.007	The export cable will be 2,500 m long in total, with a maximum of 2,045 m in contact with the seabed. Prior to installation, a pre-lay grapnel run will be undertaken along the length of the cable route. The trenching of the export cable will involve the temporary disturbance of the surrounding seabed. A maximum seabed disturbance corridor width of 15 m has been assumed due to trenching activities and associated disturbance and site preparation works, including pre-lay grapnel run. **Cable lay total temporary footprint:** [15 m x 2,045 m = 30,675 m^2= **0.03 km^2**] Once the cable is installed, under a best-case scenario it will be 100% trenched and buried, resulting in no long-term impacts to the seabed. However, there may be contingency requirement for additional cable protection (likely rock dump) along approximately 50% (1,000 m worst case) of the cable route. The cable protection will be no more than 7 m wide and will remain in place for the operational lifetime of the Project. Therefore, the long-term footprint will be equivalent to: **Total long-term impact footprint (cable lay):** [7 m x 1,000 m^2 = 7,000 m^2= **0.007 km^2**]
TOTAL	N/A	0.052	0.007	

Table 8-7 Worst case scenario specific to Benthic Ecology receptor impact assessment

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Construction (including pre-construction) and decommissioning*		
Temporary habitat disturbance	During construction activities, interaction with the seabed may temporarily disturb and remove benthic habitats and species in the direct temporary footprint (0.052 km^2).	The proposed construction activities will have a temporary seabed footprint of 0.052 km^2. Habitats and species located within this footprint may be subject to disturbance during construction operations which are estimated to last a maximum of one month.
Temporary Increase in suspended sediment and sediment deposition	During construction activities, interaction with the seabed may result in a temporary increase in suspended sediment concentrations. This may result in increased sediment deposition, causing smothering to benthic species and habitats in the Project Area.	The proposed operations will result in minor excavation and burial around the export cable corridor. This will result in sediment suspension and deposition of sediments in Project Area.
Long-term loss and/or damage to benthic habitats and species	During construction, the addition of anchoring and cable protection may result in a long-term loss and damage to benthic communities present in the operational footprint (0.007 km^2).	The Project will involve the long-term installation of infrastructure (cable protection, mooring lines and scour protection) onto the seabed. These installations will change the seabed and result in long-term change to benthic habitats and species in the area.
Disturbance of Contaminated sediments	Multiple historic wells have been drilled in the region surrounding the Project and sediment contaminants such as metals and hydrocarbons are therefore likely to be present in the area. Installation and decommissioning activities may result in the disturbance of seabed sediment, which if contaminated, may lead to the release of contaminants into the water column and cause them to enter the marine food chain.	The proposed operations will result in excavation and burial activities around the export cable corridor, mooring lines and anchoring locations. This will result in approximately 0.052 km^2 of temporary sediment suspension and deposition of sediments in Project Area.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Operation and maintenance		
Colonisation of hard structures	Artificial structures placed on the seabed (i.e., moorings and/or cable protection) may result in colonisation by marine organisms, resulting in localised changes to biodiversity and altering ecosystem structure.	The Project will involve approximately 0.007 km^2 of artificial hard structures being placed on the seabed throughout the operational lifespan. The introduction of such structures into the marine environment provides a hard surface that acts as an artificial substitute to hard substrata such as cobbles and boulders. This can therefore result in the establishment of epifaunal species that are otherwise absent in an area, resulting in a change in biodiversity an/ or community structure that can differ on both a horizontal and vertical plane.
Decommissioning		
Removal of artificial hard substrate during decommissioning	Artificial structures removed from the seabed (i.e., anchor and or cable protection) may result in the disturbance of marine organisms which have colonised the hard substrate over the duration of the project, resulting in localised changes to biodiversity and altering ecosystem structure.	The Project will involve approximately 0.007 km^2 of artificial hard structures being placed on the seabed throughout the operational lifespan. The introduction of such structures into the marine environment provides a hard surface that acts as an artificial substitute to hard substrata such as cobbles and boulders and the establishment of epifaunal species that are otherwise absent in an area. The removal of this hard substrate following the establishment of these communities would lead to their subsequent damage or loss.

8.7 Methodology for Assessment of Effects

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 6: EIA Methodology. The sensitivity of the receptor is combined with magnitude to determine impact significance. Topic-specific sensitivity and magnitude criteria are assigned based on professional judgement, as outlined in Table 8-8 and Table 8-9.

Table 8-8 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 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 • The species is listed on Annex IV of the 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
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, PMF 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 8-9 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 associated significance of effect is then determined using the matrix provided in Chapter 6: EIA Methodology.

8.8 Embedded Mitigation

As described in Chapter 6: 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 8-10. 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 8-10 Embedded mitigation measures relevant to Benthic Ecology

