Salamander Offshore Wind Farm

Offshore EIA Report

Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology

SALAMANDER

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Glossary

Term	Definition
Applicant	Salamander Wind Project Company (SWPC) Limited (formerly called Simply Blue Energy (Scotland) Limited), a joint venture between Ørsted, Simply Blue Group and Subsea7.
Benthic	Animals or plants that live in or on the seabed.
Climate Change	A long-term trend in the variation of the climate resulting from changes in the global atmospheric, and ocean, temperatures, and affecting mean sea level, wave height, period and direction, wind speed and storm occurrence.
Cumulative effects	The combined effect of Salamander Project in combination with the effects from a number of different projects, on the same single receptor/resource.
Cumulative impacts	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Salamander Project.
Electromagnetic Field	Electric and magnetic fields together are referred to as electromagnetic fields (EMFs)
Environmental Impact Assessment (EIA)	A statutory process by which the likely significant effects of certain projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment (Scotland) Regulations (2017), including the publication of an Environmental Impact Assessment Report (EIAR).
Epifauna	Animals attached to or living on the seabed
Far-field Study Area	Defined the distance away from the Project which suspended sediment plumes may be advected (and meaningfully interact with potentially sensitive receptors). This has been defined by a spring tidal excursion ellipse buffer around the Offshore Array Area and the Offshore Export Cable Corridor
Landfall	The generic term applied to the entire landfall corridor between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore Export Cable Corridor (ECC), and landfall compound, where the offshore cables come ashore north of Peterhead.
Infauna	Organisms living within seabed sediments.

Inter-related Effects	The likely effects of multiple impacts from the proposed development on one receptor. For example, noise and air quality together could have a greater effect on a residential receptor than each impact considered separately.
Intertidal Zone	The zone between Mean High Water Springs and Mean Low Water Springs. May also be referred to as the littoral zone.
Macrofauna	Benthic organisms usually retained on a 0.5 mm sieve
Near-field Study Area	The area comprising the Offshore Array Area, the Offshore Export Cable Corridor and the Landfall between Mean High Water Springs and Mean Low Water Springs.
Nearshore Export Cable Corridor	The Offshore Export Cable Corridor west of the 1°40 line to shore.
Offshore Array Area	The offshore area within which the wind turbine generators, foundations, mooring lines and anchors, and inter-array cables and associated infrastructure will be located.
Offshore Development	The entire Offshore Development, including all offshore components of the Project (WTGs, Inter-array and Offshore Export Cable(s), floating substructures, mooring lines and anchors, and all other associated offshore infrastructure) required across all Project phases from development to decommissioning, for which the Applicant is seeking consent.
Offshore Development Area	The total area comprising the Offshore Array Area and the Offshore Export Cable Corridor.
Offshore Export Cable Corridor	The area that will contain the Offshore Export Cable(s) between the boundary of the Offshore Array Area and Mean High Water Springs (MHWS).
Salamander Project	The proposed Salamander Offshore Wind Farm. The term covers all elements of both the offshore and onshore aspects of the project.
Scoping	An early part of the EIA process by which the key potential significant impacts of the Salamander Project are identified, and methodologies identified for how these should be assessed. This process gives the relevant authorities and key consultees opportunity to comment and define the scope and level of detail to be provided as part of the EIAR – which can also then be tailored through the consultation process.
Scour	Local erosion of sediments caused by local flow acceleration around an obstacle and associated turbulence enhancement.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the seabed infrastructure as a result of the flow of water.

Sediment	Particulate matter derived from rock, minerals or bioclastic debris.
Semi-Submersible	A Semi-Submersible structure is a buoyancy-stabilised platform which floats partially submerged on the surface of the ocean whilst anchored to the seabed. The structure gains its stability through the distribution of buoyancy force associated with its large footprint and geometry which ensures the wind loading on the structure and turbine are countered by an equivalent buoyancy force on the opposite side of the structure. Included in the Project Design Envelope, there are variations of the semi-submersible concept, such as barge, buoy, or hybrid.
Suspended sediment concentrations	Mass of sediment in suspension per unit volume of water.
Tension Leg Platform	A Tension Leg Platform is a semi-submerged buoyant structure, anchored to the seabed with tensioned mooring lines. The combination of the structure buoyancy and tension in the anchor/mooring system provides the platform stability. This system-driven stability (as opposed to the stability coming just from the floating substructure itself) allows for a comparatively smaller and lighter structure compared to Semi-Submersible equivalents.
Tidal excursion	The Lagrangian movement (the physics of fluid motion as an individual fluid parcel moves through space and time) of a water particle during a tidal cycle.
Tidal excursion ellipse	The path followed by a water particle in one complete tidal cycle.
Wider Survey Area	Defined as the offshore area that was surveyed during the 2020 geophysical survey. This included the original extent of the Offshore Array Area and the Offshore ECC from Offshore Array Area boundary to approximately 8 km east of the proposed Landfall location (this point being the 1°40 line).

Acronyms

Term	Definition
As	Arsenic
CBRA	Cable Burial Risk Assessment
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effect Assessment
Cefas	Centre of Environment Fisheries and Aquaculture

CEMP	Construction Environmental Management Plan
CTV	Crew Transfer Vessel
DDV	Drop-down Video
DSLP	Design Specification and Layout PLan
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ELF	Extremely Low Frequency
EMF	Electromagnetic Fields
EMODnet	European Marine Observation and Data Network
EPA	Environmental Protection Agency
EUNIS	European Nature Information System
FeAST	Feature Activity Sensitivity Tool
FEPA	Food and Environment Protection Act
GeMS	Geodatabase of Marine features adjacent to Scotland
HDVC	High Direct Voltage Current
HSPP	Hywind Scotland Pilot Park
HVAC	High Voltage Alternative Current
IMO	International Maritime Organization
INNS	Invasive and Non-native Species
JIP	Joint Industry Partner
JNCC	Joint Nature Conservation Committee
JV	Joint Venture

KP	Kilometre Points
LAT	Lowest Astronomical Tide
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MCCIP	Marine Climate Change Impacts Partnership
MHWS	Mean High Water Springs
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
MW	Megawatts
NCMPA	Nature Conservation Marine Protected Area
NMPI	National Marine Plan Interactive
NNSS	Non-native Species Secretariat
OAA	Offshore Array Area
O&M	Operation and Maintenance
OEMP	Operational Environmental Management Plan
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment
OWF	Offshore Wind Farm
PAHs	Polycyclic Aromatic Hydrocarbons
PEL	Probable Effect Level
PMF	Priority Marine Feature
SAC	Special Area of Conservation
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area

SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
SWPC	Salamander Wind Project Company Limited (formerly called SBES)
TEL	Threshold Effect Level
THC	Total Hydrocarbon Concentrations
TOC	Total Organic Carbon
TOM	Total Organic Matter
VER	Valued Ecological Receptor
WFD	Water Framework Directive
WTG	Wind Turbine Generator

9 Benthic and Intertidal Ecology

9.1 Introduction

9.1.1.1 The Applicant, Salamander Wind Project Company Limited (SWPC), a joint venture (JV) partnership between Ørsted, Simply Blue Group and Subsea7, is proposing the development of the Salamander Offshore Wind Farm (hereafter 'Salamander Project'). The Salamander Project will consist of the installation of a floating offshore wind farm (up to 100 megawatts (MW) capacity) approximately 35 kilometres (km) east of Peterhead. It will consist of both offshore and onshore infrastructure, including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume ER.A.2, Chapter 4: Project Description** for full details on the Project Design).

9.1.1.2 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the EIA of potential effects of the Salamander Project on Benthic and Intertidal Ecology. Specifically, this chapter considers the potential impact of the Salamander Project seaward of Mean High Water Springs (MHWS) during the Construction, Operation and Maintenance, And Decommissioning phases of the Offshore Development.

9.1.1.3 The chapter provides an overview of the existing environment for the proposed Offshore Development Area, followed by an assessment of significance of effect on Benthic and Intertidal Ecology receptors, as well as an assessment of potential cumulative effects with other relevant projects and effects arising from interactions on receptors across topics.

9.1.1.4 This chapter should be read alongside and in consideration of the following:

- **Volume ER.A.2, Chapter 4: Project Description**;
- **Volume ER.A.3, Chapter 7: Marine Physical Processes**;
- **Volume ER.A.3, Chapter 8: Water and Sediment Quality**;
- **Volume ER.A.3, Chapter 13: Commercial Fisheries**;
- **Volume ER.A.3, Chapter 20: Climate Change and Carbon**;
- **Volume ER.A.4, Annex 9.1: Environmental Baseline Report**;
- **Volume ER.A.4, Annex 9.2: Intertidal Report**; and
- **Volume ER.A.4, Annex 9.3: Benthic Ecology Baseline Review**.

9.1.1.5 This chapter has been authored by Environmental Resources Management Limited (ERM). Further competency details of the authors of this chapter are outlined in **Volume ER.A.4, Annex 1.1: Details of the Project Team**.

9.2 Purpose

9.2.1.1 The primary purpose of this EIAR is for the application for the Salamander Project satisfying the requirements of Section 36 of the Electricity Act 1989 and associated Marine Licences. This EIAR chapter describes the potential environmental impacts from the Offshore Development and assesses the significance of their effect.

9.2.1.2 The EIAR has been finalised following the completion of the pre-application consultation (**Volume RP.A.4, Report 1: Pre-Application Consultation (PAC) Report**) and the Salamander EIA Scoping Report (SBES, 2023) and takes account of the relevant advice set out within the Scoping Opinion from Marine Directorate –

Licensing Operations Team (MD-LOT) (MD-LOT, 2023) relevant to the Offshore Development. Comments relating to the Energy Balancing Infrastructure (EBI) will be addressed within the Onshore EIAR. The Offshore EIAR will accompany the application to MD-LOT for Section 36 Consent under the Electricity Act 1989, and Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act (2009).

9.2.1.3 This EIAR chapter:

- Outlines the existing environmental baseline determined from assessment of publicly available data, project-specific survey data and stakeholder consultation;
- Presents the potential environmental impacts and resulting effects arising from the Salamander Project on Benthic and Intertidal Ecology receptors;
- Identifies mitigation measures designed to prevent, reduce or offset adverse effects; and
- Identifies any [key] uncertainties or limitations in the methods used and conclusions drawn from the compiled environmental information.

9.3 Planning and Policy Context

9.3.1.1 The preparation of the Benthic and Intertidal Ecology Chapter has been informed by the following policy, legislation, and guidance outlined in **Table 9-1**.

Table 9-1 Relevant policy, legislation and guidance relevant to the Benthic and Intertidal Ecology assessment

Relevant policy, legislation, and guidance
Policy
Scottish Biodiversity Strategy to 2045 (Scottish Government, 2022)
Scotland's National Marine Plan
Legislation
Wildlife and Countryside Act 1981
Marine and Coastal Access Act 2009
Nature Conservation (Scotland) Act 2004
The Conservation (Natural Habitats, &c.) Regulations 1994 and the Conservation of Habitats and Species Regulations 2017
The Conservation of Offshore Marine Habitats and Species Regulations 2017
The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2019
The Conservation (Natural Habitats, &c.) Amendment Regulations 2019
Wildlife and Natural Environment (Scotland) Act 2011

Relevant policy, legislation, and guidance
Guidance
Offshore Wind Farms. Guidance note for EIA in respect to Food and Environment Protection Act (FEPA) and CPA requirements (Cefas *et al*., 2004)
Defining and Managing *Sabellaria spinulosa* Reefs (Gubbay, 2007)
Assessment of the Environmental Impact of Offshore Wind-Farms (OSPAR, 2008)
Oslo and Paris Convention for the Protection of the Marine Environment (OSPAR) Assessment of the Environmental Impacts of Cables (OSPAR, 2009)
Identification of the Main Characteristics of Stony Reef Habitats under the Habitats Directive (Irving, 2009)
Modified EC Habitats Directive Annex I *Sabellaria spinulosa* Reefiness Assessment Method (after Gubbay, 2007) (Collins, 2010)
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)
Background document on *Sabellaria spinulosa* reefs (OSPAR, 2013)
Priority Marine Features (PMFs) as described in NatureScot Commissioned Report 388 (Tyler-Walters *et al*., 2016))
Guidance for Ecological Impact Assessment (EIA) in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2019)
Advances in assessing *Sabellaria spinulosa* reefs for ongoing monitoring (Jenkins, 2018)
Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Golding *et al.*, 2020)
Defining 'Reefiness' – inclusion of 'low stony reef' as Annex I Reef feature (Brazier, 2020)
The Status of *Sabellaria spinulosa* Reef off the Moray Firth and Aberdeenshire Coasts and Guidance for Conservations of the Species off the Scottish East Coast (Pearce and Kimber, 2020)

9.3.1.2 Further details on the requirements for EIA are presented in **Volume ER.A.2, Chapter 2: Legislative Context and Regulatory Requirements**.

9.4 Consultation

9.4.1.1 Consultation is a key part of the application process. It has played an important part in ensuring that the baseline characterisation and impact assessment is appropriate to the scale of development as well as meeting the requirements of the regulators and their advisors.

9.4.1.2 An overview of the Salamander Project consultation process is outlined in **Volume ER.A.2, Chapter 5: Stakeholder Consultation**. Consultation regarding Benthic and Intertidal Ecology has been conducted through the standard EIA scoping process as well as a dedicated Benthic and Intertidal Ecology scoping workshop meeting and post-scoping consultation meetings.

9.4.1.3 The issues raised during consultation specific to Benthic and Intertidal Ecology are outlined in **Table 9-2** including consideration of where the issues have been addressed within the EIAR.

Table 9-2 Consultation Responses Specific to Benthic and Intertidal Ecology Topic

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
Green Volt Offshore Wind Farm	21 June 2023; Scoping Response	In addition to the Green Volt offshore export cable route being <1 km from the Salamander Offshore Wind Farm site, the two projects have identified a similar landfall location. Green Volt's primary option (St Fergus South) is in the vicinity of the Salamander project proposed landfall at Scotstown Beach between Lunderton and Kirkton. Therefore, there is the potential for interactions between the two project's offshore export cable corridors, including possible cable crossings.	The cumulative impacts arising from the Green Volt offshore export cable route and the Salamander Project has been assessed in **Section 9.13**.
NatureScot	28 November 2022; Scoping Workshop	**Baseline Characterisation** It was commented that smaller features such as ocean quahog may not be adequately identified by video images. If appropriate, predictive modelling (link to predictive benthic distribution modelling paper provided) may be a useful means of determining likely presence of these animals within the inshore areas of the export cable route.	The use of predictive modelling was considered but it was determined that data from within the data gap would be required to 'train' any model that may be applied. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further details), a scenario-based approach described in **Section 9.8** has been applied for the presence of ocean quahog in **Section 9.11**. It should be noted that this approach was subsequently agreed with the Marine Directorate and NatureScot (see entry for post-scoping consultation meeting on 20 September 2023, below).
NatureScot	28 November 2022; Scoping Workshop	Could eDNA be used as an alternative to grab sampling?	eDNA sampling was considered for the Nearshore Export Cable Corridor. However, the same access constraints that prevented collection of grab samples would also apply to sample collection for eDNA analysis. As such, this method was not deemed an appropriate alternative. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
			details), a scenario-based approach described in **Section 9.8** has been applied for the presence of ocean quahog in **Section 9.11**. It should be noted that this approach was subsequently agreed with the Marine Directorate and NatureScot (see entry for post-scoping consultation meeting on 20 September 2023, below).
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Scoping Questions** **Do you agree that all relevant legislation, policy and guidance documents have been identified for the benthic ecology assessment, or are there any additional legislation, policy and guidance documents that should be considered?** Answer: No specific comment. **Do you agree with the study area defined for benthic ecology?** Answer: No specific comment. **Do you agree with the data and information sources identified to inform the baseline for benthic ecology, or are there any additional data and information sources that should be considered?** Answer: No specific comment.	Noted

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Do you agree that all potential receptors and impacts have been identified for benthic ecology?** Answer: No SFF believe that the "Impact to habitats or species as a result of pollution or accidental discharge" during operation and maintenance should be scoped in and monitored. Boulders displacement should also be scoped in.	"Impact to habitats or species as a result of pollution or accidental discharge" has now been scoped-in and fully assessed (**Section 9.11.3).** Boulder displacement has been considered within the assessment for 'temporary habitat loss or disturbance' (see **Section 9.11.2** and **Section 9.11.3**).
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Do you agree that the impacts proposed can be scoped out of the benthic ecology EIA chapter?** Answer: No. As above	Now that the impacts highlighted by SFF have been scoped in (comment above), this should address SFF concerns with impacts proposed to be scoped out of the benthic ecology EIA chapter.
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Do you agree with the approach to analysis and assessment that will inform the EIA?** Answer: No specific comment	Noted
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Cumulative Impacts** **Do you agree with the approach for cumulative effects assessment and transboundary impacts?**	The realistic worst-case scenario for the projects screened in for cumulative effects assessment will be considered in **Section 9.13**.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		Answer: No. The developers will be able to deduce the size and impacts of all ScotWind projects and they could scope in the realistic worst-case scenario.	
Scottish Fishermen's Federation	21 June 2023; Scoping Response	**Mitigation** **Benthic ecology: Do you agree with the suggested embedded mitigation measures?** Answer: No. Experience tells us that post consent is too late to agree much of the mitigation; therefore, it needs to be agreed pre-consent.	This comment is noted, the Salamander Project is committed to continued engagement with the SFF, including regarding mitigation measures. It is not considered feasible to achieve this within the pre-consent timeframe, so discussions will continue into the post consent preconstruction period. It is expected that these measures will be agreed post consent and pre-construction in accordance with standard practice for other similar developments.
NatureScot	21 June 2023; Scoping Response	**Appendix D - Benthic Impact Assessment** Benthic interests (subtidal and intertidal) are considered in Section 8.1 of the Scoping Report and we have responded to the questions raised in the Scoping Report within our advice below. Our advice with respect to the HRA Stage 1 Screening Report is also provided below.	Noted
NatureScot	21 June 2023; Scoping Response	**Study area** We are content with the study area as described in Section 8.1.4 and shown in Figure 8-1, which includes the offshore array area, export cable corridor plus a 15km buffer. We also note that a larger impact area has been considered in relation to the potential introduction of marine invasive non-native species (INNS).	Noted

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
NatureScot	21 June 2023; Scoping Response	**Baseline Information** We are content that Section 8.1.2 correctly identifies the relevant legislation, policy and guidance for this receptor.	Noted
NatureScot	21 June 2023; Scoping Response	Table 8-1 captures the relevant baseline datasets, with Section 8.1.5 presenting an appropriate summary of existing data and baseline characterisation.	Noted
NatureScot	21 June 2023; Scoping Response	Section 8.1.2 details the benthic, subtidal and intertidal surveys that have been undertaken and are planned prior to submission of the EIAR. However, it is unclear from the Scoping Report whether the benthic survey work includes grab sampling. During the Scoping workshop (held 28 November 2022) it was noted that in the nearshore area (within 8km of the coast) only Drop Down Video (DDV) is proposed pre-application with a full benthic survey, including grab sampling, planned to be undertaken post consent, but prior to construction to fully inform potential impacts to benthic interests. However, we raised concerns during the workshop that some Priority Marine Features (PMFs), such as ocean quahog, will not be picked up using DDV only and thus advised consideration of predictive modelling as part of the EIA. This may also be a useful means of determining likely presence of PMFs. Our understanding from subsequent pre-application consultation is that grab sampling is now being undertaken in the nearshore area (out to 8km) this year, which we welcome. Therefore, we recommend that it is made fully clear in the EIAR what survey work has been undertaken, and where, in relation to informing the baseline characterisation and	Detail of survey work performed to date has been provided in **Section 9.6.1**. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further details), a scenario-based approach described in **Section 9.8** has been applied for the presence of Annex I and PMFs in **Section 9.11**. It is proposed that the nearshore survey will be conducted using similar methodology, albeit with a smaller boat that can be operated in shallower waters for geophysical, and possibly a jack-up vessel for geotechnical.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		what further survey work and assessment (if any) is proposed post-consent.	
NatureScot	21 June 2023; Scoping Response	In addition, we also recommend consideration of eDNA sampling to complement the benthic survey data.	eDNA sampling was considered for the Nearshore Export Cable Corridor. However, the same access constraints that prevented collection of grab samples would also apply to sample collection for eDNA analysis. As such, this method was not deemed an appropriate alternative. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further details), a scenario-based approach described in **Section 9.8** has been applied for the presence of ocean quahog in **Section 9.11**. It should be noted that this approach was subsequently agreed with the Marine Directorate and NatureScot (see entry for post-scoping consultation meeting on 20 September 2023, below).
NatureScot	21 June 2023; Scoping Response	Table 8-3 details the potential impacts to be scoped in and out of the benthic assessment, and we are broadly content, subject to the following comments. We note that impacts to designated sites has not been specifically scoped in for this receptor. Therefore, we advise that impacts to the Southern Trench nature conservation Marine Protected Area (NCMPA) benthic features (burrowed mud) is scoped in for assessment for all phases of development. This should be assessed separately against the NCMPA Conservation Objectives.	Due to the distance between the benthic ecological features in the north of the Southern Trench NCMPA and the Far-field Study Area (see **Figure 9-4**), impacts to the benthic features of this NCMPA have been scoped out. All benthic features of the Southern Trench NCMPA are assessed within **Volume ER.A.4, Annex 9.4: Benthic Features Impact Assessment Southern Trench MPA.** This assessment concluded that the Salamander Project is not capable of affecting (other than insignificantly) the

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
			protected feature of burrowed mud, and therefore this feature was not taken forward for further assessment.
NatureScot	21 June 2023; Scoping Response	We recommend that the assessment should quantify, where possible, the likely impacts to key benthic ecology PMFs. It should assess whether these could lead to a significant impact on the national status of the PMFs being considered.	The likely impacts to key benthic ecology PMFs have been considered throughout this impact assessment (see **Section 9.11**).
NatureScot	21 June 2023; Scoping Response	In addition, we note that the increased risk of introduction and spread of INNS has been scoped out for the operation and maintenance phase. However, there is a risk of potentially introducing and spreading marine INNS during the operation and maintenance phase, particularly due to biofouling (and cleaning procedures) on the floating structures. Therefore, we advise that this impact is also scoped in for assessment for this phase.	"Increased risk of introduction and spread of INNS" has been scoped in for the Operation and Maintenance phase of the Salamander Project (see **Section 9.11.3**).
NatureScot	21 June 2023; Scoping Response	**Approach to assessment** The proposed assessment approach is set out in Section 8.1.10 and we are generally content with this as detailed. However, we advise that the assessment should quantify, where possible, the likely impacts to benthic PMF species. As well as PMFs, and as noted in Section 8.1.5 of the Scoping Report, there is the potential for *Sabellaria spinulosa* reefs to be present in the Offshore Development Area. These reefs are of conservation value under OSPAR and Annex I of the Habitats Directive. Therefore, we	The likely impacts to key benthic ecology PMFs have been considered throughout this impact assessment (see **Section 9.11**). *S. spinulosa* reef was determined to be absent within the Offshore Array Area and the surveyed section of the Offshore Export Cable Corridor. The presence of *S. spinulosa* reefs is highly unlikely to occur within the Nearshore Export Cable Corridor and this position was discussed in a meeting with NatureScot and Marine Directorate on 20 September 2023. As such the impact assessment has considered the impacts on *Sabellaria* 'bommies' known from the east coast of Scotland (Pearce and

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		advise that potential impacts to this habitat are also assessed in the EIAR.	Kimber, 2020) alongside *Sabellaria* crusts and aggregations within two biotopes – *Sabellaria* on rock and *Sabellaria* on mixed sediment.
NatureScot	21 June 2023; Scoping Response	**Cumulative Impacts** We are concerned with the likelihood of multiple offshore export cables making landfall in the area around Peterhead, and the potential for cumulative impacts arising from construction and associated geophysical, geotechnical and environmental survey programmes. Therefore, we recommend that this is assessed in the EIAR. We welcome the recent consultation to collaborate with Muir Mhòr Wind Farm to reduce the number of geotechnical / geophysical surveys.	Cumulative impacts arising from the multiple offshore export cables potentially making landfall in the area around Peterhead has been assessed in **Section 9.13**.
NatureScot	21 June 2023; Scoping Response	In addition, we note that it is intended to use the CEF for the cumulative effects assessment. However, the CEF tool will be available for ornithology and marine mammal cumulative assessments only.	Noted.
NatureScot	21 June 2023; Scoping Response	**Transboundary / cross border impacts** We advise that there are unlikely to be any transboundary or cross border impacts for benthic interests.	Noted.
NatureScot	21 June 2023; Scoping Response	**Indirect Impacts** Consideration should also be given to indirect impacts on birds, fish and marine mammals, where appropriate.	The indirect impacts on birds, fish and marine mammals have been considered within **Section 9.16** and **Volume ER.A.3, Chapter 22: Inter-related Effects**.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
NatureScot	21 June 2023; Scoping Response	**Monitoring and Mitigation** We advise that the EIAR should provide details on how INNS will be considered, monitored and recorded as well as being taken account of in biosecurity plans for each phase of the development.	Mitigation for INNS has been described within this chapter and includes the implementation of biosecurity plans (see **Section 9.8.3** and **Section 9.12**). In addition, details on INNS monitoring have also been considered within this chapter (see **Section 9.8.3** and **Section 9.12**).
NatureScot	21 June 2023; Scoping Response	**Baseline Characterisation** We recommend that it is made fully clear in the EIAR what survey work has been undertaken, and where, in relation to informing the baseline characterisation and what further survey work and assessment (if any) is proposed post-consent.	Detail of survey work performed to date has been provided in **Section 9.6.1**. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further details), a scenario-based approach described in **Section 3.8** has been applied for the presence of Annex I and PMFs in **Section 9.11**. It is proposed that the nearshore survey will be conducted using similar methodology, albeit with a smaller boat that can be operated in shallower waters for geophysical, and possibly a jack-up vessel for geotechnical.
NatureScot	21 June 2023; Scoping Response	**Blue Carbon** In addition to the climate change and carbon assessment mentioned in the Scoping Report, we recommend that consideration is given to impacts on blue carbon. Not just in respect of the wind farm itself, but also in terms of any wet storage areas. We note that blue carbon has been recognised within the Benthic section of the Scoping Report at	Blue carbon habitats have been considered and discussed within **Section 9.7.1**.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		8.1.5, with key habitats identified that support blue carbon storage and sequestration.	
NatureScot	21 June 2023; Scoping Response	**Wet storage** Section 4.6.2 (Floating Substructures) refers to the potential for wet storage of the substructures prior to their installation within the array area, either at the initial assembly site, the wind turbine integration site or a separate dedicated storage location. Section 4.7.1 (Floating Assembly) also indicates that once operational the substructures and Wind Turbine Generators (WTGs) will form an integrated assembly piece – the replacement of any major component parts of which is expected to be achieved by towing the assembly to port. Wet storage could represent a significant impact. Consideration of the potential impacts on all receptors needs to be addressed with the EIAR and HRA. We would welcome further discussion on this as and when further details are confirmed, noting the intention to seek a separate Marine Licence application for any requirements for wet storage out with the array area.	Wet storage of the floating substructures (and integrated WTGs) prior to tow-out to the Offshore Array Area is considered to be outside the scope of this EIA and the Marine Licence applications for the Offshore Development. This is due to the fact that at this stage of the Salamander Project it is not known which port(s) will be used for wet storage and therefore it is challenging to undertake a meaningful assessment of impacts related to wet storage. The intent is that the Salamander Project will utilise the services of a port(s) that offer wet storage sites, which will have appropriate consents (obtained by the port authority) for wet storage of floating substructures, fabrication and assembly with the WTGs. To enable the availability of this option for the Salamander Project within the required timeframe, SWPC is an official member of the TS-FLOW UK-North Joint Industry Project (JIP) exploring the challenges of wet storage and identifying the opportunities and potentially suitable locations for these activities. This JIP is in collaboration with relevant ports and other floating offshore wind developers. Separate Marine Licences and associated impact assessments for wet storage areas out with the Offshore Development Area will be applied for and undertaken as appropriate.
Marine Directorate – Licensing	21 June 2023; Scoping Opinion	Section 4.4.1 of the Scoping Report states that the final layout of the windfarm components will be determined once the design optimisation	The final design and layout of the Offshore Array has not been developed yet due to the need for prior decisions on technology (floating substructures, mooring and anchors and inter-array cables) to be made;

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
Operations Team (MD-LOT)		process has been completed with a number of key sensitives to be considered. The Scottish Ministers advise that the EIA Report must include a full and detailed description of all layout options considered within the design envelope. The Scottish Ministers also advise that the Developer must identify how habitats of conservation value can be avoided through micrositing of windfarm components, inclusive of all cabling, in the EIA Report	these will be made post-consent. However, the impact assessment considers a realistic worst-case scenario for each impact, based on the Offshore Development Design Envelope. The final layout and design will be developed through technical and commercial requirements and through consultation with relevant stakeholders and presented within the Design Specification and Layout Plan (DSLP), that will be subject to approval during the discharge of Section 36 consent and Marine Licence conditions. The realistic worst-case scenario for each option in terms of impacts on benthic ecology is considered in the Impact Assessment (**Section 9.11**). Identification of how habitats of conservation value can be avoided thought micrositing of wind farm components, inclusive of all cabling is discussed within **Section 9.8.3**.
MD-LOT	21 June 2023; Scoping Opinion	Section 4.4.4 of the Scoping Report states that the Developer may choose the option to trench and/or bury portions of the inter-array cables and that the burial method and target burial depth will be defined based on a Cable Burial Risk Assessment. If there is any potential for cable protection to be used to protect the inter-array cables, this must be assessed in the EIA Report including details on materials, quantities and location. In addition, any seabed levelling or removal of substance or objects from on or under the seabed, required for installation of both the inter-array cables and	Information regarding the cable protection material has been described in **Section 9.8**. Impacts associated with cable protection have been assessed within **Section 9.11**.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		export cables, will require consideration in the EIA Report and may require a Marine Licence.	
MD-LOT	21 June 2023; Scoping Opinion	The Scottish Ministers are content with the Proposed Development study area as described in Section 8.1.4 and shown in Figure 8-1.	Noted
MD-LOT	21 June 2023; Scoping Opinion	With regard to the characterisation of the baseline, the Scottish Ministers agree with NatureScot representation that it is unclear in the Scoping Report whether the benthic survey work includes grab sampling. The Scottish Ministers advise that the Developer should fully consider and implement the NatureScot recommendation regarding this as well as considering predictive modelling as a means of determining the presence of Priority Marine Features ("PMF"). Further to this, The Scottish Ministers recommend that the Developer gives full consideration to eDNA sampling to complement the benthic survey data as outlined in the NatureScot representation. The Developer should continue to liaise with NatureScot and the Scottish Ministers on the progress of benthic baseline characterisation surveys.	The benthic survey for the offshore section of the Export Cable Corridor included grab sampling as described under **Section 9.6.1**. In consideration of no project-specific survey data currently available for the nearshore Export Cable Corridor (see **Section 9.6.1** for further details), a scenario-based approach described in **Section 9.8** has been applied for the presence of PMFs in **Section 9.11**. It is proposed that the same survey methodology that was applied for the offshore section of the Export Cable Corridor will be followed for data collection within the nearshore section of the Export Cable Corridor.
MD-LOT	21 June 2023; Scoping Opinion	**EIA Scope** The Scottish Ministers broadly agree with the potential impacts scoped in for further assessment in the EIA Report as contained within Table 8-3 of the Scoping Report, however, advise that potential impacts to the Southern Trench NCMPA must be scoped in as per the NatureScot representation.	Due to the distance between the benthic ecological features of the Southern Trench NCMPA and the Benthic and Intertidal Ecology Study Area (see **Figure 9-4**), impacts to the benthic features of this NCMPA have been scoped out. For impacts relating to other features of the site please refer to **Volume ER.A.4, Annex 9.4: Benthic Features Impact Assessment Southern Trench MPA.**

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
MD-LOT	21 June 2023; Scoping Opinion	The Scottish Ministers advise that the introduction and spread of marine invasive non-native species ("INNS") must be scoped in for the operation and maintenance phase.	"Increase risk of introduction and spread of INNS" has been scoped in for the operation and maintenance phase of the Salamander Project (see **Section 9.11.2** and **Section 9.11.3**).
MD-LOT	21 June 2023; Scoping Opinion	The Scottish Ministers also highlight the SFF representation regarding the impact to habitats or species as a result of pollution or accidental discharge and boulder displacement.	"Impact to habitats or species as a result of pollution or accidental discharge" has now been scoped-in and fully assessed (**Section 9.11.3**). Boulder displacement has been considered within the assessment for 'temporary habitat loss or disturbance' (see **Section 9.11.2** and **Section 9.11.3**).
MD-LOT	21 June 2023; Scoping Opinion	With regard to the approach to assessment set out in Section 8.1.10, the Scottish Ministers highlight the NatureScot recommendation that the assessment should quantify, where possible, the likely impacts of benthic PMF species and advise that this should be fully considered and implemented as necessary.	The likely impacts to key benthic ecology PMFs have been considered throughout the impact assessment (see **Section 9.11**).
MD-LOT	21 June 2023; Scoping Opinion	The Scottish Ministers advise that NatureScot recommendations regarding *Sabellaria spinulosa* reefs must also be fully considered and included in the EIA report.	The presence of *S. spinulosa* reefs is highly unlikely to occur within the Benthic and Intertidal Ecology Study Area. As such impact assessment has considered the impacts on *Sabellaria* 'bommies' known from the east coast of Scotland (Pearce and Kimber, 2020) alongside *Sabellaria* crusts and aggregations within two biotopes – *Sabellaria* on rock and *Sabellaria* on mixed sediment.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
MD-LOT	21 June 2023; Scoping Opinion	Also, the indirect impact on birds, fish and mammals must also be fully considered and included in the EIA Report.	The indirect impacts on birds, fish and marine mammals have been considered within **Section 9.16** and **Volume 3, Chapter 22: Inter-related Effects**).
MD-LOT	21 June 2023; Scoping Opinion	**Cumulative Impacts** In relation to cumulative impacts, the Scottish Ministers are broadly content with the proposed approach to the cumulative assessment as described in Section 8.1.8, however agree with NatureScot representation regarding the likelihood of multiple offshore cables making landfall in the area around Peterhead and the potential for cumulative impacts arising from construction and associated survey programmes. Therefore, the Scottish Ministers advise that this must be assessed in the EIA Report.	Cumulative impacts arising from the multiple offshore export cables potentially making landfall in the area around Peterhead has been assessed in **Section 9.13**.
MD-LOT	21 June 2023; Scoping Opinion	**Monitoring and Mitigation** In relation to mitigation, the Scottish Ministers note the proposed embedded mitigation measure to develop and implement an INNS Management Plan post consent, however the Scottish Ministers agree with NatureScot that the EIA Report must provide details on how INNS will be considered, monitored and recorded as well as being taken account of in biosecurity plans for each phase of the development. The Scottish Ministers advise that NatureScot comments and recommendations regarding this must be fully considered and included in the EIA Report and that other migratory fish species are scoped in for	Mitigation for INNS has been described within this chapter and includes the implementation of biosecurity plans (see **Section 9.8.3** and **Section 9.12**). In addition, details on INNS monitoring have also been considered within this chapter (see **Section 9.8.3** and **Section 9.12**).