MITIGATION MEASURE	DESCRIPTION	FORM (PRIMARY/ TERTIARY)	HOW MITIGATION WILL BE SECURED
Micrositing of wind turbine and the associated offshore infrastructure (including cable).	The final Project layout will be presented within the Cable Plan and Development Specification and Layout Plan (DSLP) and conditions of the marine licence. The final placement of anchors and export cable will be informed through micro siting based on available site survey data to ensure avoidance of sensitive habitats, archaeological and other structures where possible. Where this is not possible, the route will take the shortest distance possible through the sensitive areas to reduce environmental effects.	Primary	Secured through conditions attached within the Marine Licence.
Reducing localised habitat loss	Best practice will be followed to ensure that potential habitat loss is minimised throughout the proposed works (e.g. Micro-siting and minimising the benthic footprint of the Project). The amount of rock used to protect the offshore export cable or as scour protection will be kept to a minimum where possible.	Primary	Secured through conditions attached within the Marine Licence and in line with Environmental Management Plan (EMP)/ Project Environmental Management Plan (PEMP)
Cable Plan (CaP) and Cable Burial Risk Assessment (CBRA)	A CaP will be provided for the Project which will detail the location/route and cable laying techniques of the export cable and detail the methods for cable surveys during its operational life. A CBRA will also be undertaken and included within the CaP to determine required cable protection measures with an aim to minimise volume and spatial extent of protection.	Primary	Secured through conditions attached within the Marine Licence.
Environmental Management Plan (EMP)	The EMP will provide the over-arching framework for on-site environmental management during the phases of development as follows: • All construction as required to be undertaken before the commissioning of the Project • The operational lifespan of the Project from Commissioning until the cessation of electricity generation (environmental management during decommissioning is addressed by the Decommissioning Programme). The EMP will be in accordance with the Application insofar as it relates to environmental management measures. The EMP will set out the roles, responsibilities and chain of command in	Tertiary	Secured through conditions attached within the Marine Licence.

MITIGATION MEASURE	DESCRIPTION	FORM (PRIMARY/ TERTIARY)	HOW MITIGATION WILL BE SECURED
	respect of environmental management for the protection of environmental interests during the construction and operation of the Project. It will address (but not be limited to) the following overarching requirements for environmental management during construction: • Mitigation measures as identified in the Application, pre-consent and pre-construction monitoring or data collection • A pollution prevention and control method statement, including contingency plans; • Management measures to prevent the introduction of Invasive Non-Native Species (INNS); • A site waste management plan (dealing with all aspects of waste produced during the construction period), including details of contingency planning in the event of accidental release of materials which could cause harm to the environment. Wherever possible the waste hierarchy of reduce, reuse and recycle will be referred to; and • The reporting mechanisms that will be used to provide the Scottish Ministers and relevant stakeholders with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed. The EMP will be regularly reviewed by the Company at intervals agreed by the Scottish Ministers and will be updated based on current information on construction methods and operations. The EMP will be informed, so far as is reasonably practicable, by the baseline monitoring or data collection undertaken as part of the Application and the Project Environmental Monitoring Programme (PEMP) to ensure that all construction and operation activities are carried out in a manner that minimises their impact on the environment, and that mitigation measures contained in the Application, or as otherwise agreed are fully implemented.		
Project Environmental Monitoring Programme	A Project Environmental Monitoring Programme (PEMP) to provide further evidence to support these conclusions of the EIA and provide information for future offshore wind farm developments.	Tertiary	Secured through conditions attached within the Marine Licence.

MITIGATION MEASURE	DESCRIPTION	FORM (PRIMARY/ TERTIARY)	HOW MITIGATION WILL BE SECURED
Construction Method Statement (CMS)	A CMS will be developed in accordance with the EMP and detail how project activities and plans identified within the EMP will be carried out, whilst also highlighting any possible dangers / risks associated with specific Project activities. The CMS will include the Code of Construction Practice (CoCP) which will set out the approach to how construction activities will be managed and controlled in order to deliver the commitments and mitigation arising from Project.	Tertiary	Secured through conditions attached within the Marine Licence.
Decommissioning Programme	A Decommissioning Programme will be provided pre-construction to address the principal decommissioning measures for the Project, this will be written in accordance with applicable guidance and detail the management, environmental management, and schedule for decommissioning.	Tertiary	Secured through conditions attached within the Marine Licence.

8.9 Assessment of Impacts

This assessment has been informed from a variety of sources, with focus on the Marine Evidence-based Sensitivity Assessment (MarESA). Sensitivity is defined as a product of the likelihood of damage due to a pressure and the rate of recovery once the pressure has been removed (Marine Life Information Network (MarLIN), 2023). MarESA involves a systematic process to examine the biology or ecology of a feature, compile the evidence of the effect of a given pressure on the feature (species or habitat) in question, assess the likely sensitivity of the feature to the pressure against standard scales, and to document the evidence used and justify assessments made (MarLIN, 2023).

8.9.1 Potential effects during construction

8.9.1.1 Temporary Habitat Disturbance

This section focuses on the temporary habitat 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 later sections. 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 Project Area, construction, and pre-construction activities such as trenching, and boulder clearance will result in temporary disturbance to existing seabed habitats and communities. In addition, the initial installation of infrastructure such as the export cable, mooring lines and anchors may cause temporary disturbance. As discussed in Section 8.6.1, the Project will result in a temporary seabed footprint of 0.052 km^2.

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).

Seapens and burrowing megafauna communities

Within the Project Area, the primary sensitivity is the presence of the OSPAR threatened and/or declining habitat 'Seapens and burrowing megafauna'. 'Seapens and burrowing megafauna' also form part of the PMF 'Burrowed mud' habitat. As discussed in Section 8.5.3, the habitat was identified at stations R4, E7, E13, M2 and M1 (see Figure 8-2 for reference). Several of these stations are located along the proposed cable route and will therefore be subject to temporary disturbance through boulder clearance and trenching.

'Seapens and burrowing megafauna communities' were selected for inclusion on the OSPAR list based on an evaluation of their status according to the Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application (the Texel-Faial Criteria) (OSPAR, 2008b). The nomination for inclusion on the list cited the criteria decline and sensitivity, with information also provided on threat. The habitat is sensitive to mechanical damage, with much of the assessments on the habitats classification focusing on impacts such as towed fishing gear. The temporary disturbance will likely result in mechanical disturbance (i.e., through boulder clearance and trenching).