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		assessment including sea trout, European eel, and sea and river lamprey. Further to this Freshwater Pearl Mussel must also be included in the assessment.	
MD-LOT	21 June 2023; Scoping Opinion	Any embedded mitigation relied upon for the purposes of the assessment should be clearly and accurately explained in detail within the EIA Report. The likely efficacy of the mitigation proposed should be explained with reference to residual effects. The EIA Report must identify and describe any proposed monitoring of significant adverse effects and how the results of such monitoring would be utilised to inform any necessary remedial actions.	Embedded mitigation has been discussed in **Section 9.8.3**. Proposed mitigation for significant adverse effects where relevant is discussed in **Section 9.12** along with proposed monitoring.
MD-LOT	21 June 2023; Scoping Opinion	The EIA Report should clearly demonstrate how the Developer has had regard to the mitigation hierarchy, including giving consideration to the avoidance of key receptors. Section 13 of the Scoping Report provides a summary of the embedded mitigation to be considered within the EIA Report. Many of the commitments are to management or mitigation plans, however limited detail is provided regarding the content of these plans. The Scottish Ministers advise that where the mitigation is envisaged to form part of a management or mitigation plan, the EIA Report must set out these plans or the reliance on these in sufficient detail so the significance of the residual effect can be assessed and evaluated. This should also include identification of any monitoring and remedial actions (if relevant) in the event that predicted residual effects differ to actual monitored outcomes. Commitment to develop plans	A clear mitigation hierarchy is provided within **Section 9.8.3**, which includes consideration to the avoidance of key receptors. The embedded mitigation (primary and tertiary) has been considered within each impact assessment so that residual effect could be assessed. Proposed mitigation for significant adverse effects where relevant is discussed in **Section 9.12** along with proposed monitoring. See **Volume ER.A.2, Chapter 6: EIA Methodology**. The monitoring and management plans will include details of success thresholds that should be met, as measures become established, and steps that would be taken should these milestones not be achieved (i.e. adaptive management).

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
		without sufficient detail is not considered to be suitable mitigation in itself.	
Marine Directorate and NatureScot	20 September 2023; post-scoping consultation meeting.	NatureScot understands that the proposed approach is what is possible in terms of assessment with the current situation for the data gap, but flagged that application of consent conditions is the challenge.	The proposed approach to managing the data gap was agreed in consultation with the Marine Directorate and NatureScot and has been applied throughout **Section 9.11**. Details on the proposed approach can be found in **Section 9.8**.
Marine Directorate and NatureScot	20 September 2023; post-scoping consultation meeting.	Marine Directorate note that the ocean quahog PMF is for individuals not aggregations.	This comment is noted, and the ocean quahog PMF has been considered for individuals instead of aggregations throughout **Section 9.7** and **Section 9.11**.
Marine Directorate and NatureScot	20 September 2023; post-scoping consultation meeting.	NatureScot flagged up the need for assessment of the Quaternary feature of the Southern Trench and the area of moraine that looks like it could cross the cable corridor.	The Quaternary feature of the Southern Trench and the area of moraine that looks like it could cross the cable corridor has been assessed under **Volume ER.A.3, Chapter 7: Marine Physical Process**.

Consultee	Date and Forum	Comment	Where it is addressed within this EIAR
Marine Directorate and NatureScot	20 September 2023; post-scoping consultation meeting.	NatureScot noted that as long as the EIAR describes the current situation and the challenges it represents in terms of data and assessment parameters, and describes the reasons that the project is lacking data that this should be acceptable.	The current situation and the challenges it represents in terms of data and assessment parameters, and describes the reasons that the Salamander Project is lacking data have been discussed in **Section 9.6.1** and **Section 9.8**.
Marine Directorate and NatureScot	20 September 2023; post-scoping consultation meeting.	NatureScot and MD was in agreement with proposed approach. There was general agreement to approach to assessment, subject to actions being closed out.	Noted. Approach has been applied throughout **Section 9.11**.

9.5 Study Area

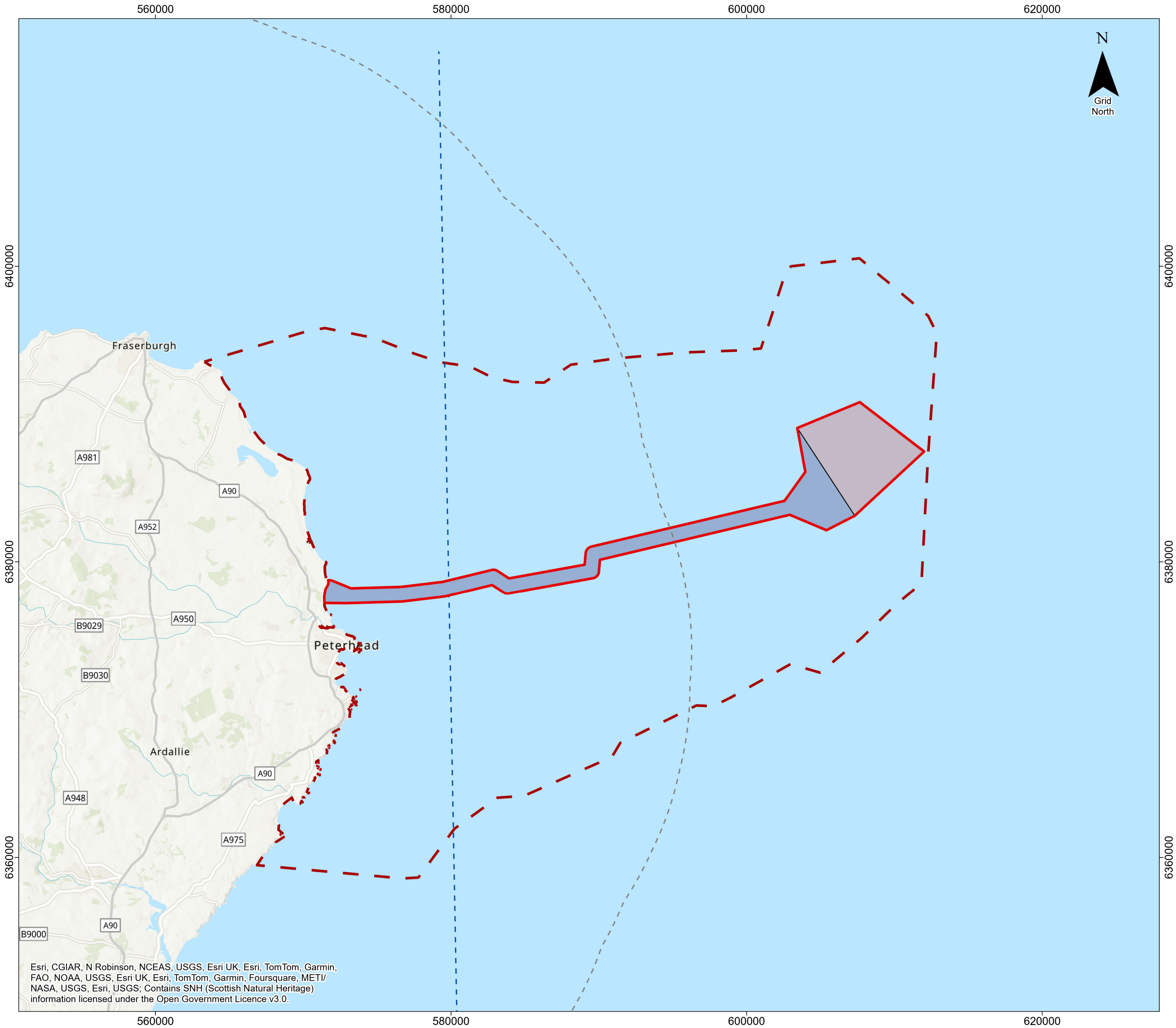
9.5.1.1 The Benthic and Intertidal Ecology Study Area has been defined on the basis of the area that will be directly impacted by the Offshore Development (Near-field) and the adjacent areas that may be affected by indirect impacts (Far-field), such as sediment suspension and resettlement.

9.5.1.2 The Near-field Study Area is divided into the following three sub-areas:

- Intertidal area at the Landfall, north of Peterhead, between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) (0.22 km²);
- Offshore Export Cable Corridor (ECC) (which is a 1 km wide corridor) (41 km²); and
- The Offshore Array Area (OAA) (33.3 km²) located outside of the 12 nautical miles (nm) limit.

9.5.1.3 The Far-field Study Area is defined as the distance away from the Salamander Project which suspended sediment plumes may be advected (and meaningfully interact with potentially sensitive receptors). This has been defined by a spring tidal excursion ellipse buffer around the OAA and the ECC as presented in **Volume ER.A.3, Chapter 7: Marine Physical Processes**.

9.5.1.4 The Study Area for Benthic and Intertidal Ecology is shown in **Figure 9-1**.



Salamander

Figure 9-1

Benthic and Intertidal Ecology Study Area

Legend

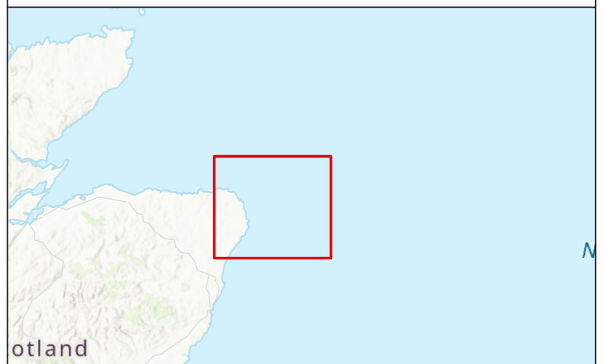
- 12 nm limit

Near-field Study Area

- Offshore Export Cable Corridor
- Offshore Development Area
- Offshore Array Area

Far-field Study Area

- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 1° 40' W line (WGS84)



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:250,000

0 7.5 15 Kilometers

0 1.75 3.5 7 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : Benthic Ecology Study Area
Doc. No : SWF01ER0322
Created by : AN
Checked by : IW
Approved by : ACV

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9.6 Methodology to inform Baseline

9.6.1 Site Specific Surveys

9.6.1.1 In order to provide site specific and up to date information on which to base the impact assessment, subtidal and intertidal surveys were conducted as presented in **Table 9-3.**

9.6.1.2 APEM Ltd was commissioned to undertake the intertidal ecological survey in summer 2022, while the subtidal ecological survey was conducted by Ocean Infinity in autumn 2022 (see **Volume ER.A.4, Annex 9.1: Environmental Baseline Report** and **Volume ER.A.4, Annex 9.2: Intertidal Report**) (Ocean Infinity, 2023a, b). Ocean Infinity successfully surveyed the Landfall survey area (0.22 km²) and the Wider Survey Area which is defined as the original extent of the OAA[1] and the Offshore ECC from OAA boundary to approximately 8 km east of the proposed Landfall location (this point being the 1°40 line) (**Figure 9-2**).

9.6.1.3 Geophysical surveys were undertaken along the Offshore ECC (excluding the last 8 km nearshore) and OAA in 2020 (Ocean Infinity, 2022). The geophysical interpretation combined with the environmental data was used as the basis for the European Nature Information Systems (EUNIS) habitat classifications and assessments of potential areas and species of conservation importance.

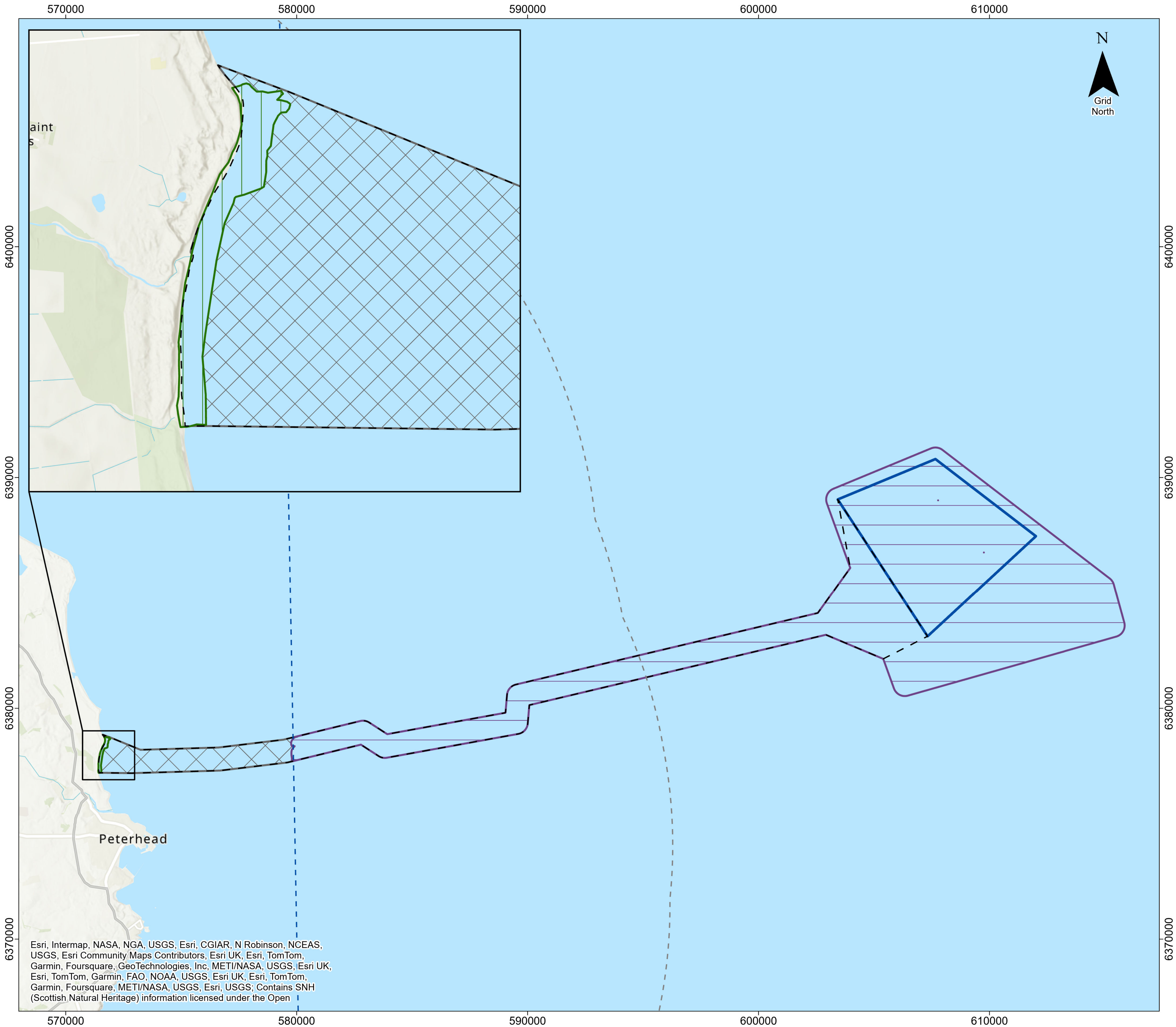
9.6.1.4 The Salamander Project has been unable to acquire project specific data, or secondary survey data, within the nearshore, approximately 8 km area of the Offshore ECC (referred to as Nearshore ECC), in a timeframe suitable to undertake the EIA in 2023 for submission of the EIAR in early 2024. This current 'data gap' covers the area from the MLWS at the Landfall location, through to the 1°40 line approximately 8 km east. Due to safety restrictions related with deployed creels it was not possible for surveys to take place in this nearshore region. The rest of the Offshore ECC from the 1°40 line to the OAA (and the OAA itself) has been surveyed.

[1] Following the subtidal ecological survey the extent of the OAA was reduced to that of the present 33.3 km².

Table 9-3 Site specific surveys of relevance to Benthic and Intertidal Ecology

Survey	Conducted by	Outcome of Survey
Intertidal Survey	APEM Ltd	**Phase I** • Distribution and extent of biotopes, biotope complexes and lifeforms. • PMF and Annex I habitats assessment. • Habitat/biotope mapping. **Phase II** • 18 x 0.04 m^2 quadrats used to determine and quantify biota present in the soft substrata. • 19 x 0.25 m^2 quadrats used to determine and quantify biota present over hard substrata.
Subtidal Survey	Ocean Infinity	**Environmental Baseline Survey** <u>Wider Survey Area</u> • 19 x 0.1 m^2 grab (Day/Hamon) samples for particle size analysis (PSA) and contaminants. • 20 x 0.1 m^2 grab (Day/Hamon) samples for faunal analysis. • 19 x Drop Down Video (DDV) transects. *Offshore Array Area* • 16 x 0.1 m^2 grab (Day/Hamon) samples for particle size analysis (PSA) and contaminants. • 16 x 0.1 m^2 grab (Day/Hamon) samples for faunal analysis. • 16 x DDV transects. *Offshore ECC*[2] • 16 x 0.1 m^2 grab (Day/Hamon) samples for PSA and contaminants. • 17 x 0.1 m^2 grab (Day/Hamon) samples for faunal analysis. • 23 x DDV transects. **Habitat Assessment** • Macrobenthic community assessments. • PMF and Annex I habitat assessments. • Physicochemical sediment analysis. • Habitat/biotope mapping.

[2] Samples collected between 1°40 line and OAA.



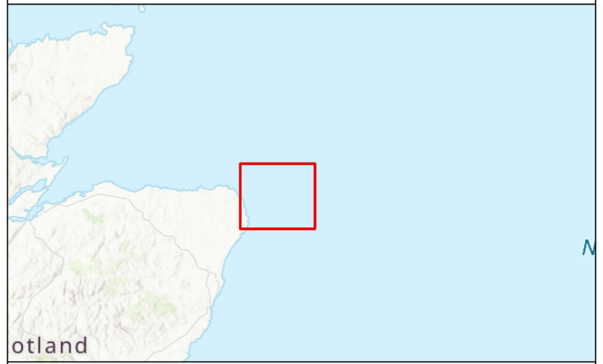
Salamander

Figure 9-2

Benthic and Intertidal Ecology Survey Area

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Intertidal Survey Area
- Subtidal Survey Area
- Nearshore Data Gap
- 1° 40' W line (WGS84)
- 12 nm limit



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:160,000

0 4.5 9 Kilometers

0 1.25 2.5 5 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : Benthic Ecology Survey Area
Doc. No : SWF01ER0379
Created by : AN
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Approved by : ACV

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9.6.2 Data Sources

9.6.2.1 The data sources that have been used to inform this Benthic and Intertidal Ecology Chapter of the EIA Report are presented within **Table 9-4**.

Table 9-4 Summary of key publicly available datasets for Benthic and Intertidal Ecology

Source	Year	Spatial Coverage	Summary
Southern Trench Survey	2015	Southern Trench (Outer Moray Firth)	Scottish Natural Heritage (SNH) (now NatureScot) Southern Trench (Outer Moray Firth) Benthic Camera and Infaunal Grab Survey.
Rattray Head Survey	2017	Rattray Head	SNH (now NatureScot) Rattray Head benthic camera survey.
Hywind Survey	2013	Hywind Scotland Offshore Wind Farm (OWF) and ECC	Environmental baseline survey (including habitat assessment) undertaken for the Hywind Scotland array area and export cable corridor.
OSPAR threatened or declining habitats	2020	North-east Atlantic	Geospatial information of know locations of OSPAR threatened or declining habitats.
Geodatabase of Marine features adjacent to Scotland (GeMS) PMF Scotland	2022	National	Geospatial information of known locations of Scottish PMFs.
Special Area of Conservation (SAC) Scotland ESRI	2022	National	Geospatial information of SACs in Scotland.
Site of Special Scientific Interest (SSSI) Scotland ESRI	2023	National	Geospatial information of SSSIs in Scotland.
Special Protection Area (SPA) Scotland ESRI	2022	National	Geospatial information of SPAs in Scotland.
MPA Scotland ESRI	2023	National	Geospatial information of nature conservation MPAs in Scotland.
UK Protected Area Datasets for Download	2019-2022	UK	Geospatial information of UK protected areas.
Annex I Reefs in UK offshore waters (public)	2022	UK	Geospatial information of know locations of Annex I reefs in UK offshore waters.

Source	Year	Spatial Coverage	Summary
Annex I Submarine structures made by leaking gases	2018	UK	Geospatial information of know locations of Annex I submarine structures made by leaking gases in UK offshore waters.
Spatial data relating to benthic ecology on National Marine Plan Interactive (NMPI)	2023	National	NMPI is a website mapping service where to view a range of spatial data including benthic ecology data.
EUSeaMap	2021	Europe	Broad-scale seabed habitat map for Europe.
Feature Activity Sensitivity Tool (FeAST)	2013	National	FeAST enables users to explore what is known about MPA protected feature sensitivity to pressures and the marine activities that can cause them.
Species distribution modelling of marine benthos: a North Sea case study	2011	North Sea	Modelled distributions for a range of benthic species.

9.6.3 Identification of Features of Conservation Interest

Annex I Assessment

9.6.3.1 Following the surveys, Annex I habitat assessments were undertaken on those features that had the potential to be deemed Annex I. Assessments considered the following relevant guidelines and their associated criteria:

- Joint Nature Conservation Committee (JNCC) The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop (Irving, 2009);
- JNCC Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef (Golding *et al.*, 2020);
- Natural Resources Wales (NRW) Defining 'Reefiness' – inclusion of 'low stony reef' as Annex I Reef feature (Brazier, 2020);
- JNCC Defining and managing *Sabellaria spinulosa* reefs. Report of an inter-agency workshop (Gubbay *et al.*, 2007);
- JNCC Modified EC Habitats Directive Annex I *Sabellaria spinulosa* Reefiness Assessment Method (Collins, 2010); and
- Advances in assessing *Sabellaria spinulosa* reefs for ongoing monitoring (Jenkins *et al.*, 2018).

Annex I Reefs – Bedrock Reefs/Stony Reefs

9.6.3.2 Rocky reefs are geogenic origin, hard compact substrata that rise from the seabed in the littoral and sublittoral zones. There is a wide variety of topographical forms of Annex I geogenic reef, ranging from vertical rock walls to horizontal ledges, sloping or flat bedrock ('bedrock reef') to a variety of broken rock, boulder fields and aggregations of cobbles ('stony reef') (JNCC, 2021). Reefs are determined as either 'High' confidence or 'Potential'.

9.6.3.3 All geophysical and ground truthing data were reviewed to assess for the presence and potential extent of Annex I Reef, with a full assessment for the presence of stony reef, following Irving (2009), undertaken on the imagery (see **Table 9-5**). For bedrock reefs no similar scoring system exists. In areas where the geophysical data could not provide information on the degree of bedrock exposure, these areas were to be delineated as potential bedrock reefs. The qualifying criteria for the classification bedrock reefs is the presence of a continuous solid mass of rock, arising from the seabed and remaining covered by seawater at all states of the tide.

9.6.3.4 For seabed with a 'low resemblance' to Annex I stony reef, the methodologies proposed by Brazier (2020) and Golding *et al.* (2020) were consulted to assess whether or not an area would meet the criteria for inclusion in Annex I stony reef. These methodologies are still under review and development and are therefore not fully implemented. They do however contain guidance on classifying and enumerating reef habitat key species as well as reef-species often present in stony reef habitats.

Table 9-5 Criteria for Assessment of Stony Reef (Irving, 2009)

Characteristic	'Reefiness'			
	Not a Reef	Low	Medium	High
Composition*	<10%	10-40% matrix supported	40-95%	>95% clast supported
Elevation	Flat seabed	<64 mm	64 mm – 5 m	>5 m
Extent	<25 m²	>25 m²		
Biota	Dominated by infaunal species	>80% of species present composed of epibiota species		
*Proportion of boulders/cobbles > 64 mm or bedrock.				

Annex I Reefs – Biogenic

9.6.3.5 Biogenic reefs are biological concretions that rise from the seabed (JNCC, 2023). The initial method developed to assess 'reefiness' was presented by Gubbay (2007) and involves the quantification of three separate criteria: Elevation (average tube height in cm), area (m²) and patchiness (percentage cover) as presented in **Table 9-6**.

9.6.3.6 All geophysical and ground truthing data were reviewed to assess for the potential presence and extent of Annex I biogenic *Sabellaria spinulosa* (Ross worm) reef. The patchiness of *S. spinulosa* was derived from the visual data analysis and the percentage coverage was calculated from each still image taken along the transect. Elevation of the *S. spinulosa* tubes was estimated from each still image taken along the transect in accordance with Pearce and Kimber (2020) '*Sabellaria spinulosa* reef height guide'. The area was calculated from boundaries (polygons) drawn in GIS based on the interpreted geophysical and bathymetrical data. To assess overall 'reefiness' the Collins (2010) method of combining the separate criteria (extent, elevation and patchiness as established by Gubbay (2007) was implemented.

Table 9-6 Characteristics of *Sabellaria spinulosa* reef (Gubbay, 2007)

Characteristic	'Reefiness'			
	Not a Reef	Low	Medium	High
Elevation (cm)	<2	2 - 5	5 – 10	>10
Extent (m²)	<25	25 – 10,000	10,000 - 1,000,000	>1,000,000
Patchiness (% Cover)	<10	10 - 20	20 - 30	>30

Priority Marine Feature Identification

9.6.3.7 The identification of PMFs within the Offshore Development Area was determined through the presence of their component biotopes and species listed in NatureScot (2020a).

Oslo Paris Convention for the Protection of the Marine Environment List of Threatened and/or Declining Species and Habitats

9.6.3.8 The identification of OSPAR List of Threatened and/or Declining Species and Habitats within the Offshore Development Area was determined through the presence of them listed in OSPAR (2023).

Invasive Non-native Species Identification

9.6.3.9 Invasive non-native species (INNS) are those species that have been introduced to areas outside of their natural geographical range either intentionally, or unintentionally. A list of INNS that threaten native Scottish habitats and species has been produced by NatureScot (2023). This list includes INNS which are now widespread and well established in Scotland as well as INNS found only in patchy locations within Scotland.

9.6.4 Habitat Classification Correlation Table

9.6.4.1 The 2022 marine version of the EUNIS habitat classification has been used throughout the chapter. For ease of correlation with the previous 2012 amended 2019 EUNIS classification, **Table 9-7** presents the biotopes referenced throughout the chapter with both 2022 and 2012 codes.

Table 9-7 European Nature Information Systems 2022 and 2012 amended 2019 habitat classification correlation

Code	Name	2012 Code[3]
MA123D1	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock	A1.3131
MA123G	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock	A1.451
MA123H	*Porphyra purpurea* or *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	A1.452
MA12442	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	A1.2142
MA1245	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock	A1.215
MA5211	Talitrids on the upper shore and strandline	A2.211
MA5233	Amphipods and *Scolelepis* spp. In Atlantic littoral medium-fine sand	A2.223
MA5251	*Limecola balthica* and *Arenicola marina* in Atlantic littoral muddy sand	A2.241
MB1	Infralittoral rock	A3
MB121A3	Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock	A3.2143
MB1215	*Laminaria hyperborea* with dense foliose red seaweeds on exposed Atlantic infralittoral rock	A3.115

[3] In 2019 the classification was further amended to include two new habitats of the revised Resolution 4 of Bern Convention.

Code	Name	2012 Code[3]
MB12151	*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed Atlantic upper infralittoral rock	A3.1151
MB12211	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock	A3.1161
MB523	Faunal communities of full salinity Atlantic infralittoral sand	A5.23; A5.24
MB5231	Sparse fauna in Atlantic infralittoral mobile clean sand	A5.231
MC12243	*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed Atlantic circalittoral rock	A4.2143
MC2211	*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment	A5.611
MC32	Atlantic circalittoral coarse sediment	A5.14; A5.1; A5
MC42	Atlantic circalittoral mixed sediment	A5.44; A5; A5.4
MC4213	*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	A5.443
MC4214	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	A5.444
MC52	Atlantic circalittoral sand	A5.25; A5.26; A5.2; A5
MC521	Faunal communities of Atlantic circalittoral sand	A5.25; A5.26

Code	Name	2012 Code[3]
MC5211	*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	A5.251
MC5212	*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	A5.252
MC5213	Medium to very fine sand, 100-120 m, with polychaetes *Spiophanes kroyeri*, *Amphipectene auricoma*, *Myriochele* sp., *Aricidea wassi* and amphipods *Harpinia antennaria*	A5.253
MC62	Atlantic circalittoral mud	A5.35; A5.36; A5; A5.3
MC6211	*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in Atlantic circalittoral sandy mud	A5.351
MC6212	*Thyasira* spp. and *Nuculoma tenuis* in Atlantic circalittoral sandy mud	A5.352
MC6213	*Amphiura filiformis* and *Nuculoma tenuis* in Atlantic circalittoral and offshore muddy sand	A5.353
MD4211	Polychaete-rich deep Venus community in offshore circalittoral mixed sediment	A5.451
MD521	Faunal communities in Atlantic offshore circalittoral sand	A5.27

9.7 Baseline Environment

9.7.1 Existing baseline

9.7.1.1 Desk-based reviews and project specific surveys and assessments have been used to characterise the existing environment within the Benthic and Intertidal Ecology Study Area. The baseline section is structured in the following sub-sections:

- Regional Overview:
  - Overview of the environment and broadscale predicted biotopes;
  - Nature conservation data on the known and predict extent of statutory designated features and INNS;
- Study Area:
  - Physical environment of the Study Area;
  - Biological environment of the Study Area;
  - Distribution of species and habitats of conservation interest within the Study Area; and
- Data gaps for consideration.

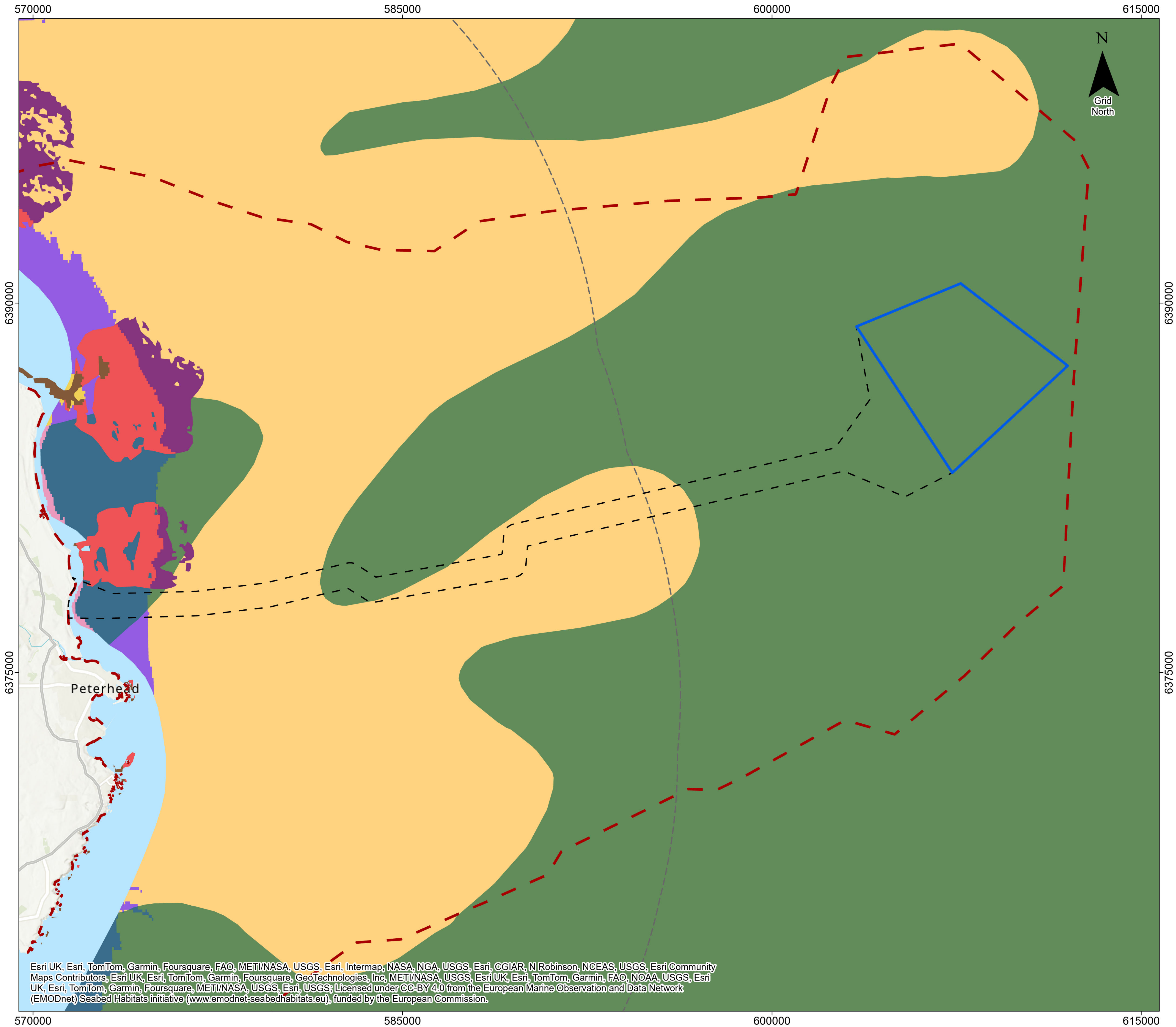
Regional Overview

9.7.1.2 The waters off the east of Scotland support a diverse range of intertidal and subtidal habitats. Predicted Marine Strategy Framework Directive (MSFD) benthic broad types are shown in **Figure 9-3** and show a clear change in habitat complexity from the nearshore to offshore areas. Across the offshore region, there is a larger expanse of offshore circalittoral sand. Closer to shore, and along the majority of the Offshore ECC, there is a large area of offshore circalittoral coarse sediment. Moving towards the coastline, the sediment becomes less uniform but generally consisted of circalittoral and infralittoral sand. To the north of the Nearshore ECC there is an area of circalittoral rock and biogenic reef mapped.