Despite sensitivity to physical disturbance, studies summarised in Hill *et al.* (2023) show that species of seapen were shown to recover rapidly from displacement and removal. *F. quadrangularis* and *P. phosphorea* were found to right themselves when dislodged, with all *P. phosphorea* individuals re-established and 50% of *F. quadrangularis* after 72 hours according to Eno *et al.*, (1997). *V. mirabilis* was found to withdraw into its burrow rapidly (approximately 30 seconds) and could not be uprooted by dragging (Hoare & Wilson, 1977; Eno *et al.*, 1997). It is possible that seapen species may therefore be able to protect themselves from temporary mechanical disturbance resulting from the

Project. Other macrofaunal species associated with the biotope typically exhibit moderate resilience to physical change, with sensitivity highly dependent on the scale of the impact. However, the resilience assessment for '*Seapens and burrowing megafauna*' is based on the recovery rates of the seapens as the important characterizing epifauna species within the biotope (Hill *et al.* 2023). If seapens can survive impact (i.e., through re-establishment or withdrawing into burrows) they will likely recover rapidly and are classed as highly resilient.

Limited data is available on the reproductive biology of seapens and British waters. Studies from ecologically and physiologically similar species suggest that larvae do not feed or settle within seven days, suggesting the potential for dispersal. However, recruitment is expected to be patchy, with the species exhibiting slow growth and long lifespan. Most key species associated with this biotope similarly exhibit slow growth cycles, therefore it will likely take several years for this habitat to reach maturity. As a result, resilience to mortality, and removal of individuals from the ecosystem is likely to be low.

According to Marine Scotland's FeAST, abrasion, and physical disturbance of surface of seabed is likely to affect mobile and sessile epifaunal and shallow burrowers. Damage to seapen species is likely to take place as a result of greater sediment disturbance. The tool uses trawl fishing as a proxy for seabed abrasion. Trawling disturbance resulted in reduced species diversity and a disproportionate increase in the abundance of a few dominant species. The short-term effects on epifauna recovered six months after trawling fishing ceased. No long-term effects on the total number of species or individuals were detected, but individual species did show effects. Overall, the tool assesses the habitats tolerance as low with a medium capacity for recovery. Similarly, according to Hill *et al.* (2023) the habitat is expected to have medium resistance and low resilience to abrasion and seabed disturbance Given the low tolerance of the habitat to physical, mechanical change and its classification as an OSPAR threatened and/or declining habitat, it can be classed as having high sensitivity.

Temporary disturbance may result in mortality of individuals directly located within the footprint as a worst-case scenario, through uprooting and physical damage. Many of the macrofauna associated with these habitats (seapens, anemone and polychaetes) are sessile and will therefore be unable to avoid disturbance should they be located in the footprint. However, as discussed in Hill *et al.* (2023), disturbed individuals may be able to survive temporary disturbance through withdrawing and re-attachment. Moreover, the habitat does not fulfil the OSPAR criteria for rarity due to its fairly wide distribution throughout the OSPAR areas (OSPAR, 2008b). Whilst little quantitative assessment has been made on the habitats distribution, it is known to be widespread throughout the CNS and Northern North Sea (NNS). As discussed in Section 8.5.3, the habitat is present throughout the Project Area. Therefore, individuals located in the vicinity of the temporary disturbance footprint may also be able to recolonise the disturbed area over time. Given the relatively small footprint for temporary disturbance (0.052 km^2) compared to the undisturbed surrounding seabed, and the wider abundance of the habitat in the area, it is unlikely that there will be any population level impacts to 'Seapens and burrowing megafauna communities'. The impact of temporary disturbance on 'Seapens and burrowing megafauna' can be classed as low magnitude.

Evaluation of significance

Taking the high sensitivity of the receptor and the low magnitude of the impact, the overall effect of temporary disturbance on Seapens and burrowing megafauna communities 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

Ocean quahog is a low-mobility species that can take up to 10 years to reach sexual maturity. Whilst no individuals were recorded in a recent survey of the Project (Appendix D), previous survey work identified 190 juveniles in the vicinity of the Culzean platform (Gardline, 2013). There is a possibility for individuals to be lost or disturbed by construction activities within the Project Area. The species exhibits a steady low level of recruitment interspersed with unpredictable large recruitment events at intervals of one or more decades, depending on location (Tyler-Waters and Sabitini, 2017). Although ocean quahog burrow into the sediment, they use a short inhalant siphon which sits above the sediment surface for feeding and respiration (Marine Scotland, 2023). Therefore, there is the potential for the species to be disturbed by the temporary disturbance resulting from construction activities.

Ocean quahog are listed under the OSPAR List of threatened and/or declining Species and are considered to have low tolerance habitat structure changes including disturbance of the surface of the substratum (Tyler-Waters and Sabitini, 2017; Marine Scotland, 2013). 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. Whilst the species has thick shell, it is still susceptible to damage through physical abrasion. Studies summarised in Tyler-Waters and Sabitini (2017) monitored recovery post-disturbance. Certain studies speculated that 50-100 years was required to for the full recovery in abundance and population size distributions. Therefore, if a population experienced significant mortality, then recovery is likely to take in excess of ten years and maybe in excess of 25 years. A precautionary resilience of 'Very low' has therefore been attributed to populations within UK waters (Tyler-Waters and Sabitini, 2017). As a result, ocean quahog can be considered to be classified as a high sensitivity receptor.