9.7.1.3 The coastal habitats north of Peterhead primarily comprise sandy beaches backed by an extensive sand dune community comprising of fixed dunes, shifting dunes, and unvegetated sand beaches above the drift line (NatureScot, 2012).

9.7.1.4 European Marine Observation and Data Network (EMODnet) mapping reports on predicted distribution of broad EUNIS biotope complexes. The dominant offshore EUNIS biotopes include:

- MD52 Atlantic offshore circalittoral sand;
- MD32 Atlantic offshore circalittoral coarse sediment; and
- MC52 Atlantic circalittoral sand.



Salamander

Figure 9-3

Predicted Marine Strategy Framework Directive Broad Benthic Habitat Type

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 12nm limit

MSFD Benthic Broad Habitat Types

- Infralittoral coarse sediment
- Infralittoral rock and biogenic reef
- Infralittoral sand
- Circalittoral coarse sediment
- Circalittoral mud
- Circalittoral rock and biogenic reef
- Circalittoral sand
- Offshore circalittoral coarse sediment
- Offshore circalittoral mixed sediment
- Offshore circalittoral mud
- Offshore circalittoral rock and biogenic reef
- Offshore circalittoral sand

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:150,000

0 25 50 Kilometers

0 5 10 20 Nautical Miles

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Regional Nature Conservation Features

Protected Sites

9.7.1.5 The Southern Trench Nature Conservation Marine Protected Area (NCMPA) was designated under the Marine (Scotland) 2010 Act and overlaps with the Offshore ECC (**Figure 9-4**). A description of the site and features of potential relevance to the assessment for benthic and intertidal ecology is described below.

9.7.1.6 Turbot Bank NCMPA, designated for sandeels, lies 16 km to the south-east of the Offshore Array Area (**Figure 9-4**). As this NCMPA is considerably outside the Far-field Study Area, the potential impacts of the Salamander Project on the benthic features of the designated site are not considered further. For further detail on this designated site see **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**.

9.7.1.7 There are no other nature conservation sites in close proximity to the Benthic and Intertidal Ecology Study Area. In addition, all Special Areas of Conservation (SACs) were screened out of the Habitats Regulations Assessment presented in **Volume RP.A.1, Report 1: Report to Inform Appropriate Assessment (RIAA)**.

Southern Trench Nature Conservation Marine Protected Area

9.7.1.8 The Southern Trench NCMPA stretches from Buckie in the west to past Peterhead in the east. The NCMPA takes its name from the 58 km long, 9 km wide and 250 m deep trench running parallel to the coast.

9.7.1.9 The benthic protected feature of the NCMPA is Burrowed mud. The trench is covered by thick, soft mud inhabited by the Norway lobster *Nephrops norvegicus*, crabs, sea pens and tube anemones (NatureScot, 2020b).

9.7.1.10 Distribution of Burrowed mud across the Southern Trench NCMPA is shown in **Figure 9-4** and shows a strictly western distribution. This benthic protected feature is located approximately 6.9 km north of the Benthic and Intertidal Ecology Study Area, therefore, its absence within the Study Area results in limited interaction between the Salamander Project and this protected benthic habitat.

Habitats and Species of Conservation Interest

9.7.1.11 The indicative distribution of features of conservation interest in the wider region is presented in **Figure 9-4** with features overlapping the Near and Far-field Study Areas in some locations.

9.7.1.12 The Offshore Array Area is located within an area associated with the Scottish PMF habitat Offshore subtidal sands and gravels. This PMF habitat extends approximately 11 km along the Offshore ECC and into the Offshore Array Area. This habitat is common throughout the Scottish North Sea waters and is not considered unique to the area surrounding the Offshore Development.

9.7.1.13 Potential OSPAR *Sabellaria spinulosa* reef was identified in the Far-field Study Area to the north and south of the Offshore ECC, and one location within the Near-Field Study Area. However, confidence on the determination as reef was determined as uncertain (EMODnet, 2021; JNCC; 2021).

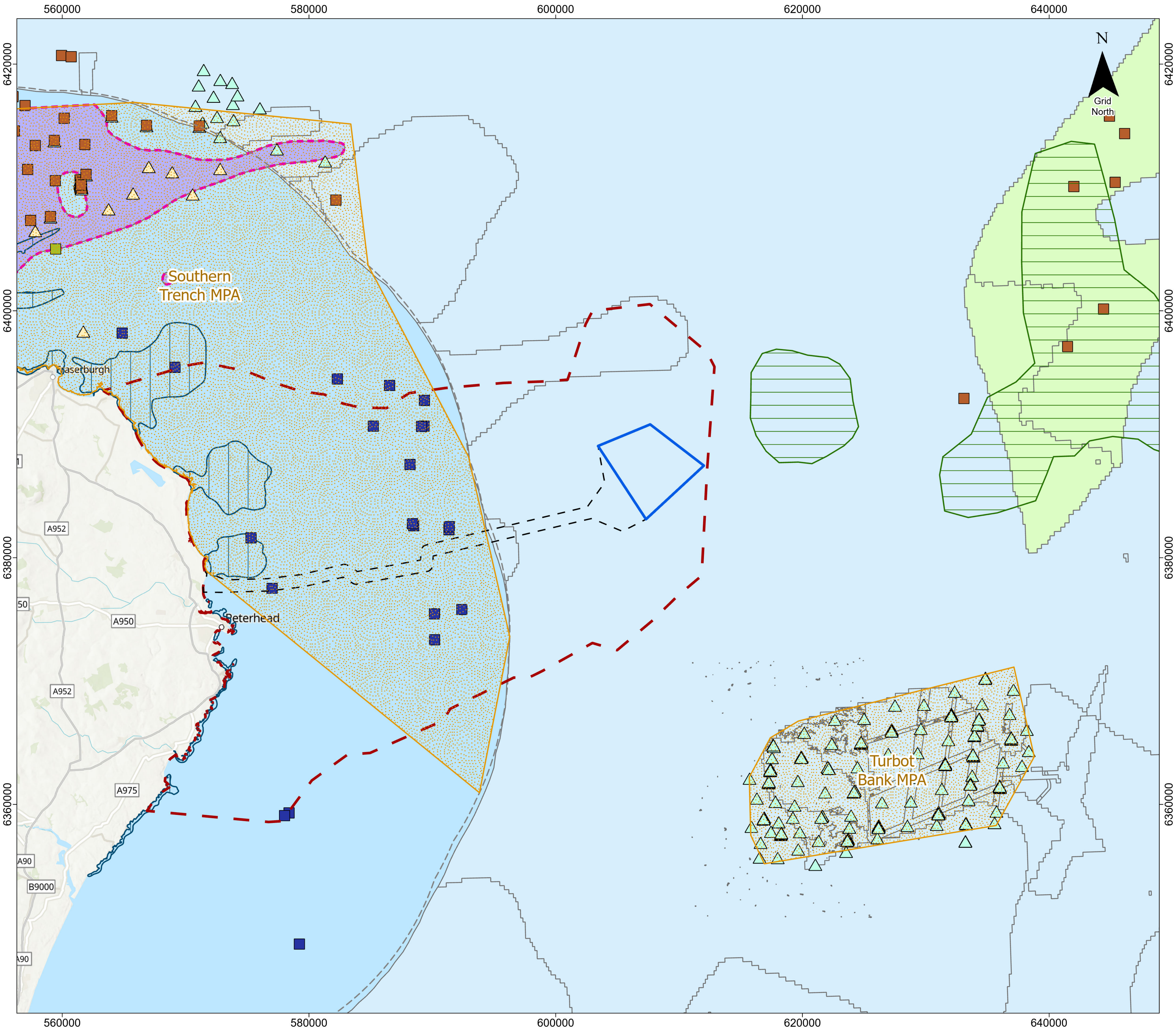
9.7.1.14 Several potential Annex I geogenic reef features have been identified within the Far-field Study Area. One feature is located directly to the north of the Nearshore ECC, with a small section overlapping the Near-field Study Area.

9.7.1.15 A potential area of submarine structures made by leaking gas ('pockmarks') is located approximately 3 km to the west of the Far-field Study Area.

Invasive Non-Native Species

9.7.1.16 Marine INNS that have been recorded in the east of Scotland include (NatureScot, 2023):

- Green sea-fingers (*Codium fragile* subsp. *Tomentosoides*);
- Red alga (*Dasysiphonia japonica*);
- Japanese kelp, wakame (*Undaria pinnatifida*);
- Acorn barnacles (*Austrominius modestus*);
- American lobster (*Homarus americanus*);
- Pacific oyster (*Magallana gigas*);
- Japanese skeleton shrimp (*Caprella mutica*);
- Orange tipped sea squirt (*Corella eumyota*); and
- Orange ripple bryozoan (*Schizoporella japonica*).



Salamander

Figure 9-4

Conservation Features

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- MPA
- Pockmarks
- 12nm limit

GeMS Habitat

- Burrowed mud
- Burrowed mud or Inshore deep mud with burrowing heart urchins
- Kelp beds
- Offshore subtidal sands and gravels

GeMS Habitat

- Burrowed mud
- Offshore deep sea muds
- Offshore subtidal sands and gravels

JNCC Annex I Reef Confidence

- Potential

OSPAR threatened and/or declining habitats and species

- Lophelia pertusa reefs
- Sabellaria spinulosa reefs
- Sea-pen and burrowing megafauna communities

OSPAR threatened and/or declining habitats and species

- Sea-pen and burrowing megafauna communities

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:300,000

0 8.5 17 Kilometers

0 2.25 4.5 9 Nautical Miles

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Physical Environment

9.7.1.17 **Table 9-8** provides an overview of the physical characteristics of the Benthic and Intertidal Ecology Study Area. Whilst a detailed description is provided in **Volume ER.A.3, Chapter 7: Marine Physical Processes**, it is important to understand the broad physical environment due to the link between the physical environment and marine ecological features. For a detailed description of the coastal processes and physicochemical properties of the subtidal sediment of the Near-field Study Area and wider area, refer to **Volume ER.A.3, Chapter 7: Marine Physical Processes** and **Chapter 8: Water and Sediment Quality**.

Table 9-8 Overview of the physical environment

Parameter	Description
Bathymetry	Offshore Array Area water depths range between 86-102 m below Lowest Astronomical Tide (LAT). The south-western part of the Offshore Array Area is generally deepest, with the shallowest depths observed in the middle of the Offshore Array Area. Water depths along the Offshore Export Cable Corridor range from 0-96 m LAT, with depths generally shallowing towards the coast. There is, however, a shoal just before the first 'elbow' along the Offshore Export Cable Corridor towards the shore, where depths are around 68 m LAT. A range of active and relict (i.e. no longer active) bedforms and geomorphological features are present within the Study Area, reflecting contemporary seabed processes and past glacial and geological activity.
Current speeds	Depth averaged mean spring currents within the Offshore Array Area are in the approximate range 0.5-0.8 m s^{-1}, with equivalent neap flows of between approximately 0.2-0.4 m s^{-1}. Depth average mean spring currents within the Offshore Export Cable Corridor are in the approximate range 0.6-1.1 m s^{-1}, with equivalent neap flows of between approximately 0.4-0.6 m s^{-1}.
Tidal Excursion (mean spring tide)	In general, the depth averaged mean spring peak current speed ranges from circa 0.5 m s^{-1} offshore, increasing to circa 1.0 to 1.5 m s^{-1} at the coast. The flow direction is generally south (flood) to north (ebb) offshore but changes closer inshore as the flow aligns with the coastline. Tidal ellipses are quite strongly rectilinear throughout the Offshore Export Cable Corridor and Offshore Array Area.
Seabed Sediments	Sediments within the Offshore Array Area mainly consist of sand and variable proportions of gravel and mud. Sediments along the Offshore Export Cable Corridor transition from sand and muddy sand near the Offshore Array Area to mostly gravelly sand towards the coast, with patches of sand where current speeds are highest.

Suspended Sediment Concentration (SSC)	Monthly averaged satellite imagery of SSC suggests that within the Offshore Array Area average (surface) SSC is generally very low, between 0.5-1.5 mg l^{-1}. SSC values along the Offshore Export Cable Corridor are also generally very low but increase slightly heading from the Offshore Array Area towards the Landfall in the winter months, ranging between 1.4-2.0 mg l^{-1}. However, during summer months SSC values decrease towards the coast ranging between 0.6-1.2 mg l^{-1}.
Sediment Quality	Within the Wider Survey Area Total Organic Carbon (TOC) and Total Organic Matter (TOM) content was Low. Similarly Total Hydrocarbon Concentrations (THC) in the sediment were generally low and within the Dutch RIVM (Rijksinstituut voor Volksgezondheid en Milieu translated as Dutch National Institute for Public Health and the Environment) Environmental Risk Limits. Polycyclic aromatic hydrocarbons (PAHs) were overall low but Canadian Council of Ministers of the Environment (CCME) Threshold Effect Level (TEL) values were exceeded at one site but were below Probable Effect Level (PEL) concentrations. Heavy metals were all below Centre of Environment Fisheries and Aquaculture (Cefas) AL1.

Biological Environment

Offshore Subtidal

9.7.1.18 A diverse subtidal community was identified across the Wider Survey Area from the 2022 grab sampling and DDV survey campaign (Ocean Infinity, 2023). From the grab samples a total of 306 non-colonial taxa were recorded across the Wider Survey Area and with a mean per station of approximately 28 taxa and 69 individuals. Abundance of individuals was generally (91 % of grabs) under 100 individuals per grab, except for 5 sampling stations (ECR_S40, ECR_S41, ECR_S58, WAA_S02, WAA_S28). Individual abundance at Station ECR_S41 was notably high (506 individuals) largely made up of individuals belonging to the annelids *Sabellaria spinulosa* and *Paradoneis lyra*, the crustacean *Verruca stroemia* and the echinoderm *Ophiactis balli*. These taxa tend to be associated with hard substrata. Number of taxa ranged from 14 (ECR_S54) to 68 per sample (ECR_S41). The high number of taxa, and wide range in abundances recorded is likely a natural artefact of heterogenous sediments across the survey area. The Wider Survey Area are dominated by sedimentary sediments and thus will be dominated by infaunal species.

9.7.1.19 The spatial variation in abundances does not appear to be associated with distance to coast but is more likely to reflect the spatial distribution of the sediment. The most abundant species sampled overall was the bivalve *Kurtiella bidentata* where it accounted for 8.5 % of total abundance. This was followed by the annelid *Scoloplos armiger*, which accounted for 4.3% of the total abundance. The echinoderms *Ophiactis balli*, *Echinocyamus pusillus* and *Amphiura filiformis* were also abundant, contributing 4.0%, 3.8% and 3.4% of the total abundance respectively. Juveniles of the heart urchin echinoderm Spatangoida were also frequently observed, recorded in 87% of all grab samples.

9.7.1.20 Despite the numerical dominance of annelids (c. 47.2% of recorded individuals), the heavier taxa such as Mollusca and Echinodermata dominated the overall biomass, contributing to approximately 75% and 53%, respectively. The echinoderms *Echinocardium pennatifidum* and *Echinocardium cordatum* and the molluscs *Antalis entalis* and *Dosinia lupinus* contributed to approximately 36% of the overall biomass.

9.7.1.21 The non-colonial epifauna from grab samples comprised five major phyla; Bryozoa, Cnidaria, Ciliophora, Entoprocta and Porifera. Bryozoa contributed to 51% of the total taxa, followed next by Cnidaria which contributed to 33% of the total taxa. The remaining phyla contributed to less than 10% of the total taxa. Mean number of colonial taxa in grab samples was approximately three per grab and ranged from zero (ECR_S42, WAA_S16_B, WAA, S35, WAA_S37 and WAA_S38) to 14 (ECR_S58). Colonial taxa are generally associated with hard substrata, and the low record of colonial taxa is likely a reflection of sedimentary sediment being dominant in the Offshore Array Area and Offshore ECC. The most frequently recorded taxa were the ciliate *Follicullinidae* and the hydrozoan suborder *Filifera*, which were the only taxa present in over 40% of all samples.

9.7.1.22 Any features of conservation interest and other notable taxa identified from the grab samples, are described separately below.

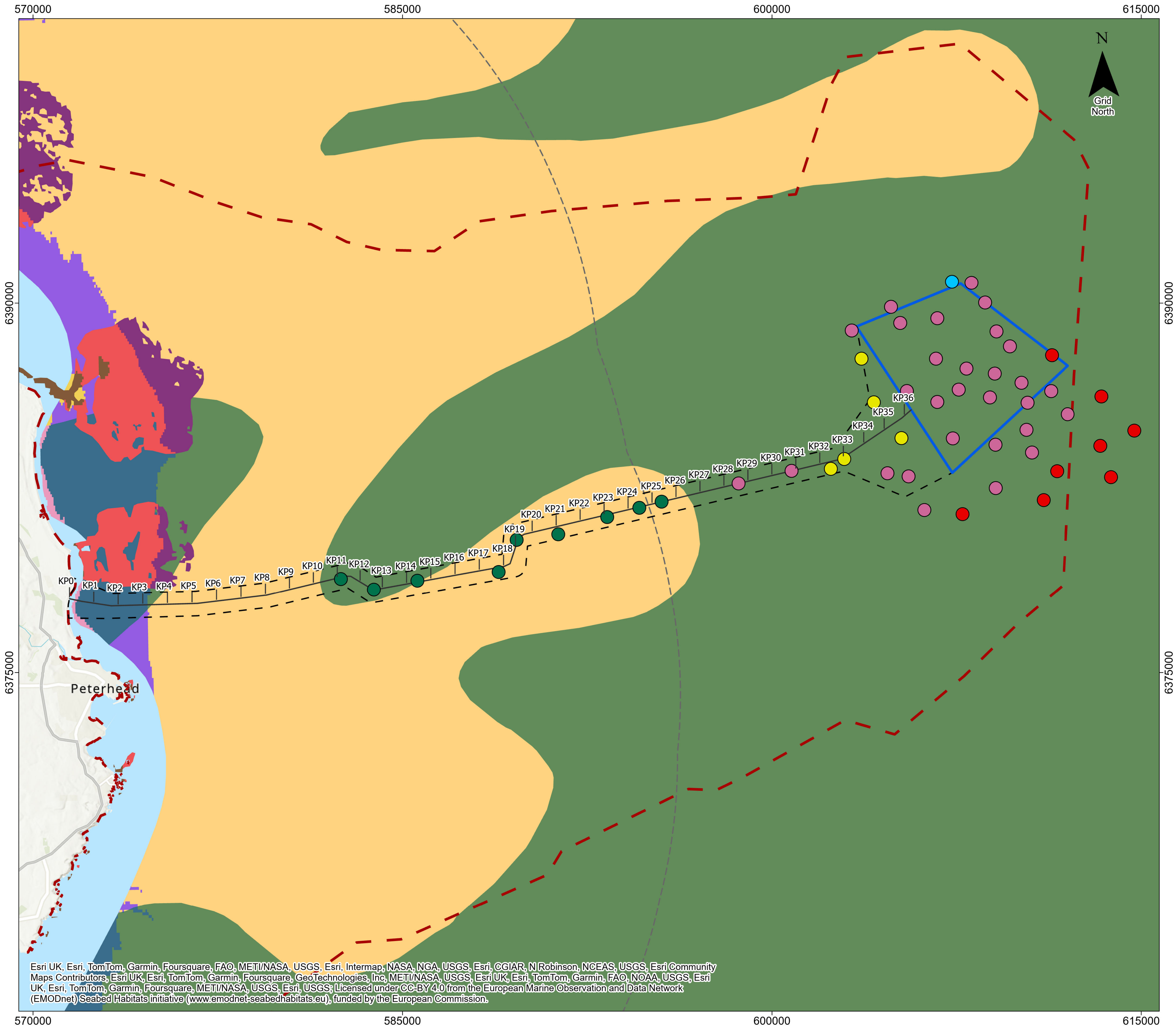
9.7.1.23 Multivariate analysis (SIMPROF Cluster analysis and SIMPER) on the non-colonial macrofauna produced five statistically distinct community groupings from the 53 grab samples. The spatial distribution of the community groups is shown in **Figure 9-5**. A summary description of each group cluster is present in **Table 9-9** below including position along the Offshore ECC based on Kilometre Points (KP) from the start of the Offshore ECC at the Landfall.

9.7.1.24 There is a clear spatial differentiation between communities further offshore and those closer to shore. Group a, comprising nine stations, represents the majority of the Offshore ECC (11-26KP), and was characterised by high abundance of *E. pusillus* and was located in areas of gravelly sand. In contrast, Group d, comprising 30 stations, represented most of the Offshore Array Area and was characterised by infaunal species such as *S. armiger* and *A. filiformis* and was recorded mainly on muddy sand and sand. Group e, comprising five stations, was recorded southwest of the Offshore Array Area and was characterised by infaunal species such as *Lumbrineris cingulata* (aggregate) and *Paradoneis lyra* on slightly gravelly muddy sand and gravelly muddy sand. Group c, representing eight stations, was located south and southeast of the Offshore Array Area and was characterised by infaunal species such as *S. armiger* and the amphipod *Harpinia antennaria* mainly found on deep (>98 m) muddy sand. Group b (WAA_S13) was an outlier located north of the Offshore Array Area, mainly due to a greater number of *H. antennaria*. For further information on macrobenthic composition in these sediments, refer to **Volume ER.A.4, Annex 9.1: Environmental Baseline Report**.

9.7.1.25 Biotope mapping, based on the combined assessment of grab, seabed imagery and geophysical data is presented below.

Table 9-9 Summary Description of the infaunal macrobenthic groups samples across the Offshore Export Cable Corridor and Offshore Array Area.

Group Cluster	No. Stations	Area	KP(s)	Depth (m)	BGS (1982) Classification (modified from Folk, 1954)	Description
A	9	Offshore ECC	11-26	72-87	slightly gravelly sand gravelly sand	Echinoderm *Echinocyamus pusillus* and Nematoda
B	1	North of Offshore Array Area	-	92	muddy sand	Amphipod *Harpinia antennaria*, annelids *Scoloplos armiger*, *Paradoneis lyra* and *Owenia* sp. And ophiuroid *Amphiura filiformis*.
C	8	South and south east of Offshore Array Area	-	97-106	muddy sand sand	Annelid *Scoloplos armiger* and amphipod *Harpinia antennaria*
D	30	Offshore ECC and Offshore Array Area	28-36	87-108	muddy sand sand slightly gravelly sand	Annelid *Scoloplos armiger* and ophiuroid *Amphiura filiformis*
E	5	Offshore ECC	32-36	92-97	gravelly muddy sand slightly gravelly muddy sand	Annelids *Lumbrineris 42ingulate* (aggregate) and *Paradoneis lyra*



Salamander

Figure 9-5

Spatial distribution of the infaunal microbenthic groups across the Wider Survey Area

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Indicative Export Cable Route
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 12nm limit

Subtidal Macrobenthos Groups

- A
- B
- C
- D
- E

MSFD Benthic Broad Habitat Types

- Infralittoral coarse sediment
- Infralittoral rock and biogenic reef
- Infralittoral sand
- Circalittoral coarse sediment
- Circalittoral mud
- Circalittoral rock and biogenic reef
- Circalittoral sand
- Offshore circalittoral coarse sediment
- Offshore circalittoral mixed sediment
- Offshore circalittoral mud
- Offshore circalittoral rock and biogenic reef
- Offshore circalittoral sand

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:150,000

0 25 50 Kilometers

0 5 10 20 Nautical Miles

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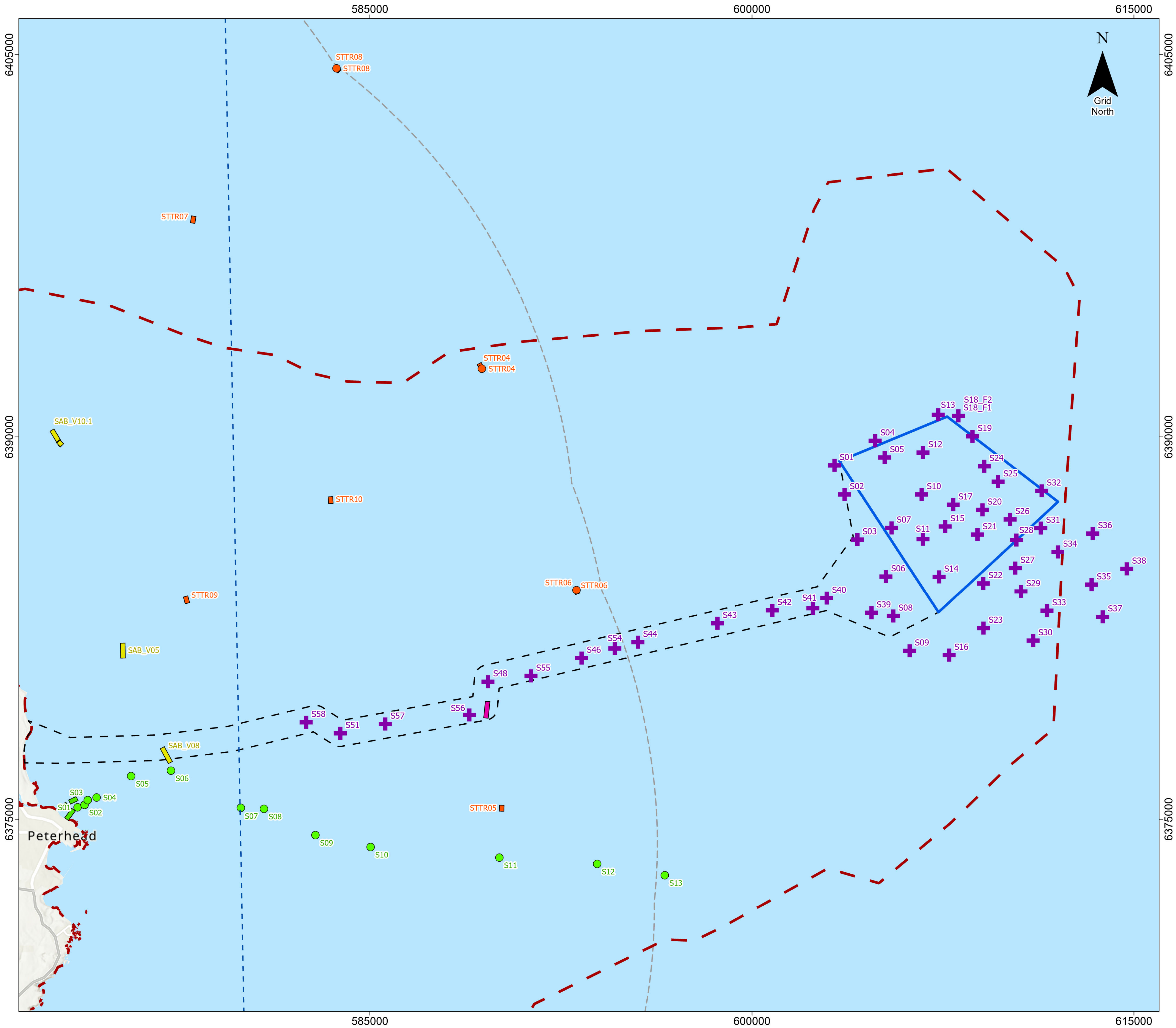
Nearshore subtidal

9.7.1.26 Project-specific surveys did not cover the Nearshore ECC between Landfall and 1°40 line. However, desktop reviews of existing data have provided an understanding of community composition in the Near- and Far-field Study Area of the Nearshore ECC (**Figure 9-6**). See, **Volume ER.A.4, Annex 9.3: Benthic Ecology Baseline Data Review** for further detail on publicly available data sources and survey results from neighbouring projects to the Salamander Project.

9.7.1.27 From the SNH (now NatureScot) (2015) survey, their Transect STTR05 falls in the Far-field Study Area, to the north of the Nearshore ECC (**Figure 9-6**). The transect was characterised by mixed gravelly sand. *S. spinulosa* tubes were found to consolidate the sediment in the forms of pebble-sized blocks (Moore *et al*., 2017). The sediments supported hydroids, the soft coral *Alcyonium digitatum,* the annelids *Chaetopterus variopedatus* and Serpulidae*,* Caridea shrimps*,* Paguridae crabs and the crab *Ebalia* sp. And the starfish *Luidia ciliaris.*

9.7.1.28 From the SNH (now NatureScot) (2017) survey, two transects (SAB_V05 and SAB_V08) fall within the Study Area (**Figure 9-6**). SAB_V08 is located within the Nearshore ECC and was characterised by cobbles and boulders encrusted with *S. spinulosa* and supporting *A. digitatum,* hydroids and bryozoan turf (Moore *et al.*, 2019). This turf was dominated by the bryozoans *Flustra foliacea* and *Securiflustra securifrons.* Other species recorded were the anemone *Urticina felina,* Caridea shrimp, squat lobster *Munida rugosa*, the crab *Ebalia* sp., the starfish *L. ciliaris* and the sea urchin *Echinus esculentus*. SAB_V08, located in the Far-field Study area was similarly characterised by widespread crusts of *S. spinulosa* and supported similar epifauna as to SAB_V05.

9.7.1.29 Sampling stations and transects collected as part of the Hywind Scotland survey corridor are located just south of the Nearshore ECC (**Figure 9-6**). The Hywind Scotland survey identified bedrock covered with large kelp (*Laminaria hyperborea*) and a variety of red seaweed at depths under 12 m (MMT, 2013). At depths greater than 12 m, kelp declined and red seaweed continued to persist. In addition to bedrock, patches of sand were sampled at Stations S01 and S03 (**Figure 9-6**). However, fauna samples from S01 identified few taxa present. The S02 and S04 sites comprised varying sizes of boulders and blocks supporting the bryozoan *S. securifrons* and the soft coral *A. digitatum* (**Figure 9-6**). Several species of starfish, anemones and squat lobsters were also present. Grab sample site S05 was located in a large sand and gravel area with frequent boulder occurrence and exceptionally strong tidal currents. Attached on the boulders were several bryozoans, hydrozoans and anthozoans. S06 also sampled this boulder field, showing an area with larger blocks in a clast and matrix supported pattern that arose from the seabed. The bryozoans *F. foliacea* and *S. securifrons* was abundant on these blocks. A lot of different species of fish, crabs and lobsters were associated with these blocks and boulders.



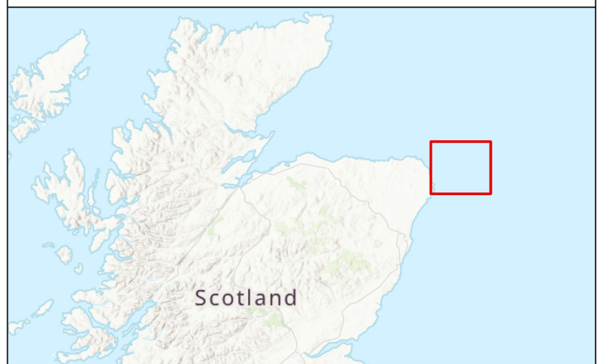
Salamander

Figure 9-6

Subtidal Sampling Locations

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 12nm limit
- 1° 40' W line (WGS84)
- EBS Macrofauna Sampling Transect
- HyWind Survey Transect
- Rattray Head Survey Transect
- Southern Trench Survey Transect
- EBS Macrofauna Sampling Location
- HyWind Survey Site
- Southern Trench Survey Site



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Scale @ A3 : 1:145,000

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0 1 2 4 Nautical Miles

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The intertidal

9.7.1.30 The intertidal Landfall has moderate wave exposure and comprises mostly clean mobile sand with low faunal abundance. The northern part of the Landfall comprises a mosaic of rocky and sedimentary habitats in the middle and lower shore.

9.7.1.31 The upper shore along the entire length of the ECC Landfall comprised barren sand below dune vegetation with a sparse strandline of debris and dead algae. Quadrat sampling in this habitat found talitirid amphipods as the only visible invertebrate fauna. The middle to lower shore across most of the cable corridor landfall consisted of clean mobile sand with low faunal abundance. Invertebrates recorded during quadrat sampling of this habitat included the polychaete *Scolelepis* spp., the isopod crustacean *Eurydice* spp. and the amphipod *Haustorius arenarius*.

9.7.1.32 Boulders higher up the shore were more widely spaced and subject to sand scour and were dominated by the ephemeral green and red algae, *Ulva* spp. and *Porphyra* spp., respectively. Lower shore boulders were mostly dominated by a dense covering of *Fucus serratus* along with *Palmaria palmata* and *Ulva* spp. Faunal diversity on these boulders was low, with a patchy distribution of the barnacles *Semibalanus balanoides* and the limpet *Patella vulgata*. The lower shore in the central portion of the boulder habitat included patches of the sand-binding red algae *Rhodothamniella* spp. either beneath the *Fucus serratus* canopy or forming distinct mats interspersed with *Ulva* spp. where *F. serratus* cover was sparse.

9.7.1.33 The middle to lower shore sand between the boulder habitats in the northern section of the cable corridor landfall had visible lugworm (*Arenicola marina*) casts on the sediment surface at a density of between 30-50 casts m^{-2}, along with areas of standing water.

9.7.1.34 **Graphic 9-1** presents example images of the different intertidal habitats observed within the Landfall.

9.7.1.35 Biotopes classified for the intertidal area at the Landfall are detailed below. For further details on the intertidal habitats and communities recorded, refer to **Volume ER.A.4, Annex 9.2: Intertidal Report**.

Graphic 9-1: (TOP LEFT) upper shore comprising barren sand with sparse strandline; (TOP RIGHT) middle-lower shore showing clean mobile sand with low faunal abundance; (BOTTOM LEFT) middle-lower shore in the northern portion of the proposed Landfall showing boulders supporting macroalgal communities; (BOTTOM RIGHT) lower shore boulder in the northern portion of the proposed Landfall with dense covering of *Fucus serratus, Palmaria palmata* and *Ulva spp.* (Source: Volume ER.A.4, Annex 9.2: Intertidal Report).