Despite the species sensitivity, construction activities will be localised, and the proportion of the supporting sands and gravels habitat affected will be small. It is also considered that all records for ocean quahog across the site were of juvenile specimens with no adults encountered during survey work at the Culzean platform (Gardline, 2013). Moreover, no individuals were identified in the most recent Project specific survey (Appendix D). This suggests that while this area may 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 the species. Given that there is predicted to be suitable habitat for ocean quahog across the wider area, beyond that directly impacted by temporary disturbance, as well as the localised nature of disturbance (0.052 km^2), it is not predicted that the ocean quahog will be impacted at a population level by construction activities. 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 disturbance on ocean quahog 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		

Subtidal sedimentary habitats

As discussed in Section 8.5.3, one EUNIS biotope, three habitat complexes and one artificial habitat were identified in the Project Area. Excluding the Faunal communities in Atlantic offshore circalittoral sand/ Seapens and burrowing megafauna in Atlantic circalittoral fine mud MD521 / MC6216 habitat complex (which has been assessed under the Seapens and burrowing megafauna section), the following remaining muddy sand habitats are located in the Project Area:

- Faunal communities in Atlantic offshore circalittoral sand (MD521);
- Faunal communities in Atlantic offshore circalittoral sand / Seapens and burrowing megafauna in Atlantic circalittoral fine mud (MD521 / MC6216);
- Faunal communities in Atlantic offshore circalittoral sand / Brissopsis lyrifera and Amphiura chiajei in Atlantic circalittoral mud (MD521 / MC6218);
- Faunal communities in Atlantic offshore circalittoral sand / Gracilechinus acutus norvegicus assemblage on Atlantic upper bathyal sand (MD521/ ME5213); and
- Constructed, industrial and other artificial habitats J (V. 2012).

The EUNIS biotope and habitat complexes identified typically reflected the muddy sand seabed which comprise the Project Area. The offshore PMF 'subtidal sands and gravels' was also identified in the vicinity of the Project and is reflective of the sedimentary characteristics in the area (Marine Scotland, 2023). This habitat type is abundant across the North Sea. As part of this assessment the impacts to the sands, muddy sands and gravels will be discussed collectively. According to FeAST (Marine Scotland, 2013), subtidal muds and sands exhibit a moderate to low sensitivity to surface abrasion (i.e., temporary disturbance) depending on the species present.

Notable taxa identified in the Project Area included sea urchins (e.g., *B. lyifera* and *G. acutus*), seapens (*P. phosphorea*, and *V. mirabilis*) and *N. Norvegicus*. As discussed previously, seapens are highly sensitive to physical disturbance (albeit with capacity to recover and re-establish post disturbance). Sea urchins such as *B. lyifera* are highly productive, short-lived and fast growing (Budd, 2004). Moreover, the larvae remain as pelagic larvae for up to 60 days, allowing for wide ranging dispersion. Whilst the species has a fragile test and individuals in the direct footprint may be damaged by abrasive force, the population and reproductive dynamics allow populations of the species to recover rapidly from damage such as intensive bottom trawl fishing (Budd, 2004). The species is therefore thought to exhibit low sensitivity and high recoverability to physical abrasion, according to Budd (2004). According to Hill and Sabatini (2008), *N. Norvegicus* inhabits shallow burrows which are common on grounds with fine cohesive mud which is stable

enough to support their unlined burrows. The species growth cycles vary geographically and are dependent on factors such as burrow density and food availability. *N. norvegicus* typically remain within their burrows by day and emerge at sunset to forage during the night but in deeper water this activity is reversed and individuals are more active by day (Hill and Sabatini, 2008). The species exhibits a longer growth cycle, with males and females reaching sexual maturity at approximately four years and three years respectively. During an experimental study on trawls and dredging (similar physical abrasion likely to be experienced during construction activities), individuals in the direct footprint were crushed. Up to 22% of eggs were also lost as a result of trawling, with burrows also being damaged. However, the majority of burrows were re-established within 2 days should the habitat remain unharmed. The species is therefore considered to exhibit low sensitivity and high recoverability in response to physical abrasion (Hill and Sabatini, 2008). As a range of species were identified across the different habitat complexes in the Project Area, medium sensitivity has been assumed for subtidal habitats.

However, temporary construction activities will be extremely localised (0.052 km^2) and the proportion of subtidal habitats impacted by construction activities will be small. The subtidal habitats found across the Project Area are some of the most common subtidal habitats found in Scottish 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. Higher tropic levels of organisms such as fish, marine mammals and seabirds are therefore unlikely to be impacted. The impact is therefore 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 disturbance on subtidal habitats 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

8.9.1.2 Temporary Increased Suspended Sediment and Deposition

Existing seabed habitats may be temporarily disturbed by the suspension of sediment and deposition during the construction activities for the Project. Localised sediment suspension is anticipated as a result of foundation mooring and cable installation and associated infrastructure. Trenching activities are also anticipated to result in direct deposition of sediment in the nearby vicinity. Impacts are only likely to be minimal due to the small scale of the Project however, there is the potential for localised increases in suspended sediment associated with construction activities. The sediments predominantly have a composition of muddy sand. More specifically, the seabed sediment has a mean grain size range of approximately 115 to 190 µm. The spread of silts is expected to remain near-bed with elevated concentrations of suspended sediment not influencing the water column above. Concentrations would rapidly reduce from the source, due to horizontal spreading of the plume and material settling out. Further details on potential suspended sediment regimes are provided in Chapter 7: Marine Physical Processes.

Seapens and burrowing megafauna communities

As discussed, '*Seapens and burrowing megafauna*' are listed on the OSPAR list of threatened and/or declining habitats due to sensitivity to physical change and potential decline. The habitat is also a constituent habitat of the PMF 'Burrowed mud' habitat. As discussed in Section 8.5.3, the habitat was identified at stations R4, E7, E13, M2 and M1 (see Figure 8-2 for reference). Several of these stations are located along the proposed cable route and will therefore be subject to increased sediment suspension and deposition.

The majority of species within this habitat are burrowing megafauna living in the sediment and therefore are likely to be tolerant to smothering by 5 cm of sediment. Burrowing species will be able to burrow through the additional layer. Characteristic seapen species typically inhabit fine sediments, in areas subject to high suspended sediment loads. These habitats are therefore subject to high accretion rates with high levels of suspended sediment (Hill *et al.* 2023). Both *P. phosphorea* and *V. mirabilis* can burrow and move into and out of their own burrows. It is probable therefore that deposition of 30 cm of fine sediment will have little effect other than to temporarily suspend feeding and the energetic cost of burrowing. *F. quadrangularis* cannot withdraw into a burrow but can stand up to two metres above the substratum, and so will likely not be affected adversely by increased sediment suspension and eventual deposition (Hill *et al.* 2023). However, the direct deposition of dredged sediment may result in clogged feeding structures. Whilst *V. Mirabilis* and *F. quadrangularis* can produce mucus which enables individuals to self-clean and remove deposited silt, disruption to feeding activity may reduce population viability. However, following deposition, feeding will likely return to normal allowing for immediate recovery (Hill *et al.* 2023). Other characteristic burrowing megafauna are similarly unlikely to be affected by sediment deposition. Several species of burrowing megafauna (e.g., *N. norvegicus*) have been reported as successfully inhabiting areas of sludge dumping for example (Hill *et al.* 2023). Given the burrowing behaviour and mechanisms in place to manage sediment suspension and deposition, the habitat '*Seapens and burrowing megafauna*' is assumed to exhibit low sensitivity to increases in sediment suspension and deposition. While it is noted that the habitat is listed under the OSPAR Convention's List of threatened and declining habitats, the behavioural and physiological characteristics of the component species suggest low sensitivity of the habitat to suspended sediment deposition.

Given the small scale of the proposed operations, the levels of suspended sediment will be localised to the Project Area. Whilst feeding of filter feeding seapens may be temporarily impeded and there may be the energetic costs of burrowing during deposition, impacts are unlikely to be long-term. Construction activities will also be short-term and intermittent resulting in limited levels of suspended sediment at any given time. Therefore, the impact from increased levels of suspended sediment to '*Seapens and burrowing megafauna*' can be considered low magnitude.

Evaluation of significance

Taking the low sensitivity of the receptor and the low magnitude of the impact, the overall effect of increased suspended sediment and sediment deposition on '*Seapens and burrowing megafauna*' during construction is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance – NOT SIGNIFICANT

Ocean quahog

As discussed in Section 8.5.3, previous survey work identified 190 juvenile ocean quahog in the vicinity of the Culzean platform. Four juvenile specimens identified in the baseline survey of the Project Area, and therefore the presence of further specimens cannot be fully discounted (Appendix D). During the proposed construction works, there is potential for suspended sediment which may impact any ocean quahog in the area. 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 (Tyler-Waters and Sabatini, 2017). A study on experimental spoil disposal exposed ocean quahog to up to 40 cm of a till / sand mixture (median grain size of 220 µm). The results found that able the species was able to burrow through 40 cm of sediment and regain contact with the surface, with no effect on growth or population structure (Tyler-Waters and Sabatini, 2017). No mortality was recorded as a result of deposition. It is therefore unlikely that sediment deposition in the Project Area (where grain size ranged from 115 µm to 190 µm) would cause mortality of long-term damage to ocean quahog in the area. Furthermore, ocean quahog is considered to have no sensitivity to low siltation changes according to Marine Scotland's FeAST (2013). While it is noted 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.

Due to the temporary nature of the construction works, low siltation can be expected. Moreover, construction activities will be localised, and the proportion of the supporting sands and gravels habitat affected by potential sediment suspension and deposition will be small. It is also worth noting that all records for ocean quahog across the site were of juvenile specimens with no adults encountered in the Project Area. Moreover, no individuals were identified in recent Project specific surveys (Appendix D). This suggests that while this area may support ocean quahog, the population that is supported may be less important for this species than other areas in the UKCS. Due to the limited scale of the Project and relative resilience of the species, it is not anticipated that there will be any population level impacts to ocean quahog as a result of sediment suspension and deposition. There, it is considered that this impact can be classified low magnitude.

Evaluation of significance

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

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance – NOT SIGNIFICANT

Subtidal sedimentary habitats

The EUNIS biotope and habitat complexes identified typically reflected the muddy sand seabed which comprise the Project Area. The offshore PMF 'subtidal sands and gravels' was also identified in the vicinity of the Project and is reflective of the sedimentary regime in the area (Marine Scotland, 2016). The following EUNIS biotope and habitat complexes were identified in the area:

- Faunal communities in Atlantic offshore circalittoral sand **MD521;**
- Faunal communities in Atlantic offshore circalittoral sand / Seapens and burrowing megafauna in Atlantic circalittoral fine mud **MD521 / MC6216;**
- Faunal communities in Atlantic offshore circalittoral sand / Brissopsis lyrifera and Amphiura chiajei in Atlantic circalittoral mud **MD521 / MC6218**; and
- Faunal communities in Atlantic offshore circalittoral sand / Gracilechinus acutus norvegicus assemblage on Atlantic upper bathyal sand **MD521/ ME5213.**

Addition of suspended sediment will alter the character of this habitat by covering it with a layer of dissimilar sediment and may 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. According to De-Bastos and Budd (2016), the MC6218 habitat complex exhibits high resistance and resilience to smothering and siltation is not sensitive to the pressure. 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 (Marine Scotland, 2016). 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.