Biotope Mapping

Offshore Subtidal

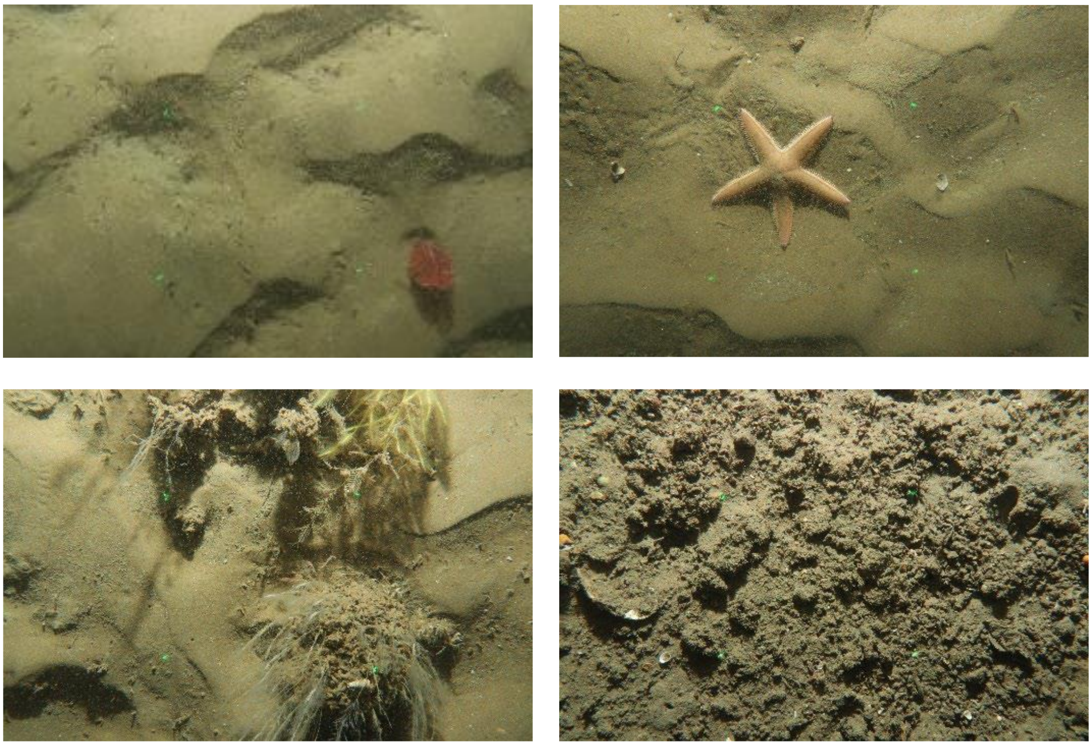
9.7.1.1 Biotope classification was based on physical characteristics such as substrate, depth, wave exposure and salinity, as well as biological factors such as characterising species. Following a combined analysis of the subtidal imagery, grabs and geophysical data, a total of six biotopes and one biotope complex were identified (**Figure 9-7**). The taxonomic assemblages from the acquired grab sample data further indicated the presence of 11 species-specific habitats and seven habitat complexes (**Figure 9-8**).

9.7.1.2 The dominant sedimentary biotopes identified within the Offshore Array Area comprised:

- MC52 'Atlantic circalittoral sand'
- MC52 'Atlantic circalittoral sand'/MC2211 '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment'

9.7.1.3 The Offshore Array Area was characterised by MC52 including MC52/MC2211 complex in the east with some small areas assessed as MC2211 only. The habitat MC62 was exclusively recorded to the south and southwest of the Offshore Array Area.

9.7.1.4 **Graphic 9-2** presents example images of the four main biotopes present within the Offshore Array Area.



Graphic 9-2: (TOP LEFT) MC62 'Atlantic circalittoral mud'; (TOP RIGHT) MC52 'Atlantic circalittoral sand'; (BOTTOM LEFT) MC52 'Atlantic circalittoral sand'/ MC2211 '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment'; (BOTTOM RIGHT) MC2211 '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment'.

9.7.1.5 Taxonomic assemblages from acquired grab samples within MC62 were generally assessed as the complex MC5213 'Medium to very fine sand, 100-120 m, with polychaetes *Spiophanes kroyeri*, *Amphipecten auricoma*, *Myriochele* sp., *Aricidea wassi* and amphipods *Harpinia antennaria*' / MC6212 '*Thyasira* spp. and *Nuculoma tenuis* in Atlantic circalittoral sandy mud', which generally corresponded to macrofauna group c. Grab samples within the habitat complex MC52/MC2211 were mainly assigned the complexes MC5211 '*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand' / MC6211 '*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in Atlantic circalittoral sandy mud'' and MC5211 / MC6213 '*Amphiura filiformis* and *Nuculoma tenuis*[4] in Atlantic circalittoral and offshore muddy sand', both which corresponded to macrofauna group d. Within the habitat MC52, grab samples comprised a variety of species-specific biotopes and habitat complexes, which generally corresponded to macrofauna group d:

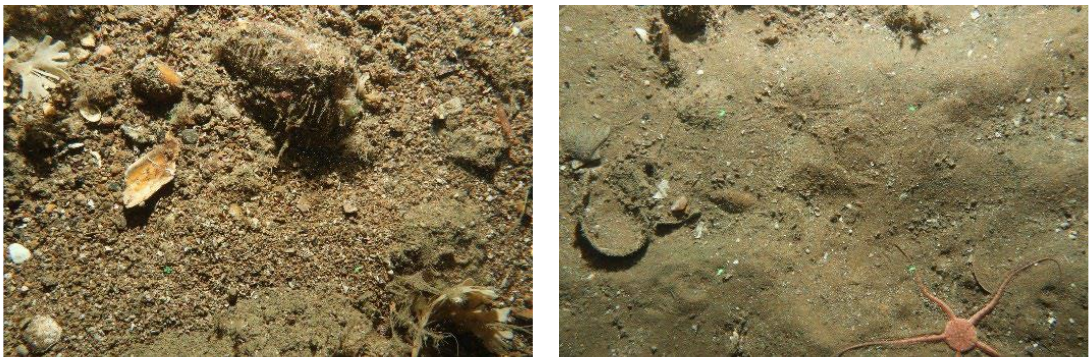
- MC6211; (group d)

[4] *Nuculoma tenuis* species name is now accepted as *Ennucula tenuis (https://www.marinespecies.org/aphia.php?p=taxdetails&id=152321)*

- MC5211; (group a and d)
- MC4213 '*Mysella bidentata*[5] and *Thyasira* spp. in circalittoral muddy mixed sediment' /MC6211; (group d)
- MC521 'Faunal communities of Atlantic circalittoral sand'; (group b)
- MC4213/MC6213; and (group d)
- MC4213/MC5212 '*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand' (group d).

9.7.1.6 Along the Offshore ECC the habitat complex MC5211/MC6213 was found predominantly from the Offshore Array Area into the ECC (>KP31). The habitat then transitions into MC52 between KP21-KP32. This section also comprised patches of MC211, becoming more extensive between KP21-24, as well as MC32 between KP23-25 and a discrete patch of MC42 between KP22-23. The habitat then transitioned to MC42 'Atlantic circalittoral mixed sediment' with scattered areas of MC32 'Atlantic Coarse sediment' until KP8.

9.7.1.7 **Graphic 9-3** presents example images of the main two biotopes present along the Offshore ECC.



Graphic 9-3: (LEFT) MC42 'Atlantic circalittoral mixed sediment'; (RIGHT) MC32 'Atlantic circalittoral coarse sediment.

9.7.1.8 Taxonomic assemblages from acquired grab samples along the Offshore ECC were assessed as MC5211 between KP11-KP26, followed by the habitat complex MC5211/MC6211 between KP28-31. Biotope MC2211 was recorded between KP32-33 and a mixture of MC5211/MC6211, MC5211/MC6213 and MC5212/MC6211 were recorded between KP34-36. The majority of the Offshore ECC was therefore characterised by MC5211.

Nearshore Subtidal

9.7.1.9 The EUSeaMap predicts MD32 'Atlantic offshore circalittoral coarse sediment' along approximately half of the Nearshore ECC (KP3-8) (EMODnet, 2021). However, site-specific surveys identified that the area just east of the 1°40 line to be representative of MC42 'Atlantic circalittoral mixed sediment' with only patches of MC52 'Atlantic circalittoral sand' (MMT, 2013; Ocean Infinity, 2023a) (**Figure 9-7**). Ground truthing data, is available from a single transect from the SNH (now NatureScot) (2017) survey, which falls within the Nearshore ECC at approximately 50 m depth. The habitat was described as predominantly fine sand (70%), with cobbles and boulders encrusted with *S. spinulosa*, and supporting the soft coral *Alcyonium digitatum*

[5] *Mysella bidentata* species name is now accepted as *Kurtiella bidentata* (https://www.marinespecies.org/aphia.php?p=taxdetails&id=140380)

and hydroid and bryozoan turfs (MC12811 '*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock') (Moore, 2019).

9.7.1.10 Hywind Scotland survey stations S05 and S06 are located in close proximity (250 m south) to this stretch of the Nearshore ECC and could be considered to serve as a proxy of the habitats expected to be encountered (MMT, 2013). Sample station S05 was described as a large sand and gravel area with frequent boulder occurrence where, despite a depth of approximately 50 m, it had very strong currents. Attached on the boulders were hydrozoans and anthozoans that together formed the habitat MC4214 '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment'. In this boulder field, the sample station S06 had an area with larger blocks in clast and matrix supported pattern that arose from the seabed representative of the habitat MC12241 '*Flustra foliacea* on slightly scoured silty circalittoral rock' (MMT, 2013).

9.7.1.11 Between KP0-3, EUSeaMap predicts sublittoral sand biotopes (MD52 'Atlantic offshore circalittoral sand', MC52 and MB52 'Atlantic infralittoral sand'), and small areas of MC32 'Atlantic circalittoral coarse sediment' (EMODnet, 2021). Site-specific survey data for Hywind Scotland recorded the presence of MD52 and MB52, including its derivative MB5231 'sparse fauna in Atlantic infralittoral mobile clean sand' close to shore.

9.7.1.12 To the north of the Nearshore ECC, between KP0-4, there is a large area of potential Annex I geogenic reef (JNCC, 2021), identified as MC12 'Atlantic circalittoral rock' and MD12 'Atlantic offshore circalittoral rock'. EUSeaMap predicts a small area of MC12 to fall within the Nearshore ECC <0.5 km from shore, however, due to the proximity of this feature to the Nearshore ECC, there is potential for the edge of the feature to be present along other sections of the Nearshore ECC between KP0-4. However, taking into consideration habitat edged dependent reduction in habitat quality (Fonseca, 2008) the presence of Annex I geogenic reef in the Nearshore ECC is expected to be of lower quality.

9.7.1.13 Based on findings from the Hywind Scotland survey (MMT, 2013), the following rocky biotopes are likely to characterise any hard substrata along the Nearshore ECC:

Close to shore (KP0-1):

- MB12211 'foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed infralittoral rock' in deeper water (>12 m);
- MB121A3 'grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock';
- MB1215 '*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock'; and
- MB12151 '*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock' in shallower water (<12 m).

Further offshore (KP1-8):

- MC12241 '*Flustra foliacea* on slightly scoured silty circalittoral rock';
- MC12243 '*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed Atlantic circalittoral rock'; and
- MC12811 '*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock'.

9.7.1.14 The potential presence of kelp biotopes within the shallow waters of the Nearshore ECC was confirmed by the site-specific intertidal surveys, which observed subtidal *Laminaria* beds visible beyond the lowest point of the tide within the northern section of the Nearshore ECC (Ocean Infinity, 2023b).

9.7.1.15 The site-specific intertidal surveys identified the Landfall area to be comprised predominantly of biotope MA5233 'Amphipods and *Scolelepis* spp. in littoral medium-fine sand', which supports the presence of sand biotopes close to shore (Ocean Infinity, 2023b).

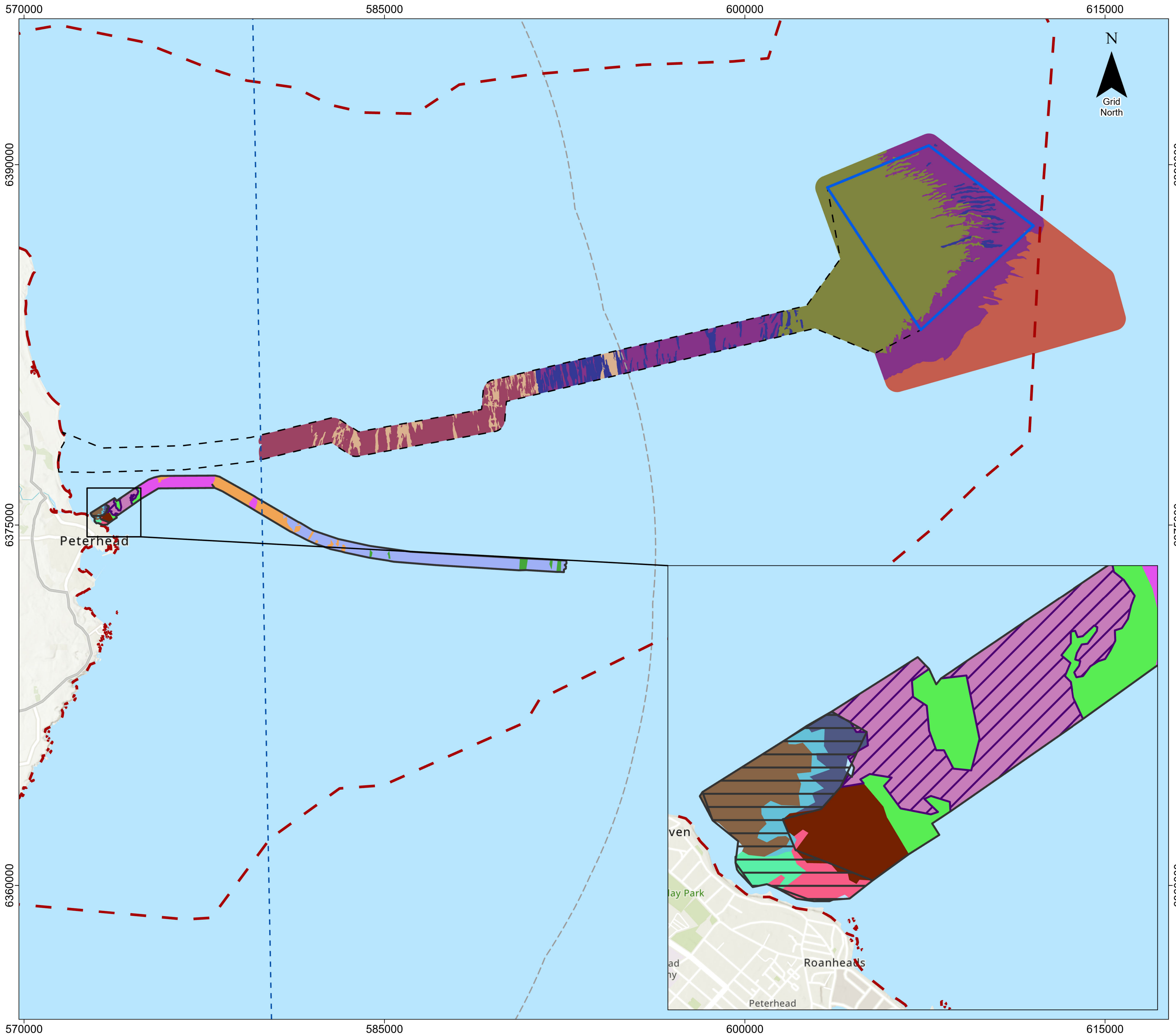
9.7.1.16 On review of the available baseline information, the presence of a number of infralittoral and circalittoral biotopes are therefore expected to be present within the Nearshore ECC. **Table 9-10** lists those predicted within the shallower coastal areas of the Nearshore ECC (KP0-1) and **Table 9-11**, the deeper areas of the Nearshore ECC (KP1-8).

Table 9-10 Infralittoral and circalittoral European Nature Information System (2021/2) biotopes predicted to occur within the Nearshore Export Cable Corridor (KP0-1)

Nearshore ECC (KP0-1)	
MB52 'Atlantic infralittoral sand'	
MC52 'Atlantic circalittoral sand'	
MC12 'Atlantic circalittoral rock'	
MC122 'Echinoderms and crustose communities on Atlantic circalittoral rock;	e.g., **MC12243** '*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock'
MB122 'Seaweeds or faunal communities on Atlantic infralittoral rock'	e.g., **MB12211** 'foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed infralittoral rock'
MB121 **'**Kelp and seaweed communities on Atlantic infralittoral rock'	e.g., **MB121A3** 'grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock' e.g., **MB1215** '*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock' e.g., **MB12151** '*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock'
MB321 'Kelp and seaweed communities on Atlantic infralittoral coarse sediment'	e.g., **MB3211** '*Laminaria saccharina* and red seaweeds on Atlantic infralittoral sediments'

Table 9-11 Circalittoral European Nature Information System (2021/2) biotopes predicted to occur within the Nearshore Export Cable Corridor (KP1-8)

Nearshore ECC (KP1-8)	
MC42 'Atlantic circalittoral mixed sediment'	
MC52 'Atlantic circalittoral sand'	
MC128 '*Sabellaria* on Atlantic circalittoral rock'	e.g., **MC12811** '*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock'
MC421 'Fauna communities of Atlantic circalittoral mixed sediment'	e.g., **MC4214** '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment'
MC122 'Echinoderms and crustose communities on Atlantic circalittoral rock'	e.g., **MC12241** '*Flustra foliacea* on slightly scoured silty circalittoral rock' e.g., **MC12243** '*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock'



Salamander

Figure 9-7

EUNIS Subtidal Biotope Classification

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 1° 40' W line (WGS84)
- Hywind Survey Area

EUNIS Biotope Code

- Annex I - Bedrock reef
- Annex I - Medium graded stony reef
- MB1
- MB121A3
- MB1215
- MB12151
- MB12211
- MB523
- MB5231
- MC12243
- MC2211
- MC32
- MC42
- MC4214
- MC52
- MC52/ MC2211
- MC62
- MC521
- MD4211
- MD521

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:155,000

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0 1 2 4 Nautical Miles

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Doc. No : SWF01ER0314
Created by : AN
Checked by : IW
Approved by : ACV

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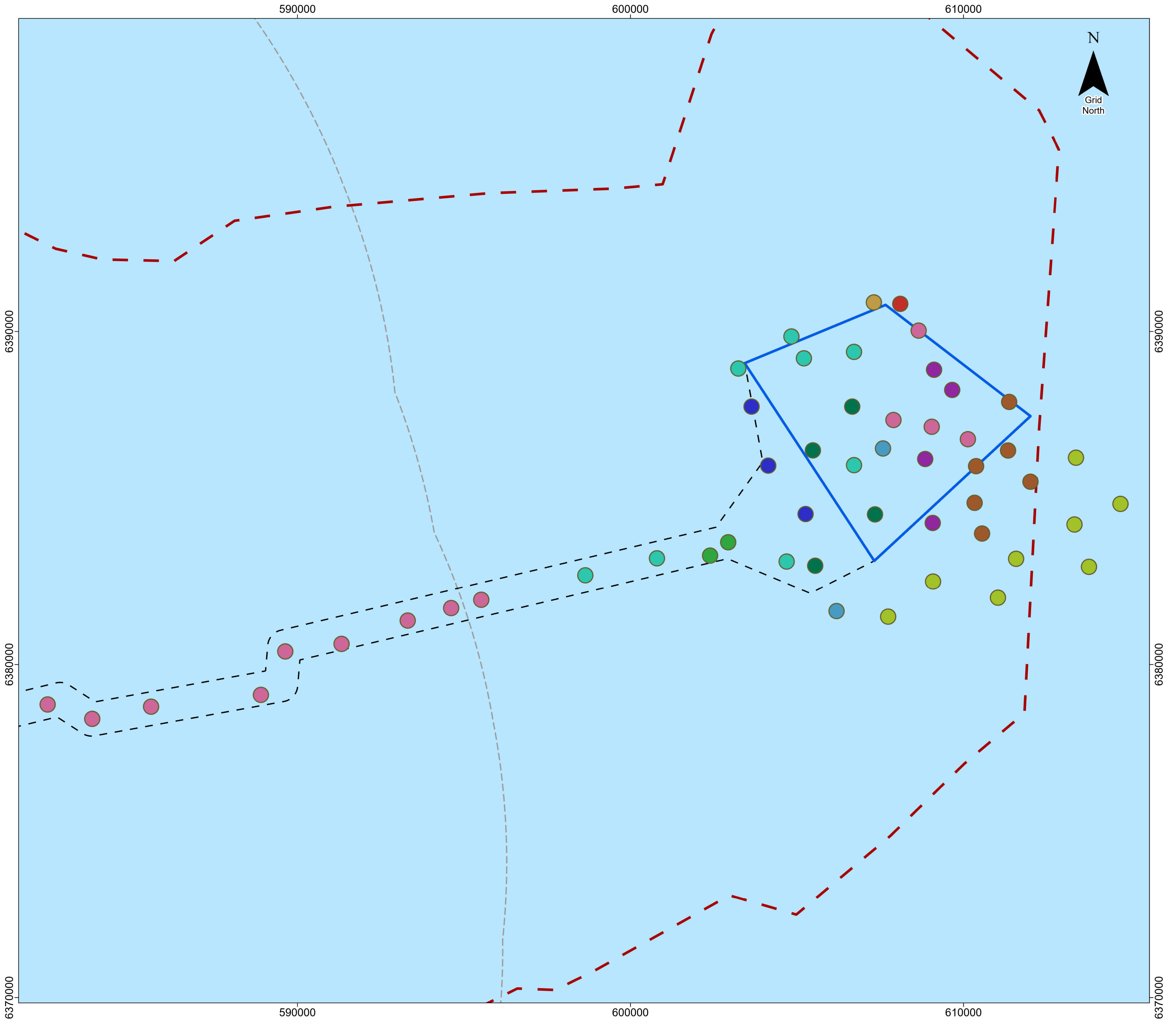

Salamander

Figure 9-8

Site-specific EUNIS Subtidal Biotope Classification

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 12nm limit

EUNIS Biotope Code

- MC2211
- MC4213/ MC5212
- MC4213/ MC6211
- MC4213/ MC6213
- MC521
- MC5211
- MC5211/ MC6211
- MC5211/ MC6213
- MC5212/ MC6211
- MC5213/ MC6212
- MC6211

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:110,000

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Doc. Title : Subtidal Biotope Sites
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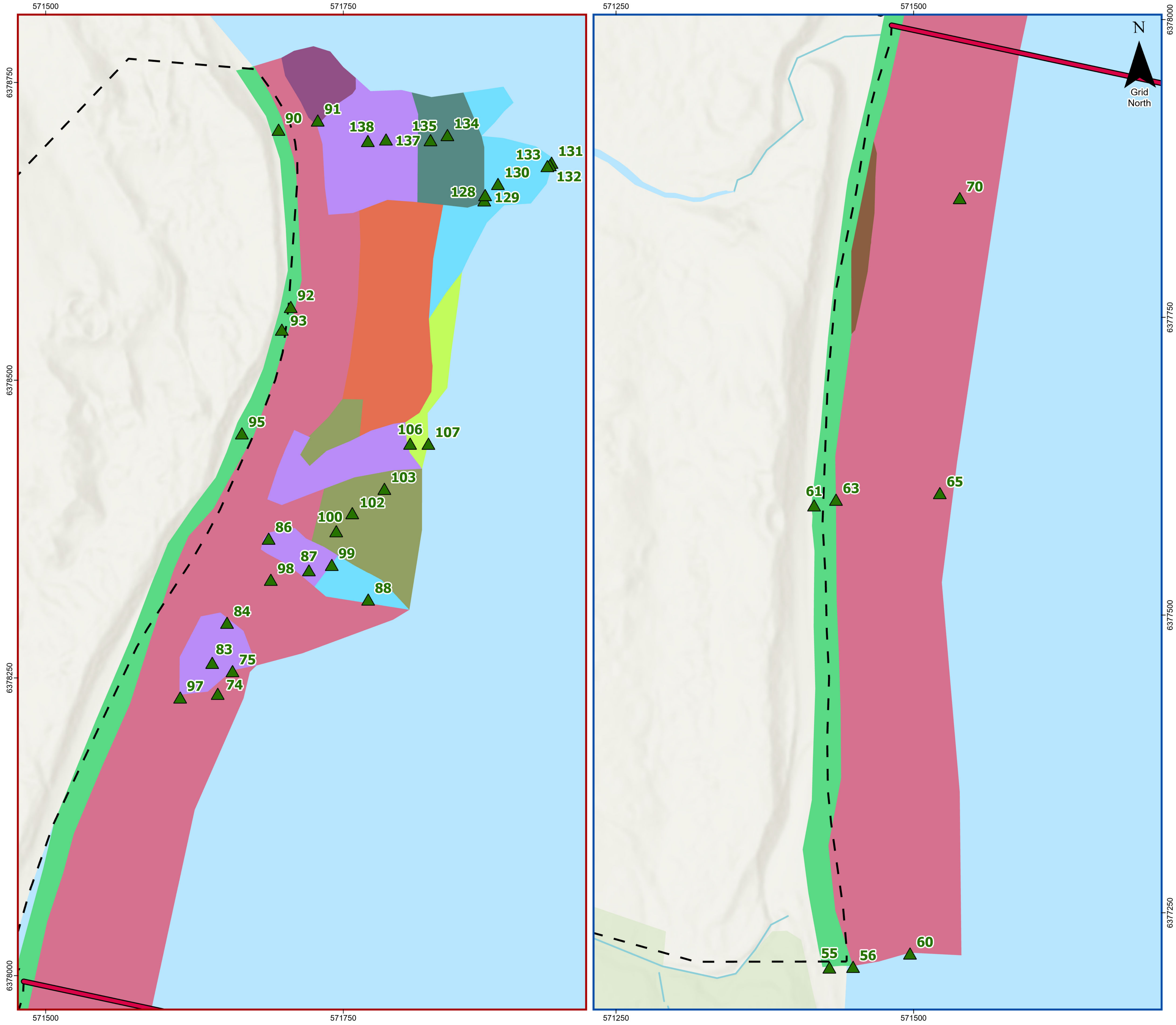
Intertidal

9.7.1.17 The intertidal area at the Landfall supports sedimentary and littoral rock habitats. A total of eight biotopes and one biotope complex were mapped. The upper shore along the whole of the Landfall comprised MA5211 'Talitrids on the upper shore and strandline' and MA5233 'Amphipods and *Scolelepis* spp. in littoral medium-fine sand', which covered the largest area of the Landfall (133,732 m²: 62%), particularly in the middle and lower shore. Just to the south of the proposed cable route there was a large shallow pool within the MA5233 biotope, high on the shore just below the strandline. The northern part of the Landfall comprised a wide variety of eulittoral rock habitats with MA521 '*Macoma balthica* and *Arenicola marina* in littoral muddy sand' located in isolated patches or in the spaces between boulders and cobbles. Of the eulittoral rock habitats, MA123H covered the largest area (16,177 m²: 8%) of the Landfall. **Table 9-12**, lists the biotopes identified within the Landfall and **Figure 9-9** shows the distribution of these biotopes.

Table 9-12 Key European Nature Information System biotopes recorded at the Landfall

EUNIS Broad Scale Habitat	EUNIS Code	Description	Area (m²)
MA12	MA123D1	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock	4,859
MA12	MA123G	*Ulva* spp. on freshwater-influenced and/or unstable upper eulittoral rock	2,490
MA12	MA123H	*Porphyra purpurea* and *Ulva* spp. on sand-scoured mid or lower eulittoral rock	16,177
MA12	MA12442	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	7,821
MA12	MA1245	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock	2,294
MA52	MA5211	Talitrids on the upper shore and strandline	26,641
MA52	MA5233	Amphipods and *Scolelepis* spp. in littoral medium-fine sand	135,329
MA52	MA5251	*Macoma balthica* and *Arenicola marina* in littoral muddy sand	8,467
MA12/MA52	MA123D1/MA5251	Mosaic of the *F. vesiculosus* and *M. balthica* biotopes	11,873



Salamander

Figure 9-9

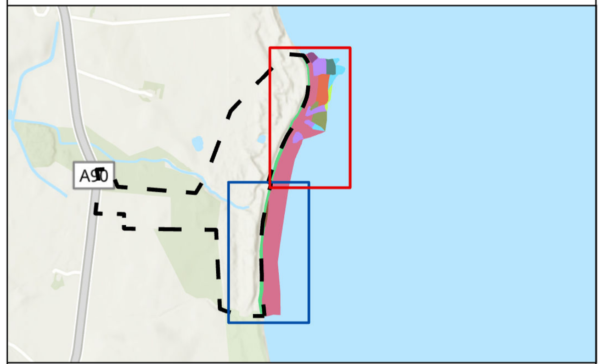
EUNIS Littoral Biotope Classification

Legend

- Landfall Area of Search
- Indicative Export Cable Route
- EBS Macrofauna Survey Location

EUNIS Biotope Code

- MA123D1
- MA123G
- MA123H
- MA12442
- MA1245
- MA5211
- MA5233
- MA5251
- MA5251/MA123D1



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Features of Conservation Interest

Annex I Reef – Stony/Bedrock

9.7.1.18 Annex I stony reef assessment, across the Offshore Array Area and Offshore ECC (>8 km), identified reef within the Offshore ECC, in areas where coarser substrata were more common.

9.7.1.19 Stony reef assessment, following criteria of Golding *et al.* (2020) and Brazier (2020), classified potential stony reef areas as 'not a stony reef' or having 'low' resemblance to being a stony reef. Where stony reefs were recorded along the same transect, they were deemed to form mosaics, and thus were difficult to differentiate with the lack of clear boundaries in the acoustic geophysical data.

9.7.1.20 In total, one transect (ECR_S47) showed evidence of stony reef located within the Offshore ECC (KP21). This site was classified as MC2211 due to the presence of boulder and cobbles and the presence of *S. spinulosa* crusts.

9.7.1.21 The Hywind Scotland sample Station S06, located approximately 0.25 km from the Nearshore ECC, was scored as having 'medium' resemblance to stony reef'.

9.7.1.22 The north Landfall survey area was characterised by eulittoral rock biotopes, which have the potential to represent Annex I geogenic reef. To classify as Annex I reef, the littoral rock must be part of a sublittoral reef that extends into the littoral zone uninterrupted (Irving, 2009). Due to the lack of nearshore data along the Nearshore ECC this area of intertidal in isolation could not be identified as Annex I reef.

Annex I Reef – Biogenic

9.7.1.23 *Sabellaria spinulosa* individuals were recorded in 10 out of the 53 grab samples with an abundance of <5 individuals per 0.1 m^2 (equivalent to <50 individuals per m^2), except for stations ECR_S40 and ECR_S41 which recorded 12 and 54 individuals per 0.1 m^2, respectively (120 individuals per m^2 and 540 individuals per m^2, respectively).

9.7.1.24 Aggregations of *S. spinulosa* were observed at 31 out of the 58 surveyed sites, with 12 sites located within the Offshore Array Area, 17 sites along the Offshore ECC and two in the wider survey area.

9.7.1.25 Imagery analysis observed *S. spinulosa* aggregations at 28 sites. Average cover was generally below 15% and this was only exceeded at 5 stations. The highest coverage was observed at Sites ECR_S47, ECR_S49 and ECR_S50 presenting average coverage of 76%, 72% and 74% respectively.

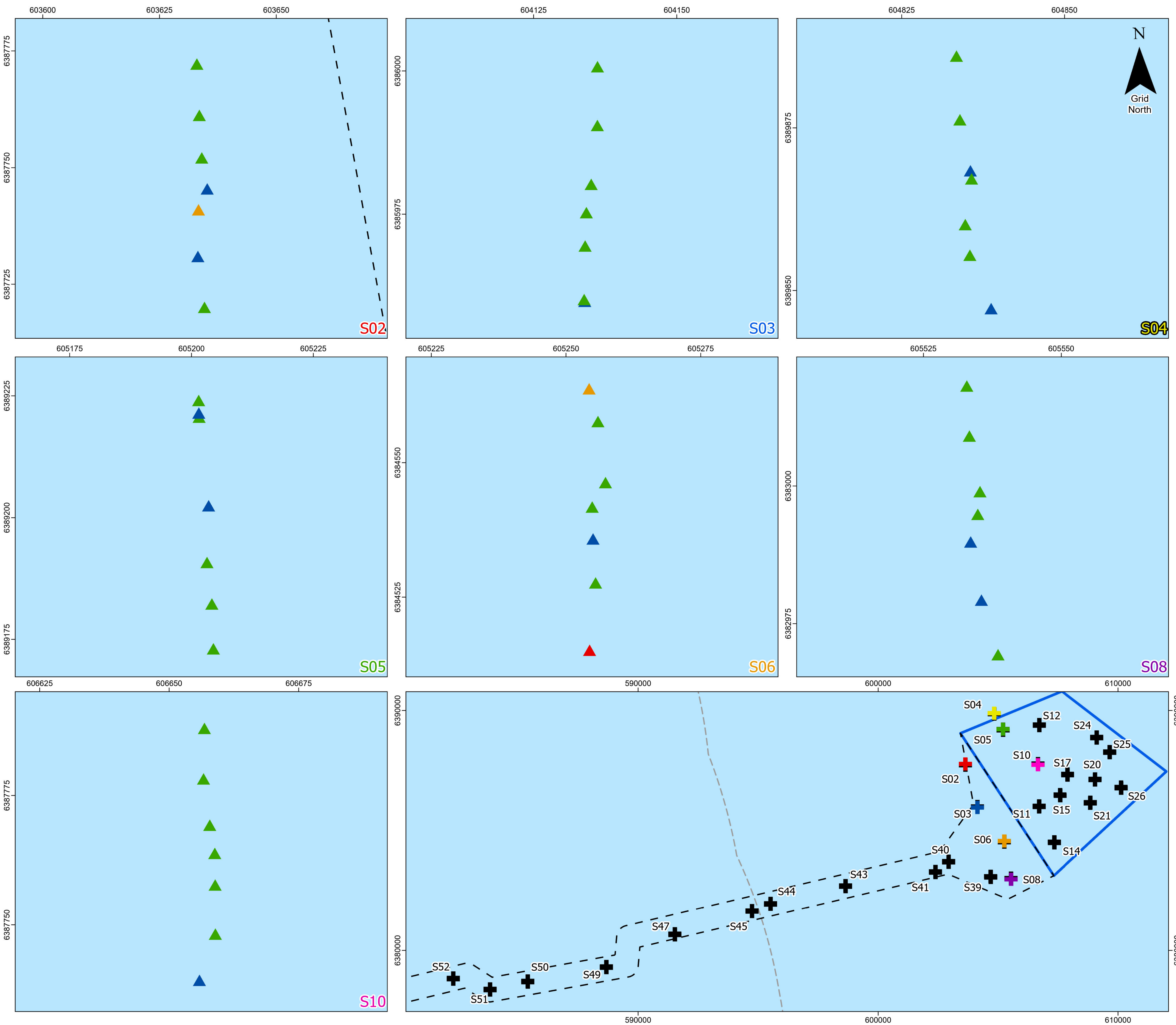
9.7.1.26 Review of the video and high-resolution acoustic data shows high patchiness of *Sabellaria* individuals, aggregations or crusts (**Graphic 9-4**).