Construction activities will be small-scale and the proportion of subtidal habitats impacted by sediment suspension and deposition activities will be minimal. The subtidal habitats found across the Project Area are some of the most common subtidal habitats found in Scottish 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. Higher trophic levels of organisms such as fish, marine mammals and seabirds are therefore unlikely to be impacted. The impact of sediment suspension and deposition is therefore 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 increased suspended sediment and sediment deposition during construction on subtidal habitats is considered to be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance – NOT SIGNIFICANT

8.9.1.3 Long-term habitat loss

Existing benthic habitats and communities may be changed in the long term due to the introduction of the infrastructure outlined in Section 8.6.1. Within the Project Area, the presence of the and remediation on the seabed will represent a long-term introduction of additional hard substrate and the long-term loss of the sandy habitat beneath. The total combined long-term footprint from all activities within the offshore Project Area is 0.007 km^2.

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).

Seapens and burrowing megafauna

Within the Project Area, the primary sensitivity is the presence of the OSPAR threatened and/or declining habitat '*Seapens and burrowing megafauna*'. '*Seapens and burrowing megafauna*' also form part of the PMF '*Burrowed mud*' habitat. As discussed in Section 8.5.3, the habitat was identified at stations R4, E7, E13, M2 and M1 (Figure 8-2). Several of these stations are located along the cable route and will therefore be subject to long-term loss or disturbance.

Characteristic species associated with this habitat (e.g., seapens, sea urchins and molluscs) rely on the soft substrate to form burrows to inhabit. According to Hill *et al.* (2023) presence is most likely primarily determined by the occurrence of a suitable substratum rather by interspecific interactions. Therefore, the conversion to hard substrate (i.e., infrastructure) will essentially remove the presence of this sedimentary habitat and create an unsuitable environment for the majority of species associated with this habitat. As a result the habitat is classed as having high sensitivity to long-term loss and/or damage to benthic habitats and species.

Installation of infrastructure will result in mortality of individuals directly located within the footprint. Many of the macrofauna associated with these habitats (seapens, anemone and polychaetes) are sessile and will therefore be unable to avoid long-term disturbance should they be located in the footprint. Whilst little quantitative assessment has been made on the habitats distribution, it is known to be widespread throughout the CNS and NNS. As discussed in Section 8.5.3, the habitat is present throughout the Project Area. Therefore, individuals located in the vicinity of the long-term disturbance footprint may also be able to recolonise the disturbed area over time, following decommissioning activities. Given the relatively small footprint for long-term disturbance (0.007 km^2), and the wider abundance of the habitat in the area, it is unlikely that there will be any population level impacts to '*Seapens and burrowing megafauna communities*'. The impact of long-term habitat loss on '*Seapens and burrowing megafauna*' can therefore be classed as 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 habitat loss effects during operation and maintenance on *seapens and burrowing megafauna* 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

Ocean quahog is a low-mobility species that can take up to 10 years to reach sexual maturity. Whilst no individuals were recorded in a recent survey of the Project (Appendix D), previous survey work identified 190 juveniles in the vicinity of the Culzean platform (Gardline, 2013). The species burrows into the sediment and uses a short inhalant siphon which sits above the sediment surface for feeding and respiration.

Ocean quahog are listed under the OSPAR List of Threatened and Declining Species and are considered to have high sensitivity to physical change to another substrate type (Tyler-Waters and Sabatini, 2017; Marine Scotland, 2013). 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 all records for ocean quahog across the site were of juvenile specimens. Moreover, only four individuals were identified in previous surveys around the Gardline platform (Gardline, 2013). This suggests that while this area may support ocean quahog populations, the population that is supported may be less important for this species than some other areas of the offshore UKCS. 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 overall effect of long-term habitat loss effects during operation and maintenance on ocean quahog is considered to be minor and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance – NOT SIGNIFICANT

Subtidal sediments

As discussed in Section 8.5.3, one EUNIS biotope, three habitat complexes and one artificial habitat were identified in the Project Area. Excluding the *Faunal communities in Atlantic offshore circalittoral sand/ Seapens and burrowing megafauna* in Atlantic circalittoral fine mud MD521 / MC6216 habitat complex (which has been assessed under the *Seapens and burrowing megafauna* section), the remaining muddy sand habitats located in the Project Area include:

- Faunal communities in Atlantic offshore circalittoral sand **(MD521):**
  - Faunal communities in Atlantic offshore circalittoral sand / *Brissopsis lyrifera* and *Amphiura chiajei* in Atlantic circalittoral mud (**MD521 / MC6218);** and
  - Faunal communities in Atlantic offshore circalittoral sand / *Gracilechinus acutus norvegicus* assemblage on Atlantic upper bathyal sand **(MD521/ ME5213).**

The EUNIS biotope and habitat complexes identified typically reflected the muddy sand seabed which comprise the Project Area. The offshore PMF 'subtidal sands and gravels' was represented throughout the Project Area by the broad EUNIS biotope Offshore circalittoral Sand and all associated sedimentary habitat complexes that are representative as muddy sand. This habitat type is abundant across the North Sea. Biological species and communities associated with this habitat rely on the soft substratum for burrowing, feeding and reproducing. Therefore, the long-term change to hard substratum (i.e., the installation of infrastructure) will result in substantial changes to the habitats in the Project Area. All 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**.

However, installation activities will be extremely localised (0.007 km^2), and the proportion of subtidal habitats converted to hard substratum will be relatively small in relation. The subtidal habitats found across the Project Area are some of the most common subtidal habitats found in Scottish offshore waters. Higher tropic levels of organisms such as fish, marine mammals and seabirds are therefore unlikely to be impacted. The impact is therefore 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 habitat loss effects during operation and maintenance on subtidal sediments is considered to be **minor** and **not significant** in EIA terms.

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

8.9.1.4 Disturbance of contaminated sediments

Multiple historic wells have been drilled in the region surrounding the Project and sediment contaminants such as metals and hydrocarbons are therefore likely to be present in the area. The potential for chemical contaminants to be present within the Project Area has been assessed based on the site-specific contaminants analysis as part of the environmental survey (Appendix D).