9.7.1.27 Within the Offshore Array Area, *S. spinulosa* aggregations were seen to coincide with the bathymetric highs of the linear, north-south trending bedforms located in between the more dynamic sand wave fields.

9.7.1.28 The collective *Sabellaria* reef assessment, in accordance with Collins (2010), concluded that none of the ground-truthed sites qualified as Annex I (1170) biogenic reef mainly due to limited elevation and high patchiness detected from the video transects. **Figure 9-10** to **Figure 9-13** present *Sabellaria* reef assessments per still image, highlighting the high degree of *S. spinulosa* patchiness within the Offshore Array Area and Offshore ECC.

Graphic 9-4: Example images of *Sabellaria spinulosa* aggregations at: (TOP LEFT) WAA_S20_003; (TOP RIGHT) WAA_S06_001; (BOTTOM LEFT) WAA_S25_003); (BOTTOM RIGHT) ECR_S39_002.

9.7.1.29 Potential *S. spinulosa* biogenic reef has been located within the Near- (KP5-6) and Far-field Study Area from underwater video surveys carried out by Cefas in 2015 and the JNCC/MSS in 2017 (Moore, 2017; 2019). This includes a new subtype of *Sabellaria* morphology termed *S. spinulosa* 'bommies' identified during an Oceana research cruise in 2017 on the east coast of Scotland. These 'bommies' are topographically distinct from the surrounding sediment. While these 'bommies' are not currently of conservation importance under any legislation, Pearce and Kimber (2020) suggest that they may need a mechanism for protection to ensure that this habitat is given due consideration, and that potential conservation value is not overlooked on the basis of extent or patchiness not matching expectations from Gubbay (2007).



Salamander

Figure 9-10

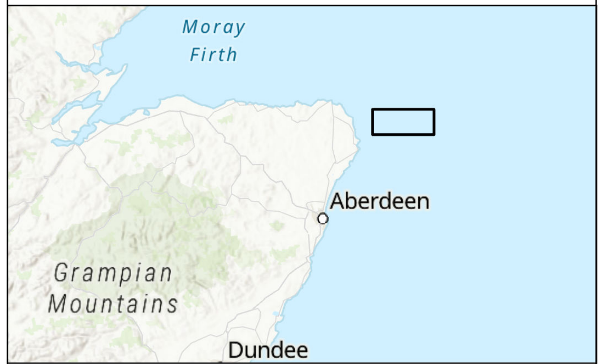
EUNIS Sabellaria Spinulosa reefiness assessment Part 1

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- 12nm limit
- Sabellaria Survey Site

Sabellaria Presence

- Medium
- Low
- No S. spinulosa
- Not a reef



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Checked by : IW
Approved by : ACV

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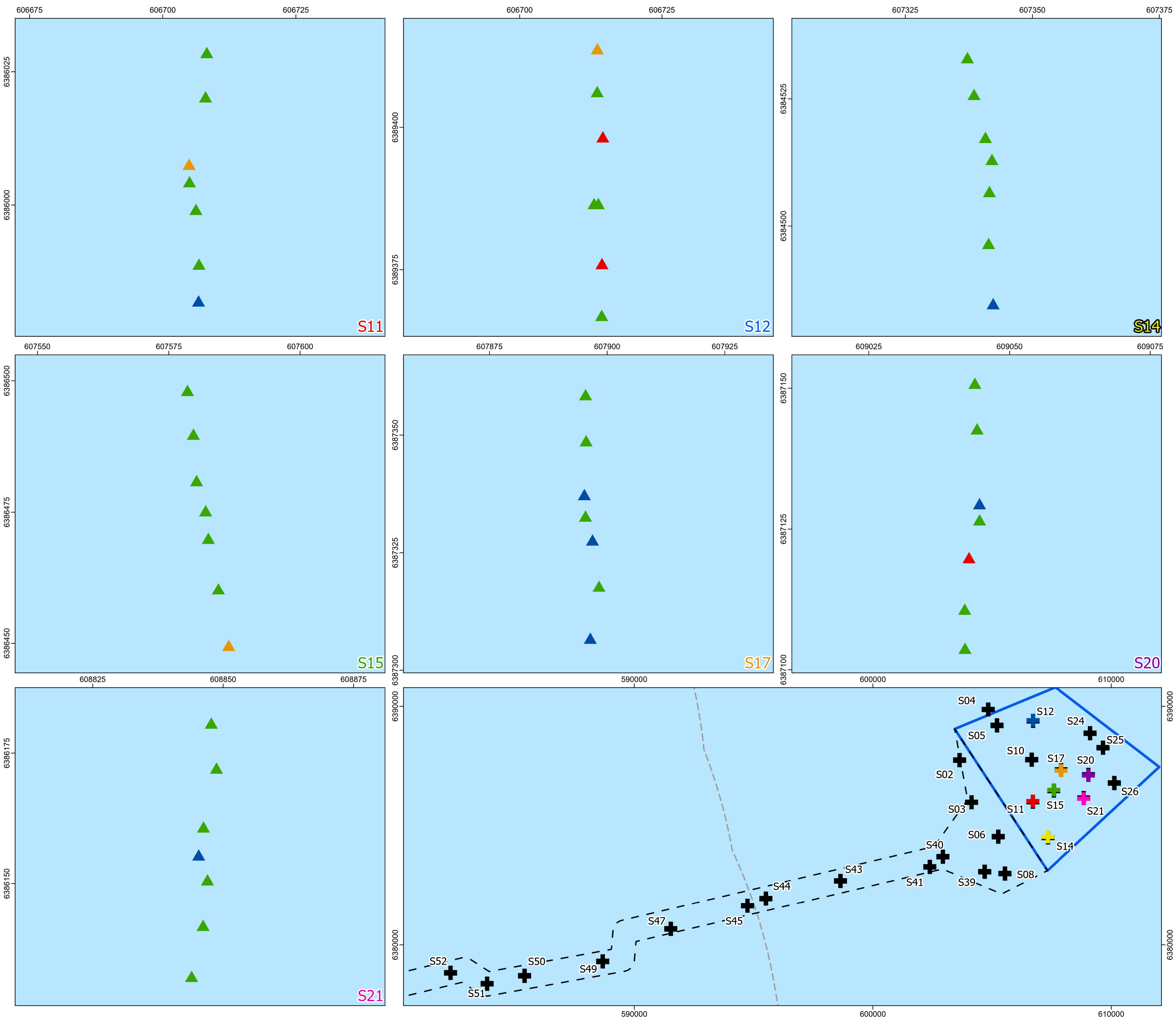
Salamander

Figure 9-11

EUNIS Sabellaria Spinulosa reefiness assessment Part 2

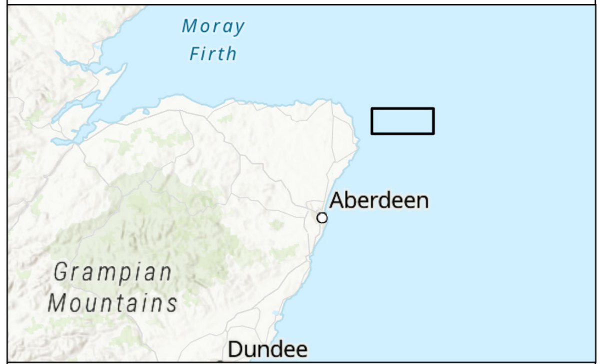


Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- 12nm limit
- Sabellaria Survey Site

Sabellaria Presence

- Medium
- Low
- No S. spinulosa
- Not a reef



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:155,000

0 0.09 0.18 Kilometers

0 0.02 0.04 0.09 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : EUNIS Sabellaria Spinulosa reefiness Part 2
Doc. No : SWF01ER0319
Created by : AN
Checked by : IW
Approved by : ACV

SALAMANDER

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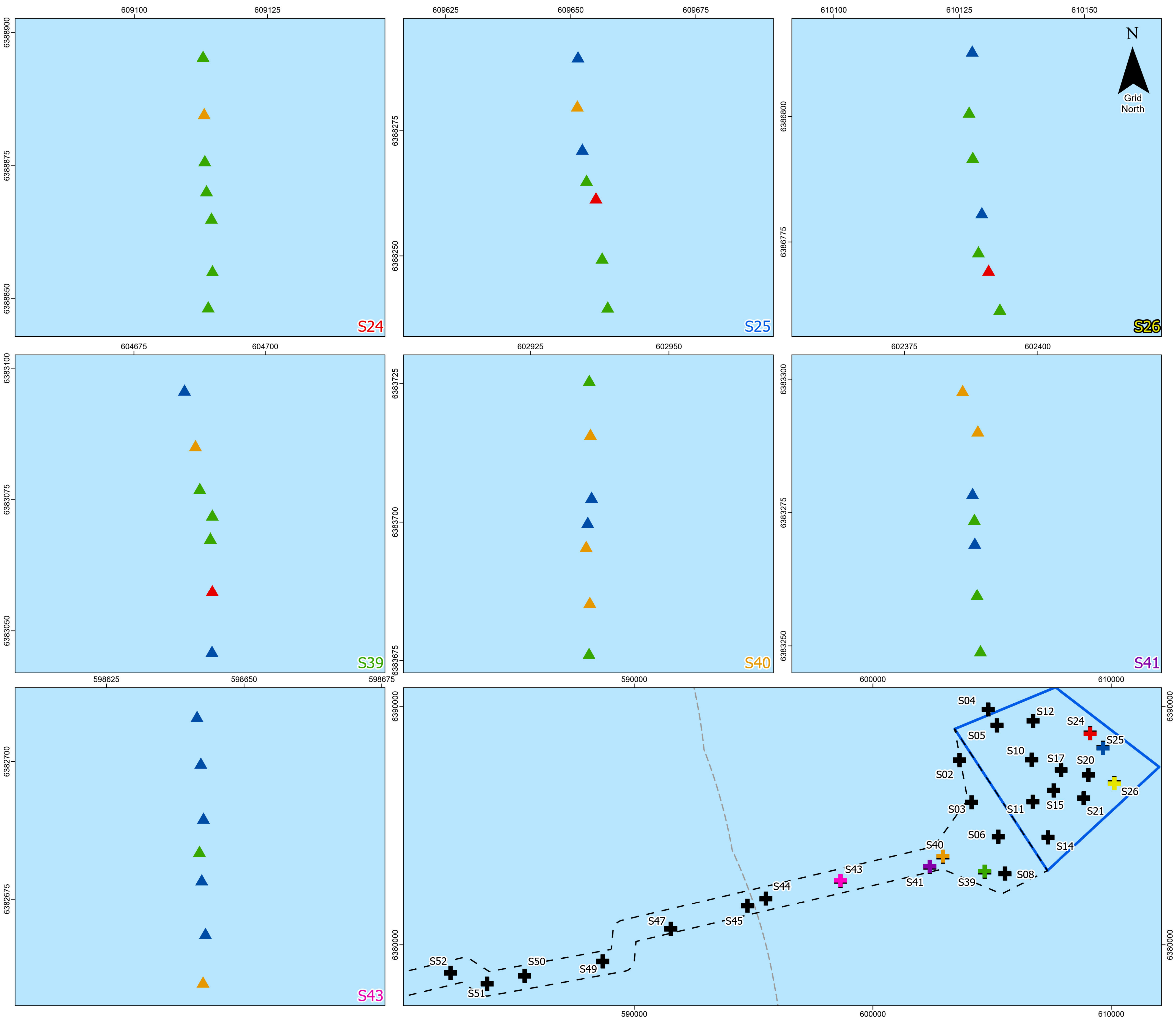
Salamander

Figure 9-12

EUNIS Sabellaria Spinulosa reefiness assessment Part 3

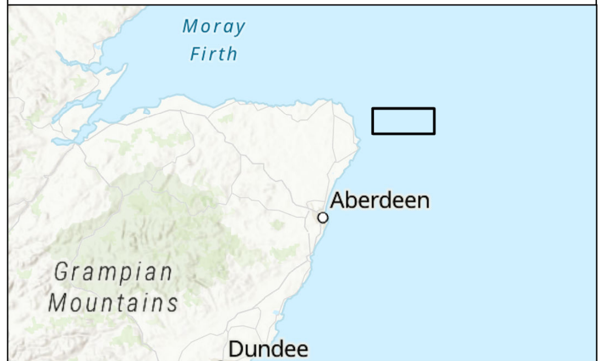


Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- 12nm limit
- Sabellaria Survey Site

Sabellaria Presence

- Medium
- Low
- No S. spinulosa
- Not a reef



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:155,000

0 0.09 0.18 Kilometers

0 0.02 0.04 0.09 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : EUNIS Sabellaria Spinulosa reefiness Part 3
Doc. No : SWF01ER0320
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Checked by : IW
Approved by : ACV

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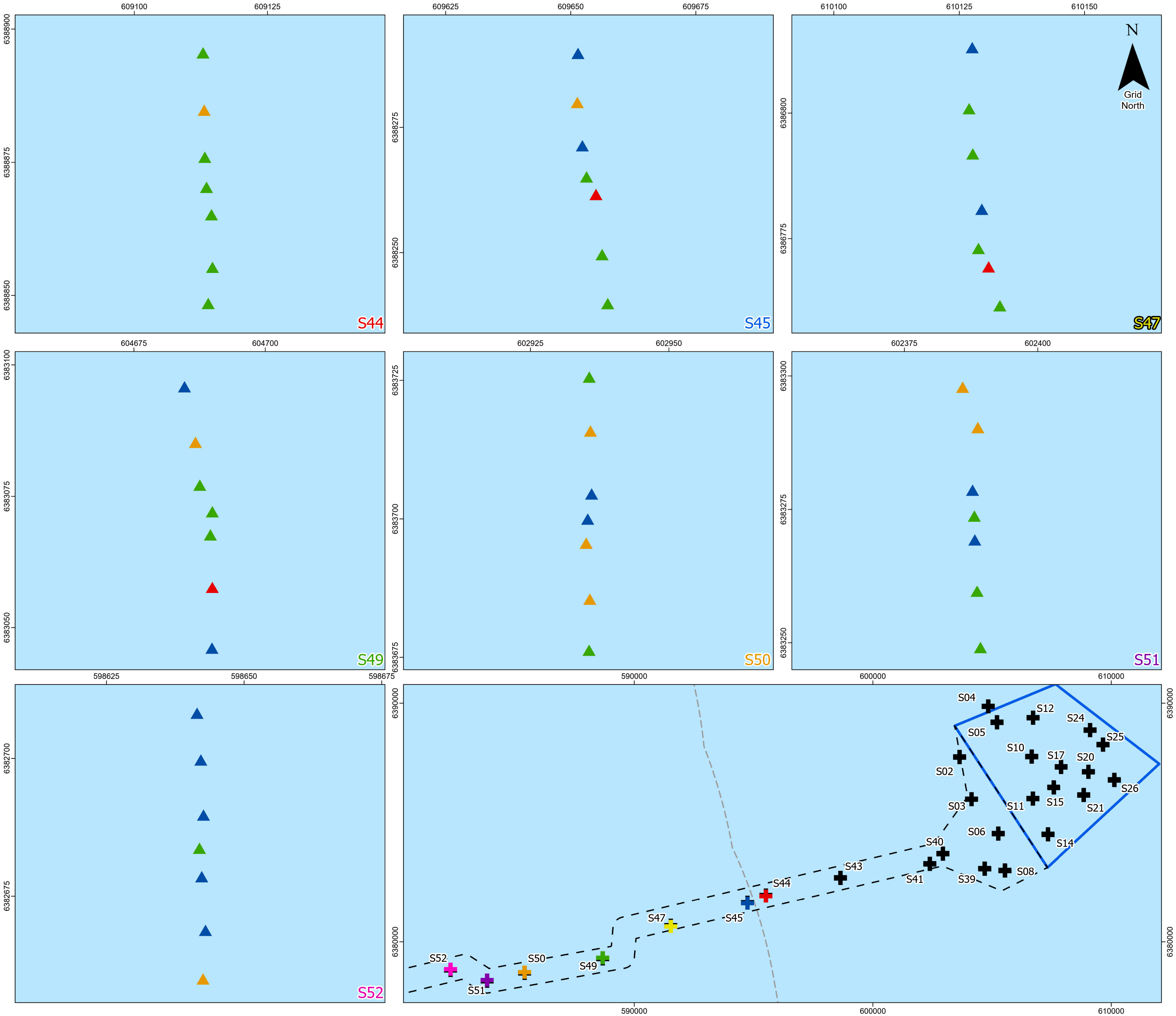


Salamander

Figure 9-13

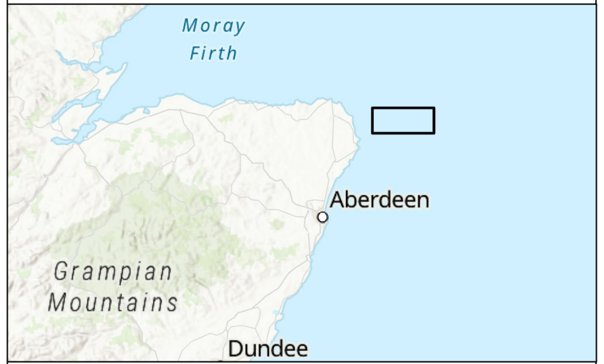
EUNIS Sabellaria Spinulosa reefiness assessment Part 4

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- 12nm limit
- Sabellaria Survey Site

Sabellaria Presence

- Medium
- Low
- No S. spinulosa
- Not a reef



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:155,000

0 0.09 0.18 Kilometers

0 0.02 0.04 0.09 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : EUNIS Sabellaria Spinulosa reefiness Part 4
Doc. No : SWF01ER0321
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Checked by : IW
Approved by : ACV

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Priority Marine Features / Oslo and Paris Convention for the Protection of the Marine Environment List of Threatened and/or Declining Species and Habitats

9.7.1.30 The distribution of habitats of conservation interest across the region is presented in **Figure 9-4**.

9.7.1.31 According with the Geodatabase of Marine features adjacent to Scotland (GeMS) the Scottish PMF habitat Offshore subtidal sands and gravels is expected to be present across the sand dominated sediments of the Offshore Array Area and Offshore ECC (The Scottish Government, 2022). This habitat extends approximately 8.7 km along the Offshore ECC and is common throughout the waters of the North Sea and is not considered unique to the area surrounding the Offshore Array Area and Offshore ECC (Tyler-Walters *et al.*, 2016) Within the Offshore Array Area and offshore areas of the Offshore ECC, the following biotopes corresponded to the PMF Offshore subtidal sands and gravels:

- MC5211 *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand
- MC5212 *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand

9.7.1.32 The following recorded biotopes along the Offshore ECC and Offshore Array Area are representative of Offshore deep sea muds PMF:

- MC62 Atlantic circalittoral mud
- MC6211 *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in Atlantic circalittoral sandy mud
- MC6212 *Thyasira* spp. and *Nuculoma tenuis* in Atlantic circalittoral sandy mud
- MC6213 *Amphiura filiformis* and *Nuculoma tenuis* in Atlantic circalittoral and offshore muddy sand

9.7.1.33 *Sabellaria spinulosa* reefs are listed under OSPAR (2008) List of Threatened and/or Declining Habitats. As per the *Sabellaria* reef assessment summarised above for Annex I biogenic reef, none of the ground-truthed sites qualify as Annex I (1170) biogenic reef mainly due to limited elevation and high patchiness.

9.7.1.34 *S. spinulosa* 'bommies' have been located near the Study Area. These 'bommies' are not currently of conservation importance under any legislation, though Pearce and Kimber (2020) suggest that they may need a mechanism for protection to ensure that this habitat is given due consideration, and that potential conservation value is not overlooked on the basis of extent or patchiness not matching expectations from Gubbay (2007).

9.7.1.35 Potential bedrock and/or stony reef features north of the Nearshore ECC are likely to comprise similar biotopes as those recorded during the Hywind Scotland cable corridor environmental survey undertaken in 2011 (MMT, 2013), and include the following:

- MB121A3 grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock;
- MB1215 *Laminaria hyperborea* with dense foliose red seaweeds on exposed Atlantic infralittoral rock;
- MB12151 *Laminaria hyperborea* forest with dense foliose red seaweeds on exposed Atlantic upper infralittoral rock;
- MB12211 Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock;
- MC12243 *Alcyonium digitatum* with *Securiflustra securifrons* tide-swept moderately wave-exposed Atlantic circalittoral rock;

- MC12241 *Flustra foliacea* on slightly scoured silty circalittoral rock;
- MC12811 *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock; and
- MC2211 *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment.

9.7.1.36 It is important to note that biotopes MB1215, MB12151 and MB121A1 are component biotopes of the Kelp beds PMF (NatureScot, 2022a) and Kelp Forests listed under OSPAR (2008) List of Threatened and/or Declining Habitats. In addition, due to the likely presence of kelp and algae communities nearshore, Kelp and Seaweed communities on sublittoral sediments and Tide-swept algal communities PMFs could occur within the Study Area.

9.7.1.37 The sea-pen *Pennatula phosphorea* was identified in the imagery across two sites located in the Offshore Array Area and at four sites in the Wider Survey Area, in areas classified as muddy Sand. However, despite the species being characteristics of the OSPAR habitat Sea-pen and burrowing megafauna communities, and PMF habitat Burrowed mud, the absence of frequent burrows and other key species (e.g. *Nephrops norvegicus*) indicate neither of the protected habitats are present.

9.7.1.38 Ocean quahog *Arctica islandica* listed under OSPAR (2008) List of Threatened and/or Declining Species and is a Scottish low or limited mobility species PMF. A total of four individuals were identified from four sites located in the Wider Survey Area, but outside the Offshore Array Area, in sediments described as muddy sand. Out of the four sites, three were located in areas characterised as MC62.

9.7.1.39 Sandeel *Ammodytes* sp. Is a taxon of commercial importance. *A. marinus* and *A. tobianus* are considered to comprise a mobile species PMF. A total of nine individuals were identified at four sites along the Offshore ECC in sediments described as gravelly Sand and slightly gravelly Sand. Impacts relating to sandeels from the Salamander Project are addressed in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**.

Invasive Non-native Species

9.7.1.40 No INNS were observed during the intertidal and subtidal ecology surveys within the Landfall survey area, Offshore ECC, Offshore Array Area and Wider Survey Area.

9.7.1.41 Although INNS were not recorded within the Offshore Development Area, there is a likelihood of INNS taxa being present in areas not directly sampled within the Landfall, Offshore ECC, and Offshore Array Area.

9.7.1.42 The orange tipped sea squirt *Corella eumyota* has been recorded in the wider region. This species was first recorded in the UK in 2004 and has since become well established. The species is found in marinas and harbours (NNSS, 2019). There are currently no known native predators of this species.

9.7.1.43 The barnacle *Austrominius modestus* has been recorded in the wider region. This species is native to Australia and was first recorded in the UK in 1946 (NNSS, 2012). Since then, this species has rapidly spread across most of the UK coastline and has become the dominant barnacle species in a number of locations around the UK (NNSS, 2012). This barnacle inhabits the intertidal zone, more commonly on the mid to lower shore, and may occur in shallow subtidal waters. The barnacle has natural predators such as worms, whelks, fish, birds, crabs and starfish. This species is more tolerant of low and fluctuating salinity than native barnacle species and is thus most likely to out compete native species in estuaries and sheltered coasts (NNSS, 2012).

Other Notable Species

9.7.1.44 A single record of the gastropod *Ceratia proxima* was recorded at one station (WAA_S13) within the Offshore Array Area. *C. proxima* is not a protected species, however it is typical of the Mediterranean. This species was first recorded in the UK in the mid-1900s, with an increase in records in the past decade (NBN, 2023a) and now is found off east Scotland.

9.7.1.45 The gastropod *Euspira fusca* was sighted at one station (WAA_S37) within the Offshore Array Area. Although this species is rarely observed in the UK, it was first recorded in the 1800s and records have increased in the last decade (NBN, 2023b). This species occurs in the Northeast Atlantic Ocean, European waters and the Mediterranean Sea.

9.7.1.46 The gastropod *Jordaniella truncatula* (formerly *Chrysallida truncatula*) was recorded at one station (ECR_S41) along the Offshore ECC. Although this species occurs in the UK, there are only four accounts presently reported in UK waters (NBN, 2023c).

Blue Carbon

9.7.1.47 Blue carbon is defined as "carbon stored in coastal and marine ecosystems" (IUCN, 2017). There are several types of blue carbon habitat in UK waters (JNCC, 2021b), ranging from kelp forests and saltmarshes, to mudflats and sandflats. At present there is no UK legislation or policy that specifically protects blue carbon habitats (Luisetti *et al.*, 2013); however, as previously noted and identified by JNCC (2021b), there is overlap between blue carbon habitats and existing Marine Protected Areas (MPAs) in the UK.

9.7.1.48 The principal threat to long term carbon storage is any process or work that disturbs the top layers of sediment (such as activities relating to the burial of subsea export cables).

9.7.1.49 Intertidal sand, subtidal sand, mud and mixed sediments are the key habitats that occur within the Near-field Study Area that support blue carbon storage and sequestration and, therefore, are also likely to be subject to temporary habitat disturbance and / or long-term habitat loss. However, these habitats are widely distributed in the wider area, and only a small area overlaps the Offshore Development Area (see **Figure 9-7** and **Figure 9-9**).

9.7.1.50 Intertidal sand has the highest average carbon storage of 6,500 ± 4,000 g m^{-2} (Parker *et al.,* 2021; Swaile *et al.,* 2022). Average carbon sequestration for subtidal sand, which is found across much of the Offshore Array Area, is low (10 g m^{-2} yr^{-1}) compared to subtidal mud (29.5 ± 29.3 g m^{-2} yr^{-1}) (Painting, 2010; Alonso *et al.,* 2012; Parker *et al.,* 2021; Swaile *et al.,* 2022). Likewise, carbon storage for subtidal mud (5,500 ± 500 g m^2) is higher than for subtidal sand (1,700 ± 100 g m^2) (Parker *et al.,* 2021; Swaile *et al.,* 2022). Lastly, average sequestration for mixed sediments (sand/mud/gravel), which is found across most of the Offshore ECC, with a rate of 7 g m^{-2} yr^{-1} (Burrows *et al*., 2014).

9.7.1.51 Other likely blue carbon habitats include kelp forests, which have potential to be present within the Near-shore Study Area. However, in comparison to subtidal sands and mud, the potential for carbon storage and carbon sequestration is much lower (665 g m^2 and 0.3 ± 0.017 g m^{-2} yr^{-1}, respectively) (Jupp and Drew, 1974; Kain, 1977; Smale *et al.,* 2016; Parker *et al.,* 2021; Swaile *et al.,* 2022).

9.7.1.52 The overall percentage carbonate in the top 10 cm of superficial sediments across the benthic ecology Study Area, interpolated from BGS sediment records, ranges from <10-20%, which is low in relative terms (NMPi, 2022). Generally, the sediments and habitats present within the Offshore Development Area only support minimal blue carbon storage or sequestration.

9.7.2 Future baseline

9.7.2.1 This section has been informed by **Volume ER.A.3, Chapter 20: Climate Change and Carbon**.

9.7.2.2 Over the operational lifetime of the Salamander Project (35 years), the baseline environment is expected to evolve without the implementation of the Salamander Project. These changes are expected to reflect existing cycles and processes, as well as the potential effects of climate change on the marine environment.

9.7.2.3 By the year 2070, UK continental shelf annual air temperatures are expected to rise by approximately 0.7°C to 4.2°C during winter, and 0.9°C to 5.4°C during summer, when compared to mean temperatures between 1981-2000 (Lowe *et al.,* 2018). Modelling sea surface temperature (SST) has shown that the rate of temperature increase over 30 years (1988-2017) in the UK has been greater in northern Scotland and the North Sea, where the Salamander Project is located. Future projections for SST report that increases by 2100 will vary, ranging from 1°C to 4°C (Cornes *et al.,* 2023; Tinker and Howes, 2020).

9.7.2.4 Warming of near-bottom temperatures are expected to be greatest across the North Sea compared to other UK regions overall. End of the century, long term climate projections for near-bottom, mean seabed temperatures, that go beyond the operational lifetime of Salamander Project, are predicted to increase by 2.84°C in the Central North Sea. This is based on temperature discrepancies between 2000 to 2019, projected for the period 2079 to 2098 (Cornes *et al.,* 2023). In addition, the timing of the onset and subsequent breakdown of thermal stratification within the water column across the UK Continental Shelf, may occur earlier and later in a year, respectively. This can affect seabed temperatures, dissolved oxygen concentrations, nutrient exchange, and productivity (Sharples *et al.,* 2020).

9.7.2.5 A strong evidence base indicates that long-term changes in the climate or in nutrients may relate to the observed changes in benthic ecology (OESEA3, 2016), with climatic processes driving shifts in abundances and species composition, as well as ecological functioning of the sedimentary communities (Weinhert *et al.,* 2022; Marine Climate Change Impacts Partnership (MCCIP), 2015). Over the last three decades, benthic ecology studies have shown that biomass has increased by at least 250 to 400%, opportunistic and short-lived species have increased, and the abundance of long-living sessile animals has decreased (Kröncke 1995; Kröncke 2011). Benthic infauna are important ecosystem engineers, through their bioturbation and feeding behaviour in soft sediments. Recent research has demonstrated that under future scenarios (bottom temperature increases of between 0.15 and 5.4°C), that the overall bioturbation potential of selected North Sea species would be relatively stable (to year 2099). This was linked to the potential high functional redundancy in the North Sea, where the relative potential of each species would change from migrations, and expansion of some species in to, and from an area, but with no overall change in activities (Weinhert *et al.,* 2022).

9.7.2.6 Observed impacts of climate change over 40 years on shallow and shelf habitats, includes shifts in the distribution of North Sea infaunal species in response to changing sea temperature (Moore and Smale, 2022). In addition, several UK kelp species have experienced changes in abundance linked to altered sea surface temperature. In particular the warm-water species *Laminaria ochroleuca* has increased in abundance and expanded its distribution into more wave-exposed conditions (Smale, 2020).

9.7.2.7 A number of studies have used modelling approaches to predict changes in the distribution and/or abundance of kelp at the UK scale, and benthic infauna and epifauna within the North Sea. All models suggest significant shifts in species into the future leading to altered community structures (Moore and Smale, 2020). For example, a large reduction in the kelp *Laminaria digitata* across much of southern and central England and Wales has been predicted by 2050 (Raybaud *et al*., 2013). It is likely that Scottish populations of *L. digitata* will also have experienced a reduction in abundance, where northern latitude populations can be less resilient to heat (Liesner *et al.,* 2020). However, this species is likely to persist in Scotland beyond the end of the century (Raybaud *et al*., 2013).

9.7.2.8 There currently lacks a marked observed response in intertidal species to climate change. SST around Scotland tend to be higher on the west coast than the east. Distributions of rocky coastal species follow this pattern, with warm water species near their limits being restricted to the west coast. For example, the warm-water barnacles (*Chthamalus stellatus* and *Chthamalus montagui*), and the purple topshell (*Steromphala umbilicalis*) reach their northern and eastern limits on the Caithness coast, and in Shetland and Orkney, with occasional individuals found beyond these limits. Between the 1980s and 2000s the purple topshell extended its range about 50 km eastwards along the north coast (Mieszkowska *et al*., 2006) but further surveys in the 2010s showed only increases in abundance at range-edge sites rather than true extensions. Similarly, the abundance of warm-water barnacles has generally increased towards the edge of their ranges but have not noticeably extended their distributions.

9.7.2.9 INNS are appearing on Scotland's coasts, with many of these being warm-water biofouling species and it is predicted that SST rises due to climate change, will result in more INNS's becoming established in the future (review by Nall*et al.,* 2015). For non-natives such as the Pacific oyster (*Magallena gigas*) cooler summer temperature (<14°C) may have limited the expansion of their distribution, but as sea temperatures rise, it is likely to enhance their spread.

9.7.2.10 Numerical models on future climate impacts on estuarine habitats indicate that increasing temperature and atmospheric CO_2 reduce nutrient levels and have a negative effect on marine invertebrate biodiversity.

9.7.2.11 Sea level rise may increase the magnitude of erosive processes and lead to the accelerated erosion of intertidal and coastal habitats. Sites which are presently accreting due to an abundant supply of sediment are more likely to survive relatively unchanged than sites where there is a limited supply of new material.

9.7.3 Summary of Baseline Environment

9.7.3.1 The Benthic and Intertidal Ecology Study Area is characterised by subtidal sands offshore with areas of low elevation encrusting *S. spinulosa* aggregations. Moving toward the coast, more mosaics of habitats are expected to occur, including a combination of sedimentary and rock habitats.