The sediment chemical and contaminants analyses were undertaken for samples acquired at eight sites within the Survey Area (Appendix D), including an analysis of metal concentrations, organics (Total Organic Matter (TOM) and Total Organic Carbon (TOC)), hydrocarbons (Total Hydrocarbon Content (THC)), Polycyclic Aromatic Hydrocarbon (PAH), Polychlorinated Biphenyls (PCB), organotins (Dibutyltin (DBT), Tributyltin (TBT), Monobutyltin (MBT), etc.), Organochlorine Pesticides (OCP) and Brominated Flame Retardants (Polybrominated Diphenyl Ethers (PBDE)). The findings are presented as follows (Appendix D):

- Low metal concentrations throughout the Survey Area, with no concentrations exceeding the OSPAR Effect Range Low (ERL) threshold levels and therefore are considered not to have adverse effects on organisms;
- TOM and TOC concentrations were within normal ranges for sediment in the region;
- THC concentrations were well below the 5000 microgram per gram (µg/g) established by the Dutch Ministry of Infrastructure and the Environment as the threshold below which the contamination of the sediment does not interfere with the chemical and ecological quality of the overlying water column;
- PAH concentrations were below OSPAR ERL reference levels, and the sum of 16 Environment Protection Agency (EPA) PAHs are well within background levels; and
- PCBs, organotins, OCP and PBDE were below the limit of detection for all sites.

Thus, sediment chemicals and contaminants are considered to be low throughout the Project Area therefore minimising the risk associated with disturbance of contaminated sediments. Nevertheless, the potential for disturbance of contaminated sediment will be controlled by implementation of an appropriate project CEMP, Marine Pollution Contingency Plan and Decommissioning Programme. The sensitivity of Benthic Ecology receptors to disturbance of contaminated sediments is assessed as low and given the embedded mitigation, the overall impact is considered to be low magnitude.

Evaluation of significance

Taking the low sensitivity of the receptor and the low magnitude of the impact, the overall effect of disturbance of contaminated sediments during construction is considered to be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance – NOT SIGNIFICANT

8.9.2 Potential effects during operations and maintenance

8.9.2.1 Colonisation of hard structures

Subsea infrastructure associated with the Project 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.

The presence of infrastructure to the Project Area 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 (i.e., mooring lines), 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 structures makes it unlikely that highly diverse communities will develop. It must be noted that all biofouling represents additional food supply within the local ecosystem. However, given the scale of the Project, it is not anticipated that the long-term provision of novel hard substrate will result in the impact propagating up the food chain.

Where possible, the export cable will be buried to reduce the long-term operational footprint. Where burial is not possible, 7 m wide cable protection will be installed. The current sediment in the Project Area is fairly homogenous, typically comprising muddy sand (Appendix C). There were sporadic occurrences of cobbles and boulders around the Culzean platform in the wider area according to previous survey work (Gardline, 2013), however no examples of these features were identified in the most recent survey (Appendix C).A reef assessment did not find any occurrences of habitats such as rocky reefs, which are linked to hard substratum. Therefore, the introduction of hard infrastructure is expected to substantially alter benthic habitats within the operational footprint (0.007 km^2). However, Langhamer, (2012) explained that the new benthic habitats resulting from the introduction of renewable structures including scour protection, can compensate for habitat loss through the creation of new habitat. Simiarly, Li *et al.* (2023) noted no net adverse impacts on benthic communities as a result of the installation of renewable infrastructure on soft sediment. The study reports that the artificially generated habitats could double species abundance and richness in the area.

Therefore, the introduced rock could therefore be considered to provide surrogate substrate and ecosystem complexity that could possibly even have positive effects on productivity 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, if any, on ecosystem productivity and 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. Whilst contemporary benthic receptors may be negatively impacted in the direct operational footprint, the creation of new habitat may allow for a net gain in species abundance and biodiversity. Therefore, the benthic receptors are classed as being of **medium sensitivity**.

Given the small scale of the long-term operational footprint (0.007 km^2), any changes to benthic as a result of colonisation of hard infrastructure are expected to be minimal. Any impacts are unlikely affect the long-term functioning of benthic receptors in the Project Area. Given that the installation is hard infrastructure may also result in net gains to biodiversity, the overall impact is considered to be **low magnitude**.

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

8.9.3 Potential effects during decommissioning

In the absence of detailed information regarding decommissioning works, the impacts during the decommissioning of the Project are considered analogous with, or likely less than, those of the construction stage. Further details on proposed decommissioning operations are provided in Chapter 4: Project Description.

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

8.9.3.1 Removal of artificial hard substrate during decommissioning

The targeted scenario for decommissioning is a clear seabed. Given the nature of the decommissioning activities, which will largely be a reversal of the installation process, the impacts during decommissioning are expected to be similar to or less than those assessed for the construction stage. It should be noted that the decommissioning options for the export cable removal will be subject to comparative assessment of options at the end of the installation life. This will involve assessing the potential removal of artificial hard structures associated with the Project. Therefore, the magnitude of impacts assigned to Benthic Ecology receptors during the construction stage are 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.

The removal of anchors, scour protection, the export cable and cable protection during the decommissioning phase of the Project has the potential to result in species and/or habitat loss. The removal of the infrastructure will essentially result in loss of the artificial hard substrate 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 Project Area, the surrounding seabed outwith 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 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 Project. Therefore, the temporary decommissioning effects are not expected to exceed those assessed for construction. While all benthic ecology receptors are of high sensitivity, and the impact is defined as being of low magnitude. The overall effect to benthic ecology receptors from decommissioning is minor and not significant in EIA terms.