9.7.3.2 Following the review of the baseline information for the Salamander Project, several key sensitivities have been identified that require specific consideration within the Impact Assessment in **Section 9.11: Impact Assessment**. These include:

- Annex I stony reef was recorded at one location along the Offshore ECC. Nearby surveys also recorded the presence of Annex I stony and bedrock reef (MMT, 2013) and as such are expected to occur along the Nearshore ECC.
- Observation of kelp from the Landfall and presence of kelp biotopes from nearby surveys suggests the potential presence of Kelp beds, Kelp and seaweed communities and Tide-swept algal communities PMFs.
- *S. spinulosa* low crusts have been recorded from the site-specific subtidal survey and other surveys in the wider region. *Sabellaria* 'bommies' too have been recorded in the wider region.
- Although only 4 individuals of ocean quahog were identified from the site-specific survey, this species is listed under OSPAR (2008) List of Threatened and/or Declining Species and is a Scottish low or limited mobility species PMF.
- INNS were not recorded during site-specific surveys, however, there is potential for INNS taxa to be present in areas not directly sampled.

9.8 Limitations and Assumptions

9.8.1.1 The following limitations and assumptions have been identified for the Benthic and Intertidal Ecology:

9.8.1.2 It is acknowledged that existing benthic ecology baseline could change, occurring because of environmental changes, seasonal expectations changing (mild winters; storm events), and over the long term (climatic changes; change in land/sea use). Such events may cause changes in the local and wider benthic community, e.g. localised changes in sediment distribution, poor recruitment periods and subsequent population crashes; and spread of climate change sensitive species and INNS species.

9.8.1.3 Every effort has been made to ensure a wide range of literature has been reviewed to support this assessment, however, the data used will only provide a representation of benthic ecology as it was, at the time of collection.

9.8.1.4 Although classification of benthic habitats from survey data is useful, there are limitations in assuming fixed limits. The boundaries of where one biotope ends and another starts cannot often be defined. There are also difficulties in defining the precise extent of each biotope. The biotope maps presented herein present useful characterisation of the benthic and intertidal environment, however, they should not be considered as definitive.

9.8.1.5 The Salamander Project has been unable to acquire project specific, or secondary survey data, within the nearshore ~8 km area of the Offshore ECC (referred to as Nearshore ECC), ahead of EIAR submission. This current 'un-surveyed area' covers the area from the MLWS at the Landfall location, through to the 1°40 line approximately 8 km east. The rest of the Offshore ECC from the 1°40 line to the Offshore Array Area (and the Offshore Array Area itself) has been surveyed.

9.8.1.6 The impact assessment methodology for Benthic and Intertidal Ecology will follow the approach outlined in **Section 9.10: Assessment Methodology**. In addition, presented below is the approach cognisant of the current absence of site-specific data within the Nearshore ECC (<8 km), and is summarised below.

9.8.1.7 Through a review of both the site-specific survey data currently available at the Landfall and between 1°40 line to the Offshore Array Area, secondary survey data, and predictive spatial seabed habitat mapping information (EUSeaMap), a list of expected biotopes and features of conservation importance (e.g. Annex I and PMFs) have been identified and presented in **Table 9-10**.

9.8.1.8 Due to the lack of site-specific information on both the quality and extent of receptors representing habitats (or species) of conservation importance within the Nearshore ECC, a scenario-based approach will be implemented for this stretch of the ECC only, for expected impact pathways. This scenario approach will consider both a reasonably likely, but still precautionary, scenario, and then a realistic worst-case scenario; with higher levels of precaution. Following submission of the EIAR, data will be collected over the Nearshore ECC in order to validate the scenario based approach. Given this approach it is considered that assessment is robust, despite the lack of site-specific information between the Landfall location and the 1°40 line. These scenarios have been presented to the Marine Directorate and NatureScot during a post-scoping consultation meeting (see **Table 9-2**) and are as follow:

- **Scenario 1 ('reasonably likely')**: The first scenario will reflect the currently available data:
  - Low reefiness of Annex I geogenic stony reef in the Nearshore ECC;
  - Low elevation encrusting *Sabellaria spinulosa* biotope(s) in the Nearshore ECC; and
  - Algal PMF presence – Kelp beds, Kelp and seaweed communities on sublittoral sediment, and Tide-swept algal communities PMFs in the Nearshore ECC.

- **Scenario 2 ('realistic worst-case')**: The second scenario will be more precautionary and will assume the following:
    - Medium reefiness Annex I geogenic stony reef in the Nearshore ECC;
    - *Sabellaria spinulosa* low crusts and *Sabellaria* 'bommies' in the Nearshore ECC;
    - Larger coverage of algal PMFs – Kelp beds, Kelp and seaweed communities on sublittoral sediment, and Tide-swept algal communities PMFs in the Nearshore ECC; and
    - Small presence of PMF Ocean quahog *A. islandica* in the Nearshore ECC.

9.8.2 Impacts scoped out of the Environmental Impact Assessment Report

9.8.2.1 The Benthic and Intertidal Ecology assessment covers all potential impacts identified during scoping, as well as any further potential impacts that have been highlighted as the EIA has progressed as outlined in **Section 9.11**.

9.8.2.2 However, following consideration of the baseline environment, the project description outlined in **Volume ER.A.2, Chapter 4: Project Description** and in line with the Scoping Opinion a number of impacts are not considered in detail within this EIAR, as illustrated in **Table 9-13**.

Table 9-13 Impacts scoped out of the Benthic and Intertidal Ecology assessment

Potential Impact	Project Aspect	Project Phase	Justification
Impacts to habitats or species as a result of pollution or accidental discharge	Offshore Array Area and Offshore ECC	Construction and Decommissioning	Accidental release of oil and fluid emissions from Project vessels. The magnitude of an accidental spill incident from Project vessels is limited by the size of chemical or oil inventory on such vessels. Embedded mitigation measures will be adopted to ensure that the potential for accidental release of pollutants is limited, including strict controls on vessel activities and procedures. For these reasons, the impacts of pollution or accidental discharge to the benthic ecology has been scoped out.
Increase in SSC and associated deposition	Offshore Array Area and Offshore ECC	Operation and Maintenance	There is the potential for operation and maintenance activities to result in increased SSC which may result in indirect impacts on benthic communities. The nature of works associated with operation and maintenance activities and the discrete areas within which these activities will be undertaken, will result in a significantly lower magnitude than that associated with construction activities. For this reason, this impact has been scoped out for further assessment within the EIAR.
Disturbance of contaminated sediments	Offshore Array Area and Offshore ECC	Operation and Maintenance	The nature of works associated with operation and maintenance activities and the discrete areas within which these activities will be undertaken, will result in significantly lower areas of disturbed sediments. In order to minimise risk, the potential for disturbance of contaminated sediment will be controlled by implementation of an appropriate project Operational Environmental Management Plan (OEMP), Marine Pollution Contingency Plan (MPCP) and Decommissioning Programme.

9.8.3 Embedded Mitigation

9.8.3.1 The embedded mitigation relevant to the Benthic and Intertidal Ecology assessment is presented in **Table 9-14**.

Table 9-14 Embedded Mitigation for the Benthic and Intertidal Ecology assessment

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Primary				
Long-term habitat loss Temporary habitat loss and disturbance	Co14	Avoidance of sensitive features during cable routing wherever practicable. Cables will be buried as the primary cable protection method, however other cable protection methods will be used where adequate burial cannot be achieved. A Cable Burial Risk Assessment (CBRA) will be completed to determine suitable cable protection measures and will be implemented within relevant Project plans.	OAA and Offshore ECC	Construction and Operation and Maintenance
Increase risk of introduction and spread INNS	Co13	The substructures will be designed to withstand a certain level of marine growth; however, to manage weight / drag-induced fatigue, growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools if substantial accumulation is in excess of design limits is in evidence.	OAA and Offshore ECC	Operation and Maintenance
Increase risk of introduction and spread INNS	Co44	Mooring lines and floating dynamic Inter-array Cables will be inspected according to the maintenance plan to confirm the structural integrity of the cable systems using a risk-based adaptive management approach. During these inspections, the presence of marine debris and occurrence of discarded fishing gear will be evaluated and appropriate actions to remove will be taken if deemed necessary to reduce the risk of establishment of INNS.	OAA and Offshore ECC	Operation and Maintenance
Impacts to habitats or species from temporary habitat loss and physical disturbance of the seabed, pollution or accidental discharge, and accidental release of INNS.	Co48	The installation of the submarine cables at landfall will be carried out using trenchless methods, being the entry pit at the Transition Joint Bay location and the exit pit no closer than 200 m below the Mean High Water Springs (MHWS).	Offshore ECC	Construction

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Tertiary				
Long-term habitat loss Temporary habitat loss and disturbance	Co12	Reducing Localised Habitat Loss. Best practice will be followed to ensure that potential habitat loss is minimised throughout the proposed works (e.g. micrositing and minimising the benthic footprint of the Offshore Development).	OAA and Offshore ECC	Construction and Operation and Maintenance
Impacts to habitats or species from temporary habitat loss and physical disturbance of the seabed, pollution or accidental discharge, and accidental release of INNS.	Co28	A Decommissioning Programme will be developed and adhered to for the decommissioning phase of the Salamander Project, however the plan will be further developed and updated to reflect best practice at the time of decommissioning.	OAA and Offshore ECC	Decommissioning
Impact to habitats or species as a result of pollution or accidental discharge	Co9	Construction Environmental Management Plan (CEMP) will be developed and will include details of: - A Marine Pollution Contingency Plan (MPCP) to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; - A chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; - A biosecurity plan (offshore) detailing how the risk of introduction and spread of invasive non-native species will be minimised; - Waste management and disposal arrangements; and - Protocol for management of Dropped Objects.	Offshore Array Area and Offshore ECC	Construction

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Impact to habitats or species as a result of pollution or accidental discharge	Co10	Operational Environmental Management Plan (OEMP) will be developed and will include details of: - A Marine Pollution Contingency Plan (MPCP) to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; and - Waste management and protection of the marine environment.	OAA and Offshore ECC	Operation and Maintenance
Increased risk of introduction and spread of INNS	Co7	Adherence with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention).	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning
Increased risk of introduction and spread of INNS	Co8	An Appropriate Code of Construction Practice (CoCP) will be developed and adhered to.	OAA and Offshore ECC	Construction

9.9 Project Design Envelope Parameters

9.9.1.1 Given that the realistic worst-case scenario is based on the design option (or combination of options) that represents the greatest potential for change, as set out in **Volume ER.A.2, Chapter 4: Project Description**, confidence can be provided that development of any alternative options within the Project Design Envelope parameters will give rise to no effects greater or worse than those assessed in this impact assessment. The Project Design Envelope parameters relevant to the Benthic and Intertidal Ecology assessment are outlined in **Table 9-15**.

Table 9-15 Design Envelope parameters for Benthic and Intertidal Ecology

Potential Impact and Effect	Project Design Envelope parameters
Construction	
Temporary habitat loss or disturbance	**Vessels and mobile equipment (244,440 m²)** • Total area of seabed disturbance from vessel anchors: 242,400 m² • Total area of seabed disturbance from Jack-up events: 2,040 m² **Within Offshore Array Area (1,532,900 m²)** • Total area of seabed disturbance during installation of cables: 1,400,000 m² • Total area of seabed disturbance during installation of anchors: 125,900 m² (for gravity base anchors) • Total area of seabed disturbance during installation of subsea hubs: 7,000 m² **Export Cable Corridor (3,400,000 m²)** • Dimensions: 85 km length at 40 m width • Total area of seabed disturbance during installation of cables: 3,400,000 m² **Landfall (1,000 m²)** • Duration of Landfall works: ≤8 months • Total area of exit pits: 1,000 m² **Total area of temporary habitat loss or disturbance: 5,178,340 m² (5.2 km²)**
Increase in suspended sediment concentrations and associated deposition	**Drilling for anchor installation** • Maximum number of pile anchors: 56 • Maximum number of Subsea Hub piles: 24 • Maximum dimensions of drilled pile anchor section: 3.0 m diameter, 70 m max penetration depth • Maximum dimensions of drilled Subsea Hub pile section: 1.5 m diameter, 30 m max penetration depth • Maximum volume of material per anchor pile: 495 m³ • Maximum volume of material per Subsea Hub pile: 53 m³

Potential Impact and Effect	Project Design Envelope parameters
	• Maximum volume of material all piles: 28,356 m^3 **Inter-array cable installation** • Maximum total length of cable trenches: <35 km • Typical trench dimensions: 7.5 m wide (at seabed); 2 m deep; 'V' shape profile. • Excavation method: Jetting, Vertical Injection, Mass Flow Excavation, Ploughing / Pre-Ploughing, Trenching / Pre-Trenching (incl. dredging, cutting) (with or without backfill). **Offshore export cable installation** • Maximum number of trenches: two • Maximum total length of trench: ≤85 km (i.e. up to 2 x 42.5 km trench) • Typical trench dimensions: 7.5 m wide (at seabed); 2 m deep; 'V' shape profile • Excavation method: as above for inter-array **Seabed levelling associated with anchor installation** • Maximum spoil volume: 48,600 m^3 (for gravity base anchors) **Sandwave levelling (within Offshore Array Area)** • Localised sandwave height: 2 m • Maximum volume of material that will be subject to levelling / temporary removal for offshore inter-array cables: Total = 1,624,000 m^3. • Levelling method: Trailing Suction Hopper Dredger (TSHD) or Mass Flow Excavator (MFE). **Sandwave levelling (within Offshore Export Cable Corridor)** • Localised sandwave height: 4 to 5 m • Maximum volume of material that will be subject to levelling / temporary removal: Total = 5,576,000 m^3 • Levelling method: TSHD or MFE
Increased risk of introduction and spread of INNS	**Number of vessel trips (660 return trips):** • Jack-Up Vessels: 2 • Heavy Lift Crane Vessels: 21 • Cable Laying Vessels: 14 • Cable Burial / Jonting Vessels: 14 • Shallow Water Cable Barge: 2 • Anchor Handling Vessels: 161 • Offshore Construction Vessels: 14 • Support Vessels: 238

Potential Impact and Effect	**Project Design Envelope parameters**
	• Crew Transfer Vessels: 194
Disturbance of contaminated sediments	As per parameters for temporary habitat disturbance **Total Area of Temporary Habitat Disturbance: 5,171,340 m² (5.2 km²)**
Operation and Maintenance (O&M)	
Long-term loss to benthic habitats and species	Maximum operational period: 35 years **Offshore Array Area (385,540 m²)** • Total seabed footprint of anchors after installation: 8,100 m² (for gravity base anchors) • Total seabed footprint of scour protection (anchor): 117,800 m² (for gravity base anchors) • Total seabed footprint of dynamic cable tether anchors: 22,400 m² • Total area of new scour protection for mooring and anchor replacement: 84,200 m² • Total seabed footprint of cable stabilisation protection: 70,000 m² • Total area of new cable stabilisation protection for cable repair and replacement: 12,000 m² • Total seabed footprint of scour protection (cable jointing): 64,000 m² • Total seabed footprint of subsea hubs: 450 m² • Total seabed footprint of scour protection material for subsea hubs: 6550 m² • Total seabed footprint of wave buoy anchor: 40 m² **Export Cable Corridor (368,160 m²)** • Total area of cable stabilisation protection: 170,000 m² • Total area of new cable stabilisation protection for cable repair and replacement: 24,000 m² • Total area of scour protection on seabed (cable jointing): 16,000 m² • Total area of cable crossing protection material on seabed: 158,160 m² **Total area of long-term loss to benthic habitats and species: 753,700 m² (0.75 km²)**
Temporary habitat loss or disturbance	Maximum operational period: 35 years **Short-term temporary (1,574,800 m²)** • Subsea cable repair and replacement events: 14 • Length of subsea cable reburial: 7,400 m (7.4 km)

Potential Impact and Effect	Project Design Envelope parameters
	• Total area of seabed impacted by cable repair and reburial: 1,468,000 m² (1.5 km²) • Total area of seabed impact from anchor and mooring replacement: 90,000 m² • Total area of seabed impact from vessel anchors during operations: 16,800 m² **Long-term temporary (4,620,000 m²)** • Total swept area of seabed by mooring lines: 3,920,000 m² (3.9 km²) • Total swept area of seabed by dynamic-cable ends: 700,000 m² **Total area of temporary habitats loss or disturbance: 6,194,800 m² (6.2 km²)**
Increased risk of introduction and spread of INNS	**Number of vessel trips (210 return trips)** • Total annual service operation vessel (SOV) / crew transfer vessel (CTV) trips: 190 • Total annual heavy lift vessel trips (in-field maintenance): 3 • Total annual towing spread trips (tow-to-port maintenance): 5 • Total annual anchor handling vessel trips: 12 **Surface Area** *Offshore Array Area (2,296,731 m²)* • Number of turbines: 7 • **Surface area of semi-submersible/tension-leg platform: 249,375 m²** • Mooring lines per turbine: 8 • Mooring line length: 1,650 m • Mooring line diameter: 300 mm • Mooring clump (per mooring line) = 10 • Dimension of mooring clump 2.5 m x 2.5 m x 2.5 m • **Total mooring line surface area (assuming chain; excluding clumps): 678,693 m²** • **Total mooring line clump surface area: 21,000m²** • **Total new mooring line (with clumps) surface area (assuming chain): 755,319 m²** • Total length of cable suspended in water column without buoyancy modules: 2,100 m • Total length of cable with buoyancy modules in water column: 1,400 m • Cable diameter: 320 mm • Outer diameter of buoyancy module section: 1.5 m • **Total surface area of cable without buoyancy modules in water column: 2,111 m²** • **Total surface area of cable with buoyancy modules in water column: 6,601 m²**

Potential Impact and Effect	Project Design Envelope parameters
	• Number of cable tether lines per dynamic cable end: 4 • Cable tether line length: 100m • Cable tether line diameter: 1000mm • **Total surface area of cable tether line: 44,344 m²** • Cable tether anchor dimensions: 20 m x 20 m x10 m • **Total surface area of cable tether anchor: 67,200 m²** • Cable stabilisation protection methods: rock placement, concrete mattress, grout/rock bag, Frond mattress • Total length of cable stabilisation protection: 7 km • Width of cable stabilisation protection: 10 m • Height of cable stabilisation protection 1.5 m • **Total surface area of cable stabilisation protection: 73,408 m²** • Total area of new cable stabilisation protection for cable repair and replacement: 12,000 m² • **Total surface area of new cable stabilisation protection: 12,660 m²** • Total number of cable joints: 16 • Total area of scour protection on seabed for cable jointing: 64,000 m² • Height of scour protection: 2 m • **Total surface area of scour protection for cable jointing: 67,520 m²** • Number of anchors per turbine: 8 • Anchor diameter (gravity based): 13.5 • Anchor height above seabed (after installation): 5 m • **Total surface area of mooring anchors: 15,141 m²** • **Total surface area of new mooring anchors: 10,815 m²** • Height of scour protection for anchors: 2 m • Total area of scour protection for anchors: 117,800 m² • Total area of new scour protection for anchors:84,200 m² • Mooring line and anchor replacement events: 40 • **Total surface area of scour protection around mooring anchors: 136,697 m²** • **Total surface area of new scour protection around anchors: 97,641 m²** • Number of Subsea Hubs: 2 • Dimensions of Subsea Hub: 15 x 15 x 10 m • **Total surface of Subsea Hub: 4,000 m²** • Total area of scour protection around Subsea Hubs: 6,500 m² • Height of scour protection: 2 m • **Total surface area of Subsea Hub scour protection material (piles and cables): 53,989 m²**

Potential Impact and Effect	Project Design Envelope parameters
	• **Total surface area of wave buoy: 85 m²** • **Total surface area of wave buoy anchor: unknown[6]** • **Total surface area of wave buoy tether: 132 m²** *Export Cable Corridor (428,160 m²)* • Cable stabilisation protection methods: rock placement, concrete mattress, grout/rock Bag, Frond Mattress • Total length of cable stabilisation protection: 17 km • Width of cable stabilisation protection: 10 m • Height of cable stabilisation protection 1.5 m **Total surface area of cable stabilisation protection: 178,160 m²** **Total surface area of new cable stabilisation protection: 25,320 m²** • Total number of crossings of 3rd party infrastructure: 24 • Height of cable crossing berm: 2 m • Diameter of cable crossing pre-lay cable protection; 20 m • Length of cable crossing post-lay cable stabilisation protection: 800 m • **Total surface area of cable crossing protection material on seabed: 207,800 m²** • **Total surface area of cable jointing scour protection: 16,880 m²** **Total surface area associated with the offshore infrastructure: 2,724,891 m² (2.7 km²)**
Impact to habitats or species as a result of pollution or accidental discharge	Maximum operational period: 35 years **Oil/chemical inventories (per turbine):** • Grease: 1,300 l • Hydraulic oil: 20,000 l • Gear oil: 2,000 l • Silicon/Ester oil: 7,000 l • Diesel fuel: 2,000 l • Nitrogen: 80,000 l • Glycol/Coolants: 13,000 l **Total oil/chemical across Offshore Array Area: 877,100 l** **Number of vessel and helicopter trips (350 return trips):** • Total annual support vessels or crew transfer vessels (CTV) trips: 190 • Total annual heavy lift vessel trips (in-field maintenance): 3

[6] The anchor is made of scrap anchor chain that are sewed together to a bundle and for that it is not possible to give an exact dimension. Overall surface area will be a minor fraction of the total surface area.

Potential Impact and Effect	Project Design Envelope parameters
	• Total annual towing spread trips (tow-to-port maintenance): 5 • Total annual anchor handling vessel trips: 12 • Total annual helicopter transfers: 140
Hydrodynamic changes leading to scour around subsea infrastructure	**Mooring system and electrical cables** • Maximum number of mooring lines per foundation: 8; 56 total for the Offshore Array Area • Mooring line bar diameter (chain): ≤300 mm • Swept area for mooring chain: 2,800,000 m² (2.8 km²) • Dimensions of individual clump weights: 2.5 m long x 2.5 m wide x 2.5 m high • Diameter of electrical cable: 320 mm • Dimensions of gravity base anchors once installed: 13.5 m diameter, ≤5 m above seabed. **Cable protection** • Applied to up to 20% (≤17 km) of the total export cable length • Applied to up to 20% (≤7 km) of the total array cable length in contact with the seabed • Rock Placement, concrete mattress, grout / rock gag and/or frond mattress / articulated pipe **Scour Protection** • Applied around anchors for floating substructures • Applied around cable jointing • Applied around subsea hub anchors and cables • Rock Placement, concrete mattress, grout / rock gag and/or frond mattress
Colonisation of hard structures	As per parameters for Increased risk of introduction and spread of INNS
Impact of cable thermal load or EMF on benthic ecology	Maximum operational period: 35 years **Offshore Array Area** • Voltage: 66 kv • Cable type: HVAC • Number of cables: 9 • Total length of cables: 35 km • Total length of cable suspended in water column: 3.5 km • Total length of cable stabilisation protection ≤ 7 km • Total length of cable buried ≤ 28 km • Dynamic cable contact length on seabed: 500 m

Potential Impact and Effect	Project Design Envelope parameters
	Export Cable Corridor • Voltage: 66 kv • Cable type: HVAC • Number of cables: 2 • Total length of cables: 85 km • Total length of cable stabilisation protection: 17 km • Total length of cable buried:68 km
Decommissioning	
Long-term loss to benthic habitats and species	As per parameters of increased risk of introduction and spread of INNS at Operation and Maintenance
Temporary habitat loss or disturbance	Assuming combined habitat loss or disturbance from Construction and Operation and Maintenance. • Decommissioning lasting up to 2 years • Buried cables and mooring systems to be removed (but to be determined in consultation with key stakeholders as part of the Decommissioning Programme and following best practice at the time) • Cable protection removed or left *in-situ*
Increase suspended sediment concentrations and associated deposition	As per parameters from Construction. • Decommissioning lasting up to 2 years • Buried cables and mooring systems to be removed (but to be determined in consultation with key stakeholders as part of the Decommissioning Programme and following best practice at the time) • Cable protection removed or left *in-situ*
Increased risk of introduction and spread of INNS	Decommissioning lasting up to 2 years. **Vessel trips for decommissioning (516 return trips):** • Heavy lift vessel trips: 21 • Anchor handling vessels trips: 77 • Support vessel trips: 238 • Crew transfer trips: 180
Disturbance of contaminated sediments	As per temporary habitat loss or disturbance
Removal of artificial hard substrate	As per parameters for Increased risk of introduction and spread of INNS minus surface area for scour protection and cable protection, which are currently assumed to be left *in situ*.

Potential Impact and Effect	Project Design Envelope parameters
Currently realistic worst-case and likely scenarios for decommissioning operations will involve full removal of all infrastructure, therefore, similar impacts to the Construction phase and magnitude of seabed disturbance have been considered. This assumption is subject to best practice methods and technology appropriate at the time of decommissioning.	

9.10 Assessment Methodology

9.10.1.1 **Volume ER.A.2, Chapter 6: EIA Methodology** sets out the general approach to the assessment of significant effects that may arise from the Salamander Project.

9.10.1.2 Whilst **Volume ER.A.2, Chapter 6: EIA Methodology** provides a general framework for identifying impacts and assessing the significance of their effects, in practice the approaches and criteria applied across different topics vary.

9.10.1.3 The proposed approach to the Benthic and Intertidal Ecology assessment that has been addressed in the EIA is outlined below.

Valued Ecological Receptors

9.10.1.4 The value of ecological features is dependent upon their biodiversity, social and economic value within a geographic framework of appropriate reference. Identifying those habitats and species that have a specific biodiversity value recognised through international or national legislation, or through local, regional or national conservation plans (e.g. Annex I habitats, OSPAR Threatened and Declining List and NCMPAs) is understood to be the most straightforward context for assessing a proxy of ecological value. Under the existing legislative or policy frameworks, only a small proportion of marine habitats and species are afforded protection and, therefore, evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value.

9.10.1.5 Over 30 EUNIS habitats/biotopes were identified from the baseline surveys and supporting data sources. For this EIA, habitats identified and mapped from the baseline surveys and supporting data sources with similar physical and biological characteristics, and, where appropriate, conservation status/interest (Annex I, PMF and OSPAR) have been grouped together as Valued Ecological Receptors (VERs).

9.10.1.6 The sensitivities of these different habitats were also considered, such that habitats and species with similar tolerance and recoverability were grouped together. Sensitivities to help inform groupings were based on the Feature Activity Sensitivity Tool (FeAST) and where relevant the Marine Evidence based Sensitivity Assessment (MarESA), as detailed on the Marine Directorate and Marine Life Information Network (MarLIN) website, respectively.

9.10.1.7 This approach avoided the requirement to assess the potential effect of the Salamander Project on each individual biotope but assess against broad "receptor groups" (VERs). The VER groupings, and their descriptions, are listed in **Table 9-16**, and represent the intertidal and subtidal rock and sedimentary benthic environments of the Benthic and Intertidal Ecology Study Area.

9.10.1.8 The VERs are listed alongside their representative biotope codes, and if they represent features of conservation interest. For those listed as present in the Nearshore ECC (<1 km and >1km), these have been predicted based on the desk stop review of the baseline environment, and application of the scenario approach, as described in **Section 9.8**. Some of these predicted VERs, are also confirmed as present in the Offshore Array Area and the Offshore ECC (e.g. VER E Circalittoral Mixed Sediment), based on the site-specific surveys.

9.10.1.9 To summarise, four of these 11 VERs comprised rocky habitats, partitioned by depth (e.g., littoral vs infralittoral). The remaining VERs comprised sedimentary habitats, partitioned by a combination of depth (e.g. littoral vs circalittoral) and sediment type (e.g. mud vs sand).

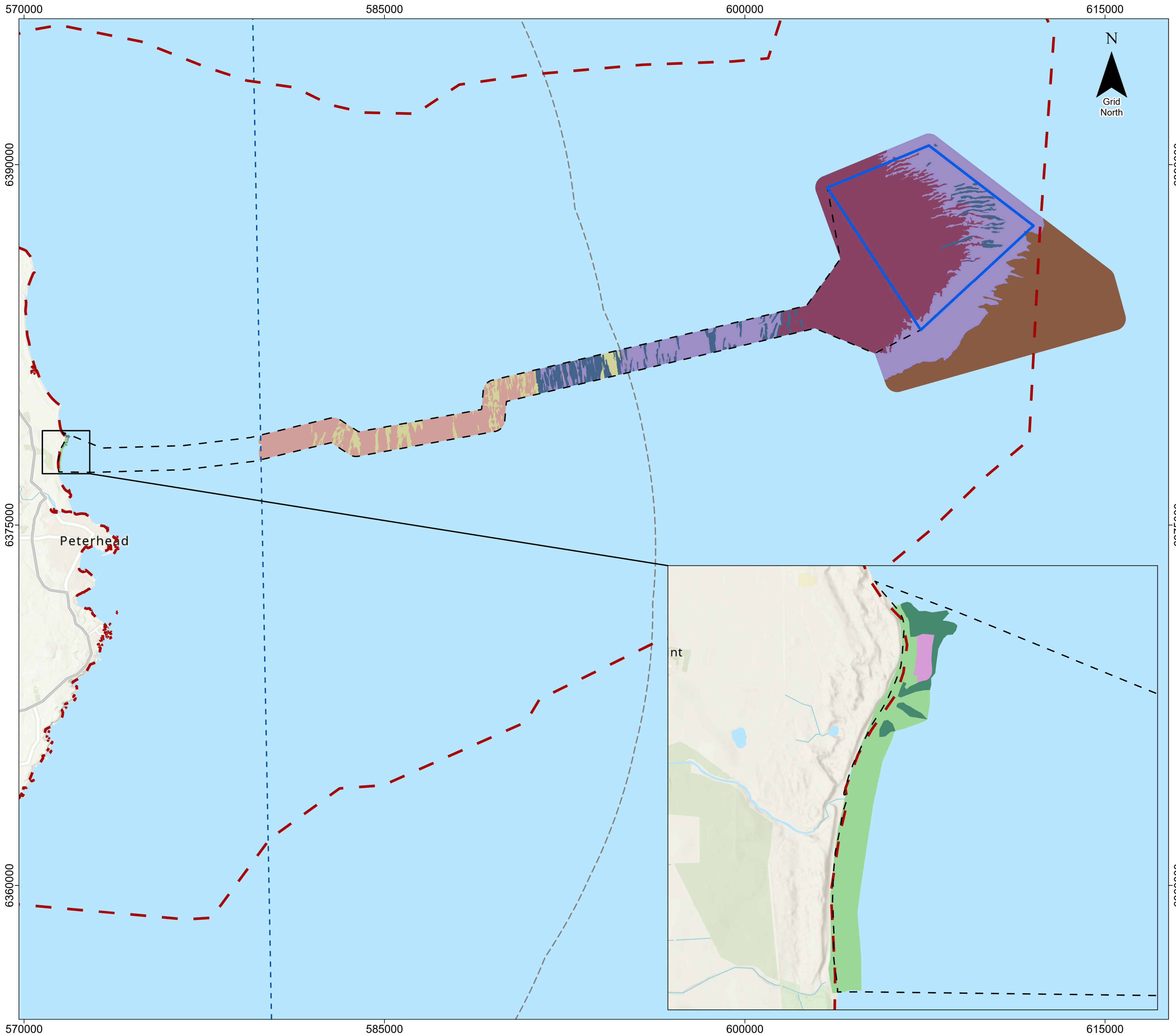
9.10.1.10 **Figure 9-14** shows the known spatial distribution of the VER groupings throughout the Near-field Study Area, with the broadscale habitat (BSH) mapped across far-field and regional areas for reference.

Table 9-16 Valued Ecological Receptors within the Salamander Project Benthic and Intertidal Ecology Study Area

VER Group	Name	Representative EUNIS code (s)	Annex I	PMF / OSPAR	Location	Summary Descriptions
Rock						
A	Littoral Rock	MA12442, MA2145 MA123D1, MB1215, MB12151	Potential Annex I Geogenic reef (if continuous from subtidal)	-	Landfall	Littoral rock characterised by either a seaweed community or one dominated by mussels and barnacles.
B	Infralittoral Rock	MB121A3, MB12151, MB1215 MB12211	Potential Annex I Geogenic reef	Kelp beds PMF	Nearshore ECC (<1 km)	Infralittoral rock dominated by kelp and seaweeds in the shallow infralittoral followed by red and brown seaweed dominated communities in the deeper infralittoral.
C	Circalittoral Rock	MC12, MC122, MC12241, MC12243 MD12	Potential Annex I Geogenic reef	-	Nearshore ECC (>1 km)	Atlantic circalittoral rock characterised by epifauna such as echinoderms and crustose communities.
D	*Sabellaria* on Atlantic Circalittoral Rock	MC12811	Potential Annex I Geogenic reef	OSPAR – *S. spinulosa* reef	Nearshore ECC (>1 km)	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock.

VER Group	Name	Representative EUNIS code (s)	Annex I	PMF / OSPAR	Location	Summary Descriptions
Mixed Sediment						
E	Circalittoral Mixed Sediment	MC42, MC421, MC4213, MC4214	-	-	Nearshore ECC (>1 km) Offshore ECC Offshore Array Area	Circalittoral mixed sediments characterised by both infauna and epifauna.
F	*Sabellaria* on Atlantic mixed sediment	MC2211	-	-	Offshore ECC Offshore Array Area	*Sabellaria spinulosa* forming loose agglomerations of tubes forming a low-lying matrix of sand, gravel mud and tubes on the seabed. Also *Sabellaria spinulosa* bommies.
Coarse sediment						
G	Sublittoral Coarse Sediment	MB321 MC32	-	Kelp and seaweed communities on sublittoral sediment PMF	Nearshore ECC (<1 km)	Includes infralittoral coarse sediments characterised by kelp and seaweed communities and circalittoral coarse sediment characterised by faunal communities.

VER Group	Name	Representative EUNIS code (s)	Annex I	PMF / OSPAR	Location	Summary Descriptions
Sand						
H	Littoral Sand	MA5211, MA5233, MA5251	-	-	Landfall	Littoral sand characterised by infaunal communities.
I	Sublittoral Sand	MB52 MC52, MC521, MC5211, MC5212, MC5213	-	 PMF – offshore subtidal sands and gravels	Nearshore ECC (<1 km) Nearshore ECC (>1 km) Offshore ECC Offshore Array Area	Subtidal sands across the infralittoral and circalittoral zones, characterised by infaunal communities.
Mud						
J	Circalittoral mud	MC62, MC6211, MC6212, MC6213		PMF – offshore deep sea muds	Offshore ECC Offshore Array Area	Circalittoral mud characterised by infauna
Species						
K	Ocean quahog *Arctica islandica*	n/a* *was recorded in MC62	-	PMF – Ocean quahog OSPAR – Ocean quahog	Wider Survey Area	A total of four individuals were identified from four sites located in the Wider Survey Area in sediments described as muddy sand.