Evaluation of significance

Taking the high 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
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

8.9.4 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 Project is provided in Table 8-11. No significant effects on benthic receptors were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in section 8.8 are not considered necessary.

Table 8-11 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 disturbance	*Seapens and burrowing megafauna*	High	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
	Ocean Quahog	High	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
	Subtidal sediments	Moderate	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
Temporary Increased suspended sediment and sediment deposition	*Seapens and burrowing megafauna*	Low	Low	Negligible (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
	Ocean quahog	Low	Low	Negligible (not significant)	None required above existing	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
					embedded mitigation.	
	Subtidal sediments	Low	Low	Negligible (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
Long-term loss and/or damage to benthic habitats and species	*Seapens and burrowing megafauna*	High	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
	Ocean Quahog	High	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
	Subtidal sediments	High	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
Disturbance of contaminated sediments	General biodiversity and ecosystem functionality	Low	Low	Negligible (not significant)	None required above existing embedded mitigation	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						
Colonisation of hard structures	General biodiversity and ecosystem functionality	Medium	Low	Minor (not significant)	None required above existing embedded mitigation.	Negligible (not significant)
Decommissioning						
Removal of artificial hard substrate during decommissioning	General biodiversity and ecosystem functionality	High	Low	Minor (not significant)	None required above existing embedded mitigation	Negligible (not significant)

8.10 Proposed Monitoring

With consideration of the embedded mitigation measures for the Project, the assessment has concluded no significant impacts to Benthic Ecology, and therefore there is no requirement for additional mitigation over and above the embedded measures. TEPSNUK will conduct post-installation surveys using a Remotely Operated Vehicle (ROV) to monitor the seabed throughout the Project lifecycle.

This chapter has used the best available evidence to inform the assessment of potential effects on Benthic Ecology receptors. The potential impacts of EMF have been scoped out of this assessment however, EMF recorders will be implemented as part of the scientific R&D programme in conjunction with the DTU and MASTS. The Project will implement a scientific R&D programme in conjunction with the DTU and MASTS. This programme will provide knowledge and experience on offshore wind turbine construction, integration, installation, operations and maintenance. In line with NatureScot (2022) Guidance on securing positive effects for biodiversity from local development, this project will also provide vital information to inform Nature Inclusive Design (NID) and the impacts on the biodiversity around WTGs and cable routes.

A full list of sub-projects is provided in Chapter 1: Introduction. Aspects relevant to Benthic Ecology include:

- eDNA-based monitoring;
- Biodiversity and ecosystem indicators; and
- Active acoustics and optics monitoring development.

The programme provides an opportunity for real-time environmental monitoring in the offshore environment and will provide a basis from which to assess the functionality of the floating WTG and the overall design of the project in the environmental setting of the CNS, which will inform similar developments in the future.

8.11 Cumulative Effects Assessment

Any potential impacts from the Project could interact with impacts from other developments, plans and activities, resulting in a cumulative effect on benthic receptors. The general approach to the cumulative effects' assessment is described in Chapter 6: EIA Methodology and further detail is provided below.

The Benthic Ecology Zone of Influence (ZoI) has been defined by a 10 km buffer around the Project. The ZoI is double the Study Area extent to capture any potential buffer of impacts from other surrounding developments.

The closest offshore development to the Project will be the Central North Sea Electrification (CNSE) Project, located approximately 11 km from the proposed operations. All other activities within the 10 km ZoI have been considered in the existing baseline impact assessment (Section 8.5.3). Any potential impacts from the Project would be localised and temporary, occurring within the Study Area. Therefore, no significant change to the cumulative effects on Benthic Ecology are expected to result from the Project.

8.12 Inter-Related Effects

Inter-relationships are defined as the interaction between the impacts assessed within different topic assessment chapters on a receptor. The other chapters and impacts related to the assessment of potential effects on Benthic Ecology are provided in Table 8-12.

Table 8-12 Benthic Ecology inter-relationships

CHAPTER	IMPACT	DESCRIPTION
Chapter 7: Marine Physical Processes	Impact of suspended sediments and deposition on benthic species	The impact pathway of suspended sediment and deposition is characterised within Chapter 7: Marine Physical Processes.
Chapter 9: Fish and Shellfish Ecology	Indirect impacts to Benthic Ecology from changes to spawning and nursery ground habitats from loss / disturbance of fish and shellfish populations.	The impacts considered in this chapter include consideration of the loss of disturbance of fish and shellfish seabed habitats and the inter-related effects on Benthic Ecology.
Chapter 10: Marine Mammals and Other Megafauna	Indirect impacts to Benthic Ecology from changes to Marine Mammals and Other Megafauna through changes in their abundance or distribution.	Changes in the abundance and distribution of Marine Mammals and Other Megafauna due to changes in prey availability and an indirect impact on, the benthic habitat on which they may rely.
Chapter 12: Commercial Fisheries	Indirect impacts to Benthic Ecology from changes to commercial fishing activities and subsequent change in fish and shellfish populations.	The impacts considered in this chapter include consideration of changes in commercial fishing activities and the potential inter-related effects on Benthic Ecology.

8.13 Summary of Impacts and Mitigation Measures

Potential impacts resulting from the Project include:

- Temporary habitat disturbance;
- Temporary increased suspended sediment and deposition;
- Long-term loss and/or damage to benthic habitats and species;
- Disturbance of contaminated sediments;
- Colonisation of hard structures; and
- Removal of hard structures during decommissioning

However, given the small-scale of the Project, all associated impacts are expected to be of minor or negligible consequence and therefore not significant. No secondary mitigation, over and above the embedded mitigation measures proposed in Section 8.8 is either required or proposed in relation to the potential effects of the Project on Benthic Ecology as no significant impacts are predicted.

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