Salamander

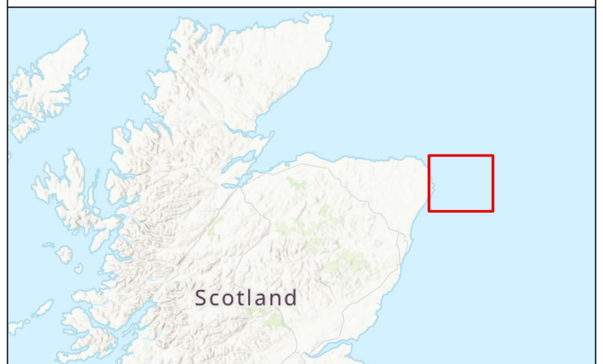
Figure 9-14
Spatial location of VERs from site-specific surveys

Legend

- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- 1° 40' W line (WGS84)
- 12nm limit

Biotope Type

- VER A
- VER A/H
- VER E
- VER F
- VER G
- VER H
- VER I
- VER I/F
- VER J



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:155,000

0 4.5 9 Kilometers

0 1 2 4 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : Spatial location of VER Biotope
Doc. No : SWF01ER0381
Created by : AN
Checked by : IW
Approved by : ACV

SALAMANDER Powered by Ørsted and Simply Blue Group

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Assessment of Potential Effect Significance

9.10.1.11 To determine whether predicted effects are likely to be significant, sensitivity of the receptor is correlated to magnitude of expected environmental effects.

Sensitivity

9.10.1.12 The overall sensitivity of a receptor is determined through consideration of the following:

- Tolerance to an impact (the extent to which the receptor is adversely affected by an impact);
- Adaptability (the ability of the receptor to avoid adverse effects that would otherwise arise from an impact); and
- Recoverability (a measure of a receptor's ability to return to a state at, or close to, that which existed before impact caused a change).

9.10.1.13 A value component may also be considered when assessing a receptor's sensitivity. This ascribes whether the receptor is rare, protected or threatened.

9.10.1.14 **Table 9-17** sets out the criteria used in defining the sensitivity of benthic ecology receptors.

Table 9-17 Sensitivity Levels for Benthic and Intertidal Ecology Receptors

Receptor Sensitivity	Definition	Value
High	The receptor has a very low capacity to accommodate a particular effect with a low ability to recover or adapt.	Receptor is designated under national or international legislation (e.g. Annex I habitat under Conservation of Habitats and Species Regulations 2017 (as amended)) and is a receptor listed as qualifying feature of a designated site (SAC and / or NCMPA).
Medium	The receptor has a low capacity to accommodate a particular effect with a low ability to recover or adapt.	Receptor is designated under national or international legislation (e.g. Annex I habitat Conservation of Habitats and Species Regulations 2017 (as amended)) but is not a receptor listed as a qualifying feature of a designated site (SAC and / or NCMPA) or the receptor is not designated and/or protected but is deemed to play a key role in habitat provision for other species.
Low	The receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.	Receptor is not designated and/or protected but is deemed to be a key part of the wider marine ecosystem.
Negligible	The receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt.	Receptor is not designated and/or protected and is deemed to be of limited importance for the wider marine ecosystem.

Magnitude

9.10.1.15 Assessment of impact magnitude is based on the expected effects on specific benthic ecological receptors from Salamander Project activities. The magnitude of an impact is dependent on its:

- Spatial extent - the area over which the impact will occur;
- Duration - the period of time over which the impact will occur;
- Frequency - the number of times the impact will occur over the duration;
- Intensity - the severity of the impact; and
- Reversibility - the ability for the receiving environment / exposed receptor to return to baseline conditions.

9.10.1.16 Potential impacts are described in terms of duration (temporary or permanent) and effect type (beneficial or adverse).

9.10.1.17 **Table 9-18** sets out the criteria used in defining the magnitude of benthic ecology receptors. Definitions in this table may not be appropriate for all impacts, for example there may be an impact that is over a very small area (i.e. 'negligible to 'low') but is repeated a large number of times during a particular phase of the project (i.e. 'medium' or 'high'). In such cases, expert judgement is used to determine the most appropriate magnitude ranking and this is explained throughout the narrative of the assessment.

9.10.1.18 For impacts occurring within the Nearshore ECC, and thus on those VERs predicted to be present, the scenario based approach (see **Section 3.8**) was done for an assessment of magnitude.

Table 9-18 Magnitude Levels for Benthic and Intertidal Ecology Impacts

Magnitude	Criteria
High	Total change or major alteration to key elements/features of the baseline conditions: Occurs over a large spatial extent, resulting in widespread, long-term, or permanent changes of the baseline conditions, or affects a large proportion of a receptor population. The impact will occur at a high frequency or intensity.
Medium	Partial change or alteration to one or more key elements / features of the baseline conditions: 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 population. The impact will occur at a moderate frequency or intensity.
Low	Minor shift away from the baseline conditions: 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 population. The impact will occur but at low frequency or intensity.
Negligible	Very slight change from baseline conditions: 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 a receptor population. The impact will occur at a very low frequency or intensity.
No change	No change from baseline conditions.

Significance of Effect

9.10.1.19 Following the identification of a benthic receptor's sensitivity and the impact magnitude, the significance of the effect is determined by correlating the magnitude and the sensitivity (**Table 9-19**). On this basis, potential effects are assessed as of negligible, minor, moderate or major significance (definitions are provided in **Volume ER.A.2, Chapter 6: EIA Methodology**).

9.10.1.20 For this assessment, any effects with a significance level of:

- **Major**: is significant in EIA terms;
- **Moderate**: is significant in EIA terms;
- **Minor**: is non-significant in EIA terms; and

- **Negligible**: is non-significant in EIA terms.

Table 9-19 Effect Significance Matrix

Significance of effect		Receptor Sensitivity			
		Negligible	*Low*	*Medium*	*High*
Magnitude of effect	*Negligible*	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major

9.10.1.21 Within the context of benthic and intertidal ecology, the terms used in **Table 9-19** to describe the predicted level of effect are defined as:

- **Major** – A fundamental change to the environment or receptor, resulting in a significant effect.
- **Moderate** – A material but non-fundamental change to the environment or receptor, resulting in a significant effect.
- **Minor** – A detectable but non-material change to the environment or receptor resulting in no significant effect or small-scale temporary changes.
- **Negligible** – No detectable change to the environment or receptor resulting in no significant effect.

9.10.1.22 Where a scenario based assessment had been required to be undertaken for potential impacts on VERs of the Nearshore ECC (see Sectio 9.8), two significance of effects will be presented, representing the outcome of each of the two scenarios for those relevant VER(s) assessed in the impact assessment.

9.11 Impact Assessment

Overview

9.11.1.1 The following assessment provides a summary of all impacts identified during Scoping and consultation, which have been noted as the EIA has progressed. Each impact is not necessarily relevant to all phases of the Salamander Project, and thus impacts have been assessed within the phase of the Project at which they will occur (Construction, Operation and Maintenance and Decommissioning). Further information of the EIA process and methodology is outlined in **Section 9.10** and **Volume ER.A.2, Chapter 6: EIA Methodology**. The impacts have been assessed on the current baseline, which could change over the operational lifetime (35 years) of the Salamander Project. The realistic worst-case parameters assumed for each individual potential impact on Benthic and Intertidal Ecology are detailed separately in **Table 9-15**. Further information on the Design Envelope is described in **Volume ER.A.2, Chapter 4: Project Description**.

9.11.1.2 Biotope mapping of the Near-field Study Area recorded a range of rocky and sedimentary habitats, and following the process of assigning each biotope to a VER receptor group, 11 VERs have been identified (VER groups A-D rock, VER groups E-J sediment and VER group K ocean quahog) (see **Table 9-16** and **Figure 9-14**).

9.11.1.3 For the assessment of potential effect on sediment and rock habitats, via the impacts scoped in for assessment, consideration will be focused on VER groups likely to interact with proposed works (directly and indirectly).

9.11.1.4 For assessment of impact on each VER group(s), the magnitude of impact will be assessed separately for each VER where appropriate, to account for variation in sediment types and benthic habitats within different parts of the Study Area, where these impacts may arise.

9.11.1.5 *Sabellaria spinulosa* (VER D and F) is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Offshore Array Area and Offshore ECC. Despite the presence of *S. spinulosa* individuals, aggregations and crusts across the Wider Survey Area, Annex I *Sabellaria spinulosa* reef was not assessed as present. On the east coast of Scotland, *S. spinulosa* is also known to form 'bommies' (Pearce and Kimber, 2020). As such, within the Nearshore ECC, *S. spinulosa* is likely to be present only as aggregations and crusts, or potentially, 'bommies'. For this reason, Annex I *Sabellaria spinulosa* reef will not be assessed further. However, the potential impact on 'bommies' will be considered as part of VER F under Scenario 2 in the Nearshore ECC, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope.

9.11.2 Construction

9.11.2.1 Under the Construction phase, the following potential impacts have been assessed:

- Temporary habitat loss or disturbance;
- Increased SSC and associated deposition;
- Increased risk of introduction and spread of INNS; and
- Disturbance of contaminated sediments.

9.11.2.2 The impact of long-term habitat loss from placement of project infrastructure is considered under the Operation and Maintenance phase impact assessment.

Temporary habitat loss or disturbance

<u>Background</u>

9.11.2.3 Construction activities will result in temporary habitat loss or disturbance to benthic habitats and species. Temporary habitat loss or disturbance will occur from the installation of the inter-array and offshore export cables; installation of anchors, installation of the subsea hubs, placement of anchors from vessels and jack-up events, seabed levelling and boulder clearance.

9.11.2.4 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Benthic and Intertidal Ecology Study Area, temporary habitat loss or disturbance may occur from construction activities and have therefore been assessed:

- **VER B** Infralittoral rock;
- **VER C** Circalittoral rock;
- **VER D** *Sabellaria* on Atlantic rock;

- **VER E** Circalittoral mixed sediment;
- **VER F** *Sabellaria* on mixed sediment;
- **VER G** Sublittoral coarse sediment;
- **VER H** Littoral sand;
- **VER I** Sublittoral sand;
- **VER J** Circalittoral mud; and
- **VER K** Ocean quahog.

9.11.2.5 Littoral rock (**VER A**) does not overlap with the Landfall intertidal works area, and as such has not been assessed.

9.11.2.6 Embedded mitigation (listed in **Section 9.8.3**) includes reduction of the spatial extent of habitat loss. Best practice will be followed to ensure that potential habitat loss is minimised throughout the proposed works (e.g. minimising the benthic footprint of the Offshore Development). With the range of habitats, receptors, PMFs, and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.2.7 The sensitivity of all VERs known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, using the most sensitive biotope within the receptor group to determine the overall VER group sensitivity. The sensitivity source for each receptor is presented in **Table 9-20**. Where relevant, sensitivity to surface abrasion, subsurface abrasion/penetration and physical removal (extraction of substratum) was determined for each VER group and the realistic worst-case was determined as overall sensitivity to temporary habitat loss or disturbance. **Table 9-20** summarises the sensitivity of each VER to habitat loss or disturbance from construction activities.

9.11.2.8 The sensitivity of rock habitats (VER groups B-D) to temporary habitat loss or disturbance (surface abrasion) from construction activities was assessed as **Medium**. The main characterising species of the rock habitats (**VER B-D**) include brittlestars (predominantly *Ophiothrix fragilis*, *Ophiocomina nigra* and *Ophiura albida*), kelp (*L. hyperborea*) and *S. spinulosa*. Brittlestars are epifaunal and have fragile arms so are likely to be directly exposed and damaged by abrasion, however brittlestars can tolerate considerable damage to arms and even the disk without suffering mortality and are capable of regeneration (Sköld, 1998). *L. hyperborea* is also capable of regeneration following impacts from abrasion (Christie *et al*. 1998). Surface abrasion is considered likely to damage the *S. spinulosa* tubes and result in sub-lethal and lethal damage to the worms, however colonies are expected to recover (Tillin *et al*., 2018).

9.11.2.9 The sensitivity of sedimentary habitats (**VER E-J**) to temporary habitat loss or disturbance (surface and subsurface abrasion and physical removal of substratum) from construction activities has been assessed as **High**. Sedimentary communities are 'highly' intolerant of substratum removal which will lead to partial or complete removal of biota (Dernie *et al*., 2003). Newell *et al.* (1998) state that removal of 0.5 m depth of sediment is likely to eliminate benthos from the affected area. Any remaining species, if they are repositioned at the sediment/water interface, may be exposed to unsuitable conditions. Recovery of the sedimentary habitat would occur via infilling, although some recovery of the biological assemblage may take place before the original topography is restored, if the exposed, underlying sediments are similar to those that were removed.

9.11.2.10 Ocean quahog (**VER K**) is assessed by FeAST as having High sensitivity to physical removal of substratum and subsurface abrasion. Removal of sediment would also remove individuals from the population with Low recovery potential. Despite having a thick heavy shell, this species is known to be vulnerable to damage from physical abrasion. As such, ocean quahog has been assessed as having **High** sensitivity to temporary habitat loss or disturbance from construction activities.

Magnitude

9.11.2.11 Through the various stages of the Construction phase there will be temporary disturbance to benthic communities within the Near-field Study Area. Under the realistic worst-case scenario this has been estimated to total 5,178,340 m² (5.2 km²) (**Table 9-15**).

9.11.2.12 The total Near-field Study Area is 80.7 km² and including the far-field, the overall Benthic and Intertidal Study Area is approximately 1,196 km². Therefore, the realistic worst-case Construction scenario design would result in the temporary disturbance of 6.4% of habitats, if only considering the Near-field and 0.43% of the entire Study Area. The Construction period has a window of 2.5 years however, construction will only take place over a period of 18 months (excluding pre-construction surveys); however, each disturbance event occurring at any one location within the Study Area will not be continuous during this 18-month period, and will be short-term. Furthermore, each individual construction activity requires a limited number of months for completion (refer to **Volume ER.A.2, Chapter 4: Project Description**).

9.11.2.13 While the impact will be locally significant and comprise temporary short-term habitat loss or disturbance within the Near-field Study Area, the loss and disturbance will be highly localised. As the habitats and characterising biotopes are common and widespread throughout the wider region, loss and disturbance of these habitat is assessed as discernible and the magnitude is assessed as **Low**.

9.11.2.14 **Kelp beds PMF (VER B)** is recognised as having potential to be present along the Nearshore ECC between KP0-1. Due to the lack of site-specific information, Kelp beds PMF could overlap the construction footprint. This PMF is likely to either be present (Scenario 1) or have a high coverage (Scenario 2) in the Nearshore ECC. Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands. Scotland holds a significant proportion of the UK records of kelp beds and therefore the habitat is considered to be nationally important (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from the construction works and the large national resource of Kelp beds PMF, loss of this PMF is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.2.15 **Kelp and seaweed communities on sublittoral sediment PMF (VER G)** has the potential to be either present along the Nearshore ECC (KP0-1) (Scenario 1) or present as a greater extent (Scenario 2). This PMF is particularly widespread along the west coast of Scotland and in sheltered areas at Orkney and Shetland, with occasional records on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from construction activities and the large national resource of this PMF, loss of this feature is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.2.16 **Annex I geogenic reef (VER's B, C, D)** is recognised as having potential to be present along the Nearshore ECC between KP0-4. Due to lack of site-specific information, Annex I geogenic reef could overlap with the construction footprint, represented as a 'low' reefiness feature (Scenario 1) or as 'medium' reefiness (Scenario 2). This would represent a very small percentage of the total area of potential geogenic reef within the Benthic and Intertidal Ecology Study Area. Due to the localised impact of the construction activities, and the presence of potential Annex I geogenic reef in the wider region, temporary habitat loss or disturbance is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.2.17 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the localised impact of habitat loss or disturbance from construction activities and the widespread presence of *S. spinulosa* aggregations on mixed sediment in the wider region, temporary habitat loss or disturbance of VER F has been assessed as discernible, and the magnitude as **Low**. In contrast, due to low potential overlap with *S. spinulosa* on rock (VER D), magnitude has been considered **Negligible** under Scenario 1 and **Low** under the more precautionary Scenario 2.

9.11.2.18 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific surveys, however, the total area of temporary habitat loss or disturbance is considered to represent a very small percentage loss (<0.01%) of the total area of the OSPAR Region II (Greater North Sea) within which ocean quahog is listed as under threatened and/or declining. The magnitude of the impact on ocean quahog is **Negligible**.

Significance of Effect

9.11.2.19 Overall, the sensitivity of rock and sedimentary habitats to the impacts associated with habitat loss or disturbance from construction activities has been assessed as Medium and High, respectively. Magnitude ranged from Negligible to Low for rock habitats and was Low for all sedimentary habitats. The High sensitivity and the Low magnitude of impact would result in an effect of **Minor** effect. As such, temporary habitat loss or disturbance from construction activities is **Not Significant** in EIA terms.

Further Mitigation

9.11.2.20 No further mitigation is required following the assessment of temporary habitat loss or disturbance from construction activities as having Minor effect, which is **Not Significant** in EIA terms.

Table 9-20 Summary of Impact Assessment for temporary habitat loss or disturbance during the Construction phase.

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**.	Negligible	Stamp, 2015
			2	Medium	Low	Minor		Minor	
VER C	Circalittoral Rock	MC12243	1	Medium	Negligible	Negligible		Negligible	De-Bastos and Hill, 2016a
			2	Medium	Low	Minor		Minor	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Medium	Negligible	Negligible		Negligible	Till *et al.*, 2018a
			2	Medium	Low	Minor		Minor	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	High	Low	Minor		Minor	De-Bastos and Marshall, 2016
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	High	Low	Minor		Minor	Tillin *et al.*, 2018b
			2	High	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	High	Negligible	Negligible		Negligible	Stamp *et al.*, 2022
			2	High	Low	Minor		Minor	

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER H	Littoral Sand	MC6211	N/A	High	Low	Minor		Minor	Tillin, 2016
VER I	Sublittoral Sand	MC5211	N/A	High	Low	Minor		Minor	Tillin, 2022
VER J	Circalittoral Mud	MC6211	N/A	High	Low	Minor		Minor	De-Bastos and Hill, 2016b
VER K	Ocean quahog	N/A	N/A	High	Negligible	Negligible		Negligible	The Scottish Government, 2013

Increase in suspended sediment concentrations and associated deposition

Background

9.11.2.21 The following assessment is supported by information presented in **Volume ER.A.3, Chapter 7: Marine Physical Processes** and **Volume ER.A.4, Annex 7.1: Marine Physical Processes Technical Annex**.

9.11.2.22 Temporary increase in SSC is expected to arise from construction activities such as drilling of pile anchors, seabed preparation (including sandwave levelling), cable burial (ploughing, trenching and jetting) and drilling fluid release during installation at the Landfall. Disturbance of the seabed from these activities can release sediment into the water column as a plume, increasing SSC and water turbidity. The suspended sediment will settle downwards at a rate depending upon its grain size. During settling, the sediment plume will be advected away from the point of release by currents and will disperse laterally through turbulent diffusion. Deposition of sediment may cause indirect impacts of smothering on marine organisms, while increase SSC may affect primary production of primary producers such as kelp.

9.11.2.23 The scale of this impact will vary spatially across the Study Area, and will depend on the installation activity, the sediment type and local hydrodynamics and geomorphology processes.

9.11.2.24 Due to the far-reaching effects of increased suspended sediment, all VER groups will be assessed.

9.11.2.25 With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s).

Sensitivity of Receptor

9.11.2.26 The sensitivity of all VERs known to characterise the Near-field Study Area have been assessed according to FeAST, and where relevant MarESA, using the most sensitive biotopes within the receptor group to determine the overall VER sensitivity. The sensitivity source for each receptor is presented in **Table 9-21.** Where relevant, sensitivity to water clarity changes, siltation changes (low) and siltation changes (high) was determined for each VER group and the realistic worst-case was determined as overall sensitivity to increase SSC and associated deposition. **Table 9-21** summarises the sensitivity of each VER group to increase in SSC and associated deposition.

9.11.2.27 The sensitivity of the rock habitats (**VER A-D**) to increased suspended sediments and associated deposition was assessed as **Medium**. For VERs characterised by photosynthetic organisms, changes in suspended solids (water clarity) will have a direct impact on the photosynthesising capabilities of these species. VERs characterised by non-photosynthesising species were determined as Not sensitive to Low sensitivity to changes in suspended solids. Rock habitats generally had Medium sensitivity to siltation (either low or high). Sedimentation can directly affect rocky habitats particularly by burial and scour abrasion of organisms. In rocky habitats, there are many sessile organisms that are incapable of relocating in response to increased sedimentation. However, if clearance of deposited sediment occurs rapidly then communities are expected to recover quickly.

9.11.2.28 Sedimentary biotopes (**VER E-J**) are generally considered less sensitive (Low to Medium sensitivity) to changes in suspended solids as many of the characterising species live within the sediment and are unlikely to be directly affected by an increased SSC. Sedimentary biotopes are determined to be more sensitive to smothering, ranging from Low sensitivity to Medium sensitivity depending on amount of deposition. This comes down to the ability of the infauna to migrate through the sediment and re-position themselves.

Overall, sensitivity of sedimentary habitats to increase suspended sediments and associated deposition was assessed as either **Low** or **Medium**.

9.11.2.29 The ocean quahog (**VER K**) is assessed by FeAST as having no exposure to changes in suspended particulate matter (The Scottish Government, 2013). In addition, it is not sensitive to low siltation rate changes but is considered highly sensitive to high siltation rate changes. Although ocean quahog lives within the sediment, they respire and feed through a short inhalant siphon which protrudes just above the sediment surface. As a result, ocean quahog is considered as having **High** sensitivity to increase suspended sediment and associated deposition.

Magnitude

9.11.2.30 Monthly averaged satellite imagery of SSC suggests that within the Offshore Array Area and Offshore ECC average (surface) concentration is generally very low, ranging between 0.5-1.5 mg/l and 0.6-1.2 mg/l, respectively (Silva, 2016), with relatively higher values anticipated during large spring tides and storm conditions. Higher concentrations are also expected to be observed at any given time closer to the seabed. Modelled residual sediment transport direction varies around the Offshore Array Area but is broadly to the northeast along the western margin, and southeasterly in central/eastern areas. Residual transport along the Offshore ECC is generally towards the south.

9.11.2.31 The assessment of changes to SSC within the Benthic and Intertidal Ecology Study Area from construction activities, can be summarised broadly in three main zones, based on the distance from the activity causing sediment disturbance:

- **0-50 m – Nearfield zone** has the highest SSC increase and greatest likelihood of deposition. At the time of active disturbance, very high SSC increase (tens to hundreds of thousands of mg/l) are predicted lasting for the duration of active disturbance plus up to 30 minutes following the end of disturbance. Sands and gravels may deposit in local thicknesses of tens of centimetres to several metres, while fine sediment is unlikely to deposit in measurable thickness. One hour after the active disturbance, no change to SSC and no measurable ongoing deposition is predicted.
- **50 to 500 m – Intermediatory zone** is predicted to experience measurable SSC increases, and measurable, but lesser, thicknesses of deposition. At the time of active disturbance, high SSC increases (hundreds to low thousands of mg/l) are predicted lasting for the duration of active disturbance, plus up to 30 minutes following end of disturbance. Sands and gravels may deposit in local thicknesses of up to tens of centimetres, while fine sediment is unlikely to deposit in measurable thickness. More than one hour after end of disturbance, no change to SSC from the baseline and no measurable ongoing deposition is predicted.
- **500 m to the tidal excursion buffer – Far-field Zone** is predicted to experience lesser but measurable SSC increase and no measurable thickness of deposition. At the time of active disturbance, it is predicted that there will be low to intermediate SSC increase (tens to low hundreds of mg/l) as a result of any remaining fines in suspension, only within a narrow plume (tens to a few hundreds of metres wide). SSC is then predicted to decrease rapidly by dispersion to return to background SSC between six to 24 hours. Fine sediment is unlikely to deposit in measurable thickness. No measurable change from baseline SSC is predicted after 24 to 48 hours following cessation of activities.

9.11.2.32 It is noted here, that in shallower waters (*circa* <30 m) during storm events, wave driven currents can naturally cause very high SSC (thousands of mg/l or more) close to the bed in areas where mobile sediment is present. Accordingly, even when SSC increases occur in response to windfarm construction activities, they are expected to be comparable to (or less than) the increases which occur naturally under (extreme) baseline conditions.

9.11.2.33 Trenchless cable installation techniques will be used to transition the Offshore ECC to the Onshore ECC at Landfall. The causes the potential of drilling fluid comprising natural bentonite clay in water to be released into the coastal water at the punch-out location. This may cause a sediment plume in the nearshore area. The realistic worst-case considered is a release of drilling mud with a conservative maximum concentration of 80,000 mg/l of bentonite within the drilling fluid, up to the total volume of the conduit (1,964 m^3), in a relatively short period of time (minutes to hours), at up to two trenchless punch out locations for the two export cables. The size of the plume will be initially very small in extent and localised to the end of the drill bit and borehole (order of a few metres diameter); the SSC of the undiluted drilling fluid at this point will be very high (30,000 to 80,000 mg/l). The plume will be subject to turbulent dispersion over time and distance as it is advected. Bentonite clay grains are very small and so are likely to stay in suspension for long periods of time (days to weeks or longer) in the relatively turbulent marine environment. As a result, the bentonite clay in the drilling fluid is expected to become progressively dispersed to very low concentrations (not measurably different from ambient natural turbidity levels) over periods of hours to days, and will therefore not settle or accumulate onto the seabed in measurable thickness in any location more than a few tens of metres from the main point of release.

9.11.2.34 **Overall**: where sediment plume dispersal is far reaching (fines in suspension), SSC increase and sediment deposition is likely to be negligible. In cases where sediment deposition is significant (coarse sediments) the extent is likely to be limited to within the Offshore ECC and Offshore Array Area, and likely persist over a limited temporal period. The Construction period is expected to run over a 18-month period (excluding pre-construction surveys); however, each disturbance event occurring at any one location within the Study Area will not be continuous during this 18-month period, and will be short-term. The impact of increased SSC and associated deposition from construction activities is therefore expected to be short-term, intermittent and of localised extent (within one tidal excursion) and temporary. As the habitats and characterising biotopes are common and widespread throughout the wider region, increase suspended sediments and associated deposition is assessed as discernible and the magnitude as **Low**.

9.11.2.35 **Kelp beds PMF (VER B)** is recognised as having potential to be present along the Nearshore ECC between KP0-1, which is likely to overlap with the Near-field and Intermediatory zones where heavy siltation is expected to occur. SSC increases are expected to be comparable to (or less than) the increases which occur naturally under (extreme) baseline conditions in shallower waters. This PMF is likely to be present (Scenario 1) or present with an extensive coverage (Scenario 2) along the Nearshore ECC. Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands and is considered to be nationally important (Tyler-Walters *et al.*, 2016: Scottish Government, 2022). Due to the short-term, intermittent, localised extent (within one tidal excursion), reversibility, similar SSC to (extreme) baseline conditions, and the large national resource of Kelp beds PMF, magnitude is assessed as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.2.36 **Kelp and seaweed communities on sublittoral sediment PMF (VER G)** has the potential to be present along the Nearshore ECC (KP0-1) (Scenario 1) or have present with an extensive coverage (Scenario 2). SSC increases are expected to be comparable to (or less than) the increases which occur naturally under (extreme) baseline conditions in shallower waters. This PMF is particularly widespread along the west coast of Scotland and in sheltered areas at Orkney and Shetland, with occasional recorded on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the short-term, intermittent, localised extent (within one tidal excursion), temporary similar SSC to (extreme) baseline conditions, and the large national resource of this PMF, magnitude is assessed as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.2.37 **Annex I geogenic reef (VER's A-D)** is recognised as having potential to be present along the Nearshore ECC between KP0-4, where it likely to overlap with Near-field zone under Scenario 1, represented by 'low' reefiness, and the Near-field zone under Scenario 2 with 'medium' reefiness. There is potential Annex I geogenic reef features in the far-field Study Area that will overlap with the Fari-field zone (**Figure 9-4**). However, due to the short-term, intermittent, and localised extent (within one tidal excursion), reversibility and the presence of potential Annex I geogenic reef in the wider region, the magnitude is assessed as **Low** for both scenarios.

9.11.2.38 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the short-term, intermittent, and localised extent (within one tidal excursion), reversibility and the presence of *Sabellaria* aggregations in the wider region **(Figure 9-4**), the magnitude is assessed as **Low** for both scenarios.

9.11.2.39 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific surveys but were located outside the Near-field Study Area. Heavy deposition (and therefore relevant to ocean quahog) will be restricted to 500 m from the Offshore Development Area and is considered to represent a very small percentage (0.02%) of the total area of the OSPAR Region II (Great North Sea) within which ocean quahog is listed as under threatened and/or declining. The magnitude of the impact on ocean quahog is **Negligible**.

Significance of Effect

9.11.2.40 Overall, the sensitivity of rock habitats to the impacts associated with increase suspended sediments and associated deposition during construction has been assessed as Medium. Sensitivity of sedimentary habitats was assessed as either Low or Medium. Magnitude ranged from Negligible to Low for rock and sedimentary habitats. Therefore, Medium sensitivity and Low magnitude of impact would result in an effect of **Minor effect**. As such, increased suspended sediments from construction activities is **Not Significant** in EIA terms.

Further Mitigation

9.11.2.41 No further mitigation is required following the assessment of increased suspended sediments and associated deposition from construction activities as having Minor effect, which is **Not Significant** in EIA terms.

Table 9-21 Summary of Impact Assessment for increase suspended sediments and associated deposition during the Construction phase

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER A	Littoral Rock	MA123D1	N/A	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**.	Minor	Parry and d'Avack, 2015
VER B	Infralittoral Rock	MB12151	1	Medium	Negligible	Negligible		Negligible	Stamp, 2015
			2	Medium	Low	Minor		Minor	
VER C	Circalittoral Rock	MC12243	1	Medium	Low	Minor		Minor	De-Bastos and Hill, 2016a
			2	Medium	Low	Minor		Minor	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Medium	Low	Minor		Minor	Till *et al.*, 2018a
			2	Medium	Low	Minor		Minor	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	Low	Low	Negligible		Negligible	De-Bastos and Marshall, 2016
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	Medium	Low	Minor		Minor	Tillin *et al.*, 2018b
			2	Medium	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	Low	Negligible	Negligible		Negligible	Stamp *et al.*, 2022
			2	Low	Low	Negligible		Negligible	

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER H	Littoral Sand	MA5233	N/A	Low	Low	Negligible		Negligible	Tillin, 2016
VER I	Sublittoral Sand	MC5211	N/A	Medium	Low	Minor		Minor	Tillin, 2022
VER J	Circalittoral Mud	MC6211	N/A	Medium	Low	Minor		Minor	De-Bastos and Hill, 2016b
VER K	Ocean quahog	N/A	N/A	High	Negligible	Negligible		Negligible	The Scottish Government, 2013

Increase risk of introduction and spread of INNS

Background

9.11.2.42 Although no INNS were reported from the project-specific surveys, there may be the risk that during Construction, INNS become newly introduced and/ or be spread within the Study Area. The risk of INNS introduction and spread can be described through a consideration of potential impact (severity), multiplied by the likelihood of introduction (a suitable vector) combined with the likelihood of introduction and spread (ecological preferences and spread) (Macleod *et al.,* 2016).

9.11.2.43 Increased project related vessel activities, including construction vessels, support and crew transfer vessel trips, transport of floating substructures and WTGs, and the moorings and anchors themselves, may become vectors for INNS. It is not currently known which port(s) these vessels may transit between, but it can be predicted that there may be the risk of INNS of concern, as listed by NatureScot (2023) being present in these busy waterways and being transported to the wider marine environment. Non-native biofouling species have been recorded from the hulls of commercial vessels using Scottish dry docks and harbours, such as the skeleton shrimp *Caprella mutica* and the barnacle *Austrominius modestus*(McCollin and Brown, 2014).

9.11.2.44 There may also be the risk of introduction of INNS to the intertidal area through the proposed Landfall works, where plant machinery and construction personnel may become potential vectors for transfer of non-native fauna and flora.

9.11.2.45 The placement of marine subsea infrastructure during Construction, may promote the colonisation and further spread of INNS within the Study Area. The risk of this, from long-term placement of such structures is assessed separately in **Section 9.11.3** for the Operation and Maintenance phase, alongside any additional risk of the introduction of INNS from Operation and Maintenance vessel activities.

9.11.2.46 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Study Area, the increased risk of introduction and spread of INNS on receptors that may occur from construction activities and have therefore, been assessed for:

- **VER B** Infralittoral rock;
- **VER C** Circalittoral rock;
- **VER D** *Sabellaria* on Atlantic rock;
- **VER E** Circalittoral mixed sediment;
- **VER F** *Sabellaria* on mixed sediment;
- **VER G** Sublittoral coarse sediment;
- **VER H** Littoral sand;
- **VER I** Sublittoral sand;
- **VER J** Circalittoral mud; and
- **VER K** Ocean quahog.

9.11.2.47 All VERs are recorded as present within the Near-field Study Area and thus may overlap with construction activities and be exposed to the potential risk of INNS introduction, with the exception of VER A Littoral Rock that lies outside of the Landfall works, and VER K ocean quahog, where only a small number of individuals were recorded from the Wider Survey Area. However, on a precautionary basis VER K is considered here.

9.11.2.48 The assessment for sensitivity and magnitude will primarily be combined for these receptors, however, with separate assessments, where relevant, on habitats and species of conservation value that may be representative of these VERs.

Sensitivity of Receptor

9.11.2.49 It can be difficult to predict the exact nature of potential impacts from the introduction of INNS on benthic receptors, as the associated sensitivity of, and interactions with, existing benthic communities or species can be highly complex and specific. Invasion by non-native species may threaten native benthic biodiversity, with some INNS identified from UK waters already identified as high risk. However, many others yet have scant information on the vulnerability of native habitats and native benthic species to their presence (Macleod *et al.,* 2016).

9.11.2.50 The sensitivity of all VERs known to characterise the Near-field Study Area, and thus which may overlap with construction activities have been assessed, where information is available, according to FeAST and where relevant MarESA. The sensitivity source for each receptor is presented in **Table 9-22.** The most sensitive biotope within the receptor group was used to determine the overall VER sensitivity. Ocean quahog has also been assessed on a precautionary basis, even though individuals had been recorded from the Wider Survey Area, outside both the Near-field and Far-field Study Areas. **Table 9-22** summarises the sensitivity of VERs to the introduction and spread of INNS from construction activities.

9.11.2.51 **Overall**, a range of sensitivities have been assigned to the VERs groups (low – high), partly on a precautionary basis where there currently is a lack of evidence, or where through FeAST and where relevant MarESA evidence specific INNS reviewed for their threat to native habitats and species. It is to be recognised however, that the distribution of some of the INNS considered under these specific assessments have yet to become established in the waters impacted by the Salamander Project, though that may also be in part an artifact of a lack of data under reporting their presence. Furthermore, the relative importance of these more southerly distributed INNS species, may however, become more important in the future and over the long-term during the Operation and Maintenance phase of the Salamander Project (this risk is assessed separately under **Section 9.11.3**).

9.11.2.52 **Kelp beds PMF (VER B)** is recognised as having the potential to be present along the Nearshore ECC between KP0-1. Due to the lack of site-specific survey data, kelp beds PMF could overlap the construction footprint and be present (Scenario 1), or present with larger coverage (Scenario 2). Rocky infralittoral habitats such as VER B, that that may support this PMF, may be more susceptible to INNS introductions, where larvae and / or sporophytes of INNS species may find suitable hard substrate for colonisation amongst native species. Under FeAST (The Scottish Government, 2013), for the habitat *'Tide-swept algal communities'* a low sensitivity was determined overall, in reference to sensitivity of the kelp *Saccharina latissima* to the impacts of the INNS macroalgal species *Sargassum muticum* in shallow waters. However, MarESA (Stamp, 2015) concludes a high sensitivity through the potential impacts of the invasive Japanese kelp wakame *Undaria pinnatifida*, which can result in a significant decrease in *Laminaria hyperborea.* It is not known if any INNS are currently confirmed as present and already established across these infralittoral rock habitats of VER B, thus on a precautionary basis a **High** sensitivity is assigned for VER B for both Scenario 1 and Scenario 2.

9.11.2.53 **Kelp and seaweed communities on sublittoral sediment PMF (VER G)** has the potential to be either present along the Nearshore ECC (KP0-1) (Scenario 1) or present with a greater extent (Scenario 2). Under FeAST, a medium sensitivity is reported for the equivalent habitat 'Kelp and seaweed communities on sublittoral sediment', with the slipper limpet *Crepidula fornicata* cited as an INNS that may significantly alter these sedimentary habitats through smothering of the substratum and production of pseudofaeces (The Scottish Government, 2013). Presently, this gastropod has a distribution mainly limited to English and Welsh waters, and the risk of introduction of this species during the Construction period may be low. However, under MarESA (Stamp *et al*., 2022) competition with INNS macroalgal species of *U. pinnatifida* and *S. muticum* are also identified as a potential threat and a high sensitivity is assigned*;* both algae are identified as present in eastern Scottish waters. For this PMF representing VER G, therefore, a precautionary **High** sensitivity is assigned for both Scenario 1 and Scenario 2.

9.11.2.54 **Annex I geogenic reef (VER's B-D)** is recognised as having the potential to be present along the north of the Nearshore ECC (KP0-4), and likely to be of 'low' reefiness, overlapping the 0-500 m zone under Scenario 1, and of 'medium' reefiness overlapping the 0-50 m zone under Scenario 2. With reference to the MarESA review for the representative biotope of VER C (MC12243), there is currently no evidence of a threat from INNS to this receptor (Stamp and Williams, 2021). This assessment had been made in reference to the carpet sea squirt *Didemnum vexillum*, which under suitable conditions can grow rapidly and smother native species and habitats, however, presently is reported to be isolated to sheltered locations (e.g. ports). In Scotland, it is currently limited to Loch Creran, on the west coast. However, it was noted that this species may have the potential to colonise more exposed locations, and as such a precautionary **Medium** sensitivity to assigned for geogenic reef habitat (e.g. VER C circalittoral rock only) under both Scenario 1 and Scenario 2, to allow for risk of epifaunal INNS colonising rocky substrates in nearshore areas that may overlap KP0-4 of the Nearshore ECC.

9.11.2.55 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope.

9.11.2.56 S. spinulosa on rocky habitats are not listed under FeAST. Under MarESA for VER D, using the biotope 'Sabellaria spinulosa encrusted circalittoral rock', this biotope is assessed as not sensitive to the introduction or spread of INNS. This has been concluded in part, due to the lack of a spatial overlap in distributions between habitats that commonly support INNS and the non-indigenous S. spinulosa reef habitats. It has been reported however, that the Pacific oyster Magallana gigas exhibits interspecific pressures on the conspecific Sabellaria alveolata reef building species (Tillin et al., 2018). VER D may support other species that are sensitive to INNS introductions during the Construction phase, and therefore, precautionary Medium sensitivity is assigned to VER D under both Scenario 1 and 2, and in consideration of the sensitivity assigned to Annex I geogenic reef (see above) that VER D may also be representative of *S. spinulosa* on sedimentary habitats (VER F) are not listed under FeAST. As assessed under MarESA for VER D, VER F is also reported to be not sensitive to the introduction and spread of INNS (Tillin *et al.,* 2022). On a precautionary basis a **Low** sensitivity is assigned to VER F overall under both Scenario 1 and 2.

9.11.2.57 **Ocean quahog (VER K)** was recorded in low numbers outside of the Near-field Study Area, within the Wider Survey Area. Under FeAST there is currently no available information to determine the effects of INNS on this protected species. (The Scottish Government, 2013) and under MarESA there is no evidence that this species is adversely affected by INNS (Tyler-Walters and Sabatini, 2017). A precautionary **Low** sensitivity is assigned.

9.11.2.58 **Circalittoral mixed sediments (VER E)** under FeAST, a precautionary high sensitivity for the habitat 'Continental shelf mixed sediments' had been assigned as it was reported the feature ranges from not sensitive to high, but with a lack of evidence to support this (The Scottish Government,2016). Under MarESA (biotope MC4213), a high sensitivity is also assigned (De Bastos and Marshall, 2016). It is of note, that as also reviewed above for the VER of sublittoral coarse sediment supporting the PMF 'Kelp and seaweed communities on sublittoral sediments' (VER G), that the risk to this feature had been identified as being from interactions with INNS slipper limpet *C. fornicata*. It is unlikely that this species is yet present in the region of the Salamander Project, and an overall **Medium** sensitivity is assigned for risk of introduction and spread of INNS during the Construction phase.

9.11.2.59 **Littoral (VER H) and Sublittoral sands (VER I)** overall have a lack of evidence confirming the risk of INNS to these sandy substrates, and FeAST assigns a precautionary medium sensitivity to allow for this for both the 'Tide swept coarse sands with burrowing bivalves' and 'Continental shelf sand' subtidal features (The Scottish Government, 2013). The risk of the slipper limpet *C. fornicata* and the carpet sea squirt *D. vexillum* are discussed as potential threats to the representative biotope of VER I (MC5211 '*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand) where under MarESA an associated high sensitivity was determined (Tillin, 2022). However, as noted above, their likely presence for introduction during the Construction phase are not confirmed. Few INNS are likely to be able to colonise mobile sandy substrates, but there is the risk that those that can (e.g. oyster drill *Urosalpinx cinerea*) may negatively affect characterising bivalve species (Tillin, 2022). For both littoral and sublittoral sands (VER H and I, respectively), a **Medium** sensitivity is assigned.

9.11.2.60 **Circalittoral Muds (VER J)** overall has a lack of evidence confirming the risk of INNS to these muddy habitats, and FeAST assigns a precautionary medium sensitivity to allow for this for the features 'Continental shelf muds' (The Scottish Government, 2021). Therefore, a **Medium** sensitivity if assigned for VER J.

Magnitude

9.11.2.61 During the maximum 18-month (excluding pre-construction surveys) offshore Construction period, there is estimated to be 432 support vessel and CTV trips, 77 mooring and anchor handling vessel round trips, 116 subsea cable handling vessel round trips, and 35 round trips of handling vessels for the floating substructures and WTGs (see **Table 9-15**). The potential risk for the introduction and spread of INNS will be from this relatively high frequency of construction vessels operating in the area of the Salamander Project during Construction. However, this risk will be limited to a restrictive period for each individual trip, and all trips will be occurring over the short-term, 18-month Construction phase.

9.11.2.62 The risk of the introduction and spread of INNS during the Construction phase will be significantly reduced through adherence to best practice tertiary mitigation measures (see **Section 9.8.3**). Those relevant to reducing the risk of INNS include:

- Development of a Biosecurity Plan as part of the Construction Environmental Management Plan (CEMP) which will set out best practice guidelines.
- All construction vessels to adhere to International Maritime Organization (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediment for international standards for reducing risk of spread of invasive aquatic species.

9.11.2.63 In consideration that the risk of introduction of INNS occurring will primarily be local, there is only a short period to time in which introduction may occur, and can be further reduced through incorporation of best practice measures a negligible risk is determined for most VERs. However, it will be important to consider the magnitude of impact, should it occur on areas supporting protected features (PMFs, *Sabellaria spinulosa* reefs etc.), and as such, where under Scenario 2 a potential greater extent, and higher quality of these features are potentially present in the Nearshore ECC, then a precautionary low magnitude is assigned. This range in magnitude of **Negligible** to **Low** is determined on a precautionary basis with an acknowledgement of risk of occurrence and impact on potentially valuable features.

Significance of Effect

9.11.2.64 Overall, the sensitivity of benthic and intertidal ecology receptors associated with the introduction and potential spread of INNS during the Construction phase has been assessed as between Low to High. Magnitude was determined to be between Negligible to Low (see **Table 9-22**). Overall, on a realistic worst-case scenario, a High sensitivity and Low magnitude of impact would result in an effect of **Minor** effect overall. As such, increase introduction and spread of INNS from construction activities is **Not Significant** in EIA terms.

Further Mitigation

9.11.2.65 No further mitigation is required following the assessment of introduction and spread of INNS as having **Minor** effect, which is **Not Significant** in EIA terms.

Table 9-22 Summary of Impact Assessment for introduction and spread of invasive non-native species during the Construction phase

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	High	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**Table 9-14	Negligible	Stamp, 2015
			2	High	Low	Minor		Minor	
VER C	Circalittoral Rock	MC12243	1	Medium	Negligible	Negligible		Negligible	Marine Scotland (no Marine Directorate)., 2020
			2	Medium	Low	Minor		Minor	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Medium	Negligible	Negligible		Negligible	Till *et al.,* 2018a
			2	Medium	Low	Minor		Minor	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	Medium	Negligible	Negligible		Negligible	The Scottish Government, 2013
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	Low	Negligible	Negligible		Negligible	Tillin *et al.*, 2018
			2	Low	Low	Negligible		Negligible	
VER G	Sublittoral Coarse Sediment	MB3211	1	High	Negligible	Negligible		Negligible	Stamp *et al.*, 2022
			2	High	Low	Minor		Minor	

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER H	Littoral Sand	MC6211	N/A	Medium	Negligible	Negligible		Negligible	The Scottish Government, 2013
VER I	Sublittoral Sand	MC5211	N/A	Medium	Negligible	Negligible		Negligible	The Scottish Government, 2013
VER J	Circalittoral Mud	MC6211	N/A	Medium	Negligible	Negligible		Negligible	The Scottish Government, 2013
VER K	Ocean quahog	N/A	N/A	Low	Negligible	Negligible		Negligible	The Scottish Government, 2013

Disturbance of contaminated sediments

Background

9.11.2.66 This assessment has been informed by the Water and Sediment Quality assessment in **Volume ER.A.3, Chapter 8: Water and Sediment Quality**. Construction activities will result in disturbance of contaminated sediments during installation of the wind turbine array and offshore export cables, installation of anchors, installation of the subsea hubs, placement of anchors from vessels and jack-up events, seabed levelling and boulder clearance. Contaminated sediments may be suspended in the water column and advected away from the point source by currents, and eventually settling downwards. However, concentration of contaminated sediments will remain highest near the point source.

9.11.2.67 Due to the potential far-reaching effects of disturbance of contaminated sediment, all VER groups have been assessed.

9.11.2.68 Embedded mitigation (listed in **Section 9.8.3**) includes reducing localised habitat loss, which indirectly reduces the area disturbed through construction activities. With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.2.69 The sensitivity of all VER groups known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, and with a consideration of the Water Framework Directive (WFD) 'higher' and 'lower' sensitivity habitats. Where possible, sensitivity to nutrient enrichment, organic enrichment, synthetic (inc. pesticides, antifoulants, pharmaceuticals) and non-synthetic (inc. heavy metals, hydrocarbons, produced water) compound contamination was determined for each VER group and the realistic worst-case was determined as overall sensitivity to temporary habitat loss or disturbance. **Table 9-23** summarises the sensitivity of each VER to disturbance of contaminated sediments from construction activities.

9.11.2.70 Infralittoral rock (VER B) and sublittoral coarse sediment (VER G) are both representative of 'subtidal kelp beds' as defined by the WFD as higher sensitivity habitats (Environment Agency, 2017). Higher sensitivity habitats are considered to have a low resistance to, and recovery rate from human pressures while lower sensitivity habitats have a medium to, and recovery rate from, human pressures. The following lower sensitivity habitats as defined by the WFD are represented by VER groups recorded within the Near-field Study Area:

- Cobbles, gravels and shingle (VER G);
- Intertidal soft sediments (VER H);
- Rocky shore (VER A);
- Subtidal boulder fields (VERs B, C, D);
- Subtidal rocky reef (VERs B, C, D); and
- Subtidal soft sediments like sand and mud (VER I and J).

9.11.2.71 FeAST assessed 'Tide-swept algal communities' (corresponding to **VER B**) as having Low sensitivity to organic, nutrients, synthetic and non-synthetic contamination (The Scottish Government, 2013). However, the WFD considers ‘subtidal kelp beds’ as higher sensitivity habitats and as such this VER has been assessed as having **Medium** sensitivity to disturbance of contaminated sediments. Due to the lack of assessment for sublittoral coarse sediment (**VER G**), sensitivity has been assumed similar to VER B due to similar taxa (*Laminaria*) and due to likely similar hydrodynamic exposure. VER G has therefore been assessed as having **Medium** sensitivity to disturbance of contaminated sediments. As there is no equivalent habitat in FeAST for littoral rock (**VER A**), MarESA assessed VER A as not sensitive to nutrient enrichment but having medium sensitivity to organic enrichment (Perry and d’Avack, 2015). Sensitivity to synthetic and non-synthetic compounds was not assessed by MarESA, as such sensitivity was assumed to be the same as for ‘Tide-swept algal communities’ due to present of similar characterising taxa such as fucoids. VER A was thus assessed as having **Medium** sensitivity to disturbance of contaminated sediments from construction activities.

9.11.2.72 Like VER A, circalittoral rock (**VER C**) was not assessed by FeAST. However, MarESA determined no sensitivity to nutrient and organic enrichment and did not assess synthetic and non-synthetic contamination (De-Bastos and Hill, 2016a). There is some evidence that shows brittlestars (*Amphiura* spp.) as sensitive to non-synthetic contamination (Newton and McKenzie, 2006) as such VER C was assessed as having **Medium** sensitivity to disturbance of contaminated sediments.

9.11.2.73 *Sabellaria* on Atlantic rock (**VER D**) was not assessed by either FeAST or MarESA. However, the characterising species *S. spinulosa* is likely not sensitive to synthetic compounds and non-synthetic compounds due to the presence of the species in polluted areas (Hoare and Hiscock, 1974). However, due to the lack of information, sensitivity to disturbance of contaminated sediments was assessed precautionary as **Low**. For this same reason, *Sabellaria* on mixed sediment (**VER F**) was assessed as having **Low** sensitivity.

9.11.2.74 Littoral sand (**VER H**) was not assessed on FeAST and only nutrient and organic enrichment were assessed under MarESA and was determined as not sensitive (Tillin, 2016). However, the characterising amphipod species are expected to be intolerant of synthetic chemicals (Cole *et al*.,1999) and intolerance to some specific chemicals has been observed in amphipods. Species of a different genus are likely to differ in their susceptibility to synthetic chemicals and that this may be related to differences in their physiology (Powell, 1979). As such VER H has been assessed as having **Medium** sensitivity to disturbance of contaminated sediment.

9.11.2.75 FeAST assessed the sensitivity of ‘continental mixed sediment, which corresponds to circalittoral mixed sediment (**VER E**), to synthetic and non-synthetic compounds as sensitive and not sensitive to organic and nutrient enrichment (The Scottish Government, 2013). There have been studies looking at the sensitivity of bivalves to various pollutants, have shown immune effect to synthetic and non-synthetic pollution (review by Renault, 2015). As such VER F, has been assessed as having Medium sensitivity to disturbance of contaminated sediments.

9.11.2.76 FeAST assessed the sensitivity of ‘continental shelf sand’, which corresponds to subtidal sands (**VER I**), to synthetic and non-synthetic compounds as sensitive and not sensitive to organic and nutrient enrichment (The Scottish Government, 2013). Echinoderms are suggested to be sensitive to various types of marine pollution (Newton and McKenzie, 1995) As such, VER I has been assessed as having **Medium** sensitivity to disturbance of contaminated sediments.

9.11.2.77 FeAST has assessed ‘continental shelf muds’, which corresponds to circalittoral mud (VER J), as having High sensitivity to organic enrichment but recognises that sensitivity will be dependent on the characterising species (The Scottish Government, 2013). The habitat was also determined as not sensitive to nutrient enrichment, but sensitive to synthetic and non-synthetic compounds. MarESA assessed VER J as having

Medium sensitivity to organic enrichment. Based on these two sources, VER J has been assessed as having **Medium** sensitivity to disturbance of contaminated sediments.

9.11.2.78 Ocean quahog (**VER K**) was assessed by FeAST as sensitive to both non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water) and synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals) (The Scottish Government, 2013). Although ocean quahog is not sensitive to contaminants at Environmental Quality Standards (EQS) levels (Tyler-Walters and Sabatini, 2017), above this baseline, some contaminants may impact the conservation status of ocean quahog depending on the nature of the contaminant (UKTAG, 2008; EA, 2014). Liehr *et al.*, (2005) recorded lower densities of ocean quahog at contaminated historical dumping sites compared to a reference site. As such, ocean quahog has been assessed as having **Medium** sensitivity to disturbance of contaminated sediments.

Magnitude

9.11.2.79 *In situ* characterisation of the sediment physicochemical properties was carried out through site-specific surveys (Ocean Infinity, 2022a) where sediment quality data was collected. Results are briefly summarised below but for further information on sediment quality refer to **Volume ER.A.3, Chapter 8: Water and Sediment Quality**.

9.11.2.80 TOM and TOC both varied slightly across the survey area, with a mean content of 1.3% (±0.3 SD) and 0.18% (±0.07 SD), respectively. Both TOM and TOC had notably higher values at site ECR_S44, which is situated centrally within the Offshore ECC.

9.11.2.81 THC were low across the Offshore ECC and Offshore Array Area but were generally higher in the Offshore Array Area and lowest at the stations closest to shore. Similarly, polycyclic aromatic hydrocarbons (PAHs) were overall low but variable across the survey area following a similar trend to THC. Canadian Council of Ministers of the Environment TEL values are defined as the point biological effects are expected to occur only rarely, while Probably Effect Level (PEL) is the point at which adverse effects may be expected frequently in a wider range of organisms. The TEL for the Dibenzo[a,h]anthracene congener were exceeded at station WAA_S16, located outside the Offshore Array Area in the Wider Survey Area, but remained below PEL concentrations. Both THC and some of the 16 Environmental Protection Agency (EPA) PAHs were positively correlated with sediment fines (clay and silt). Clay and silt themselves were positively correlated with depth within the Offshore Study Area.

9.11.2.82 Heavy metal concentrations throughout the Near-field Study Area were low, with concentrations below Cefas AL1, for all metal species investigated. However, arsenic (As) concentrations increased with proximity to the shore and, although below Cefas AL1, the concentrations were reported above the TEL values (>7.24 mg/kg_{dw}) at five stations along the Offshore ECC. There is no indication of active sources of pollution in the area and slightly elevated As concentrations are commonly found in the North Sea (Whalley *et al*., 1999). With sediment particulate size increasing westward and consistently low levels of TOM, As concentrations above Cefas AL1 and AL2 in the gap area are not expected.

9.11.2.83 Overall, subtidal sand (VER I) and subtidal muds (VER J) which dominate the Offshore Array Area and the deepest parts of the Offshore ECC are most likely to be exposed to release of contaminated soils as well as *Sabellaria* on mixed sediment (VER F), which forms a mosaic with VER I in the deeper sections of the Near-field Study Area. Based on site-specific surveys, the concentrations are not expected to result in any adverse effects on benthic communities. The Construction period is expected to run over a 18-month period (excluding pre-construction surveys); however, each disturbance event occurring at any one location within the Study Area will not be continuous during this 18-month period, and will be short-term. Magnitude for VER F, I and J and ocean quahog (VER K) has been assessed precautionary as **Low**. Due to an increase in coarse sediments towards the shore and decrease in depth, magnitude for all other receptors were assessed as **Negligible**, including all scenarios for PMF and Annex I habitats within the data gap.

Significance of Effect

9.11.2.84 Overall, the sensitivity of the receptors ranged from Low to Medium, while magnitude ranged from Negligible to Low. The Medium sensitivity and Low magnitude of impact would result in an effect of **Minor** effect. As such, disturbance of contaminated sediments from construction activities is **Not Significant** in EIA terms.

Further Mitigation

9.11.2.85 No further mitigation is required following the assessment of temporary habitat loss or disturbance from construction activities as having **Minor** effect, which is **Not Significant** in EIA terms.

Table 9-23 Summary of Impact Assessment for disturbance of contaminated sediments during the Construction phase

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER A	Littoral Rock	MA123D1	N/A	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**.	Negligible	The Scottish Government[1], 2013; Perry and d'Avack, 2015
VER B	Infralittoral Rock	MB12151	1	Medium	Negligible	Negligible		Negligible	The Scottish Government[1], 2013; Environmental Agency, 2017
			2	Medium	Negligible	Negligible		Negligible	
VER C	Circalittoral Rock	MC12243	1	Medium	Negligible	Negligible		Negligible	Newton and McKenzie, 2006; De-Bastos and Hill, 2016a
			2	Medium	Negligible	Negligible		Negligible	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Low	Negligible	Negligible		Negligible	Hoare and Hiscock, 1974
			2	Low	Negligible	Negligible		Negligible	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	Medium	Negligible	Negligible		Negligible	The Scottish Government[2]; 2013; Renault, 2015
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	Low	Low	Negligible		Negligible	Hoare and Hiscock, 1974
			2	Low	Low	Negligible		Negligible	

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER G	Sublittoral Coarse Sediment	MB3211	1	Medium	Negligible	Negligible		Negligible	Referred from VER B
			2	Medium	Negligible	Negligible		Negligible	
VER H	Littoral Sand	MC6211	N/A	Medium	Negligible	Negligible		Negligible	Powell, 1979; Cole *et al.*, 1999; Tillin, 2016
VER I	Sublittoral Sand	MC5211	N/A	Medium	Low	Minor		Minor	Newton and McKenzie, 1995; The Scottish Government, 2013[3]
VER J	Circalittoral Mud	MC6211	N/A	Medium	Low	Minor		Minor	The Scottish Government, 2013[4]
VER K	Ocean quahog	N/A	N/A	Medium	Low	Minor		Minor	Leihr *et al.*, 2005; The Scottish Government, 2013; Tyler-Walters and Sabatini, 2017

1 Sensitivity derived from ‘Tide-swept algal communities’
2 Sensitivity derived from ‘Continental shelf mixed sediments’
3 Sensitivity derived from ‘Continental shelf sands’
4 Sensitivity derived from ‘Continental shelf muds’

9.11.3 Operation and Maintenance

9.11.3.1 Under the Operation and Maintenance phase, the following potential impacts have been assessed:

- Long-term habitat loss;
- Temporary habitat loss or disturbance;
- Impact to habitats or species as a result of pollution or accidental discharge
- Increased risk of introduction and spread of INNS;
- Hydrodynamic changes leading to scour around subsea infrastructure;
- Colonisation of hard structures; and
- Impact of cable thermal load or EMF on benthic ecology.

Long-term loss to benthic habitats and species

Background

9.11.3.2 Placement of project infrastructure will result in long-term loss to benthic habitats and species during Operation and Maintenance. Habitat loss within the Offshore Array Area will occur from installation of the anchors for the WTG and associated scour protection, the tethers on the inter-array cables and installation of cable protection, and from the installation of the subsea hubs and associated scour protection. Along the Offshore ECC, long-term loss to benthic habitats and species will be mostly associated with cable protection. In addition to the long-term habitat loss through installation of infrastructure during the Construction phase, it is to be considered that during the Operation and Maintenance phase of the Salamander Project, there may be the requirement for additional and / or replacement scour protection to be installed which may result in localised additional long-term habitat loss.

9.11.3.3 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Benthic and Intertidal Ecology Study Area, long-term habitat loss may occur from placement of infrastructure and have therefore been assessed:

- **VER B** Infralittoral Rock;
- **VER C** Circalittoral Rock;
- **VER D** *Sabellaria* on Atlantic Rock;
- **VER E** Circalittoral Mixed Sediment;
- **VER F** *Sabellaria* on Mixed Sediment;
- **VER G** Sublittoral Coarse Sediment;
- **VER I** Sublittoral Sand;
- **VER J** Circalittoral Mud; and
- **VER K** Ocean quahog.

9.11.3.4 No long-term habitat loss will occur in the Landfall intertidal area, as cable protection will not be used within the Landfall, as such **VER A** and **VER H** are not assessed.

9.11.3.5 Primary mitigation (listed in **Section 9.8.3**) includes reducing localised habitat loss through micro siting of offshore infrastructure. With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.3.6 The sensitivity of all VER groups known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, using the most sensitive biotope within the receptor group to determine the overall VER group sensitivity. The sensitivity source for each receptor is presented in **Table 9-24.** Where relevant, sensitivity to physical change (to another seabed type) was determined for each VER group and the realistic worst-case was determined as overall sensitivity to temporary habitat loss or disturbance. **Table 9-24** summarises the sensitivity of each VER group to placement of project infrastructure.

9.11.3.7 The sensitivity of rock habitats (**VER B-D**) to long-term loss from the placement of project infrastructure has been assessed as **Low**. Although the addition of rock or artificial hard substrate is likely to cause damage to species immediately within the footprint, in time the new substrate may provide additional substrate on which species could recolonise.

9.11.3.8 The sensitivity of sedimentary habitats (**VER E-J**) to long-term habitat loss from the placement of project infrastructure is determined as **High**. If the sediment was replaced with rock or artificial substrata, this would represent a fundamental change to any sedimentary biotope and the loss of the characterising sedimentary infaunal communities (Tillin, 2022).

9.11.3.9 Ocean quahog (VER K) was assessed by FeAST to have high sensitivity to physical change to another seabed type. Ocean quahog lives in sediment and will therefore be unable to inhabit hard substrate associated with the project infrastructure. As such, ocean quahog has been assessed to have **High** sensitivity to long-term habitat loss.

Magnitude

9.11.3.10 Following the initial placement of project infrastructure on the seabed during Construction, there will be a direct long-term (35 years) habitat loss for benthic communities within the Offshore Development Area. Under the realistic worst-case scenario, this has been estimated to total 753,700 m² (0.75 km²) from the installation of the turbines (anchors and associated scour protection), cables (tethers and cable protection) and subsea hubs (footprint and scour protection) (**Table 9-15**).

9.11.3.11 The total area of the Near-field Study Area is 80.7 km², and inclusive of the Far-field Study Area, is 1,196 km². Therefore, the realistic worst-case design scenario would result in the long-term habitat loss of 0.93% of the benthic habitats within the Near-field Study Area and, inclusive of the Far-field Study area, 0.06% of benthic habitats.

9.11.3.12 **Overall:** While the impact will be locally significant and comprise long-term change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. As the habitats and characterising biotopes are common and widespread throughout the wider region, loss of these habitats is assessed as discernible, and the magnitude is assessed as **Low**.

9.11.3.13 **Kelp beds PMF (VER B)** is recognised as having potential to be present along Nearshore ECC between KP0-1. This PMF is likely to be either present (Scenario 1) or present with a large coverage (Scenario 2) in the Nearshore ECC. Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands. Scotland holds a significant proportion of the UK records of kelp beds and therefore, the habitat is considered to be nationally important (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from potential cable protection and the large national resource of Kelp beds PMF, loss of this PMF is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.14 **Kelp and seaweed communities on sublittoral sediment PMF (VER G)** has the potential to be present along the north of the Nearshore ECC (KP0-1) (Scenario 1) or present with a larger coverage (Scenario 2). This PMF is particularly widespread along the west coast of Scotland and in sheltered areas at Orkney and Shetland, with occasional records on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from potential scour protection and the large national resource of this PMF, loss of this feature is assessed as discernible, and the magnitude as **Negligible** under Scenario 1, and **Low** under Scenario 2.

9.11.3.15 **Annex I geogenic reef (VER's B, C, D)** is recognised as having potential to be present along the north of the Nearshore ECC between KP0-4. Due to the lack of site-specific information, 'low' reefiness Annex I geogenic reef could overlap with some of the cable protection (Scenario 1) or 'medium' reefiness reef could overlap (Scenario 2). This would represent a very small percentage of the total area of potential geogenic reef within the Study Area. Due to the localised impact from potential scour protection, and the presence of potential Annex I geogenic reef in the wider region, loss of this habitat is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.16 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the localised impact from potential project infrastructure and the widespread presence of *S. spinulosa* aggregations on mixed sediment (VER F) in the wider region, loss of VER F has been assessed as discernible, and the magnitude as **Low**. In contrast, due to the low potential of overlap with *S. spinulosa* on rock (VER D), magnitude has been considered **Negligible** under Scenario 1 and **Low** under the more precautionary Scenario 2.

9.11.3.17 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific surveys, however, the total area of long-term habitat loss is considered to represent a very small percentage loss (<0.01%) of the total area of the OSPAR Region II (Greater North Sea) within which ocean quahog is listed as under threat and/or declining. The magnitude of the impact on ocean quahog is therefore **Negligible**.

Significance of Effect

9.11.3.18 Overall, it is predicted that the sensitivity of rock biotopes is Low and the magnitude of the impact is Negligible to Low. The Low sensitivity of receptors and the Low magnitude of impact would result in a **Negligible** effect. On the other hand, it is predicted that the sensitivity of sedimentary habitats is High and the magnitude of the impact is **Low**. The High sensitivity and the Low magnitude of impact would result in an effect of **Minor** effect. As such, long-term habitat loss from project infrastructure is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.19 No Further Mitigation is required following the assessment of disturbance or damage due to long-term habitat loss from project infrastructure as having a Minor effect, which is **Not Significant** in EIA terms.

Table 9-24 Summary of Impact Assessment for long-term habitat loss

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	Low	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**.	Negligible	The Scottish Government; 2013[1]
			2	Low	Low	Negligible		Negligible	
VER C	Circalittoral Rock	MC12243	1	Low	Negligible	Negligible		Negligible	De-Bastos and Hill, 2016a
			2	Low	Low	Negligible		Negligible	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Low	Negligible	Negligible		Negligible	Tillin *et al.*,2018a
			2	Low	Low	Negligible		Negligible	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	High	Low	Minor		Minor	The Scottish Government, 2013[2]
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	High	Low	Minor		Minor	Tillin *et al.*, 2018b
			2	High	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	High	Negligible	Negligible		Negligible	The Scottish Government, 2013[3]

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
			2	High	Low	Minor		Minor	
VER I	Sublittoral Sand	MC5211	N/A	High	Low	Minor		Minor	The Scottish Government, 2013[4]
VER J	Circalittoral Mud	MC6211	N/A	High	Low	Minor		Minor	The Scottish Government, 2013[5]
VER K	Ocean quahog	-	N/A	High	Negligible	Negligible		Negligible	The Scottish Government, 2013

1 Sensitivity derived from 'Tide-swept algal communities'

2 Sensitivity derived from 'Kelp and seaweed communities on sublittoral sediment'

3 Sensitivity derived from 'Continental shelf mixed sediments'

4 Sensitivity derived from 'Continental shelf sands'

5 Sensitivity derived from 'Continental shelf muds'

Temporary habitat loss or disturbance

Background

9.11.3.20 **Table 9-15** summarises the realistic worst-case scenario for temporary habitat disturbance from cable repair and replacement activities during the Operation and Maintenance phase, and with consideration of swept areas from the mooring system and dynamic cables within the Offshore Array Area. It is also considered that during the Operation and Maintenance phase that there may be the requirement for installation of replacement and/ or additional scour protection, but across highly localised areas.

9.11.3.21 Due to the location of the following VER groups (and their representative biotopes species and conservation features) within the Study Area, temporary habitat loss or disturbance may occur from Operation and Maintenance activities and have therefore been assessed:

- **VER B** Infralittoral Rock;
- **VER C** Circalittoral Rock;
- **VER D** *Sabellaria* on Atlantic Rock;
- **VER E** Circalittoral Mixed Sediment;
- **VER F** *Sabellaria* on Mixed Sediment;
- **VER G** Sublittoral Coarse Sediment;
- **VER H** Littoral Sand;
- **VER I** Sublittoral Sand;
- **VER J** Circalittoral Mud; and
- **VER K** Ocean quahog.

9.11.3.22 Littoral rock (**VER A**) does not overlap with the Landfall intertidal works area, and as such has not been assessed.

9.11.3.23 Embedded mitigation (listed in **Section 9.8.3**) includes reducing localised habitat loss, which indirectly reduces the area of temporary habitat loss and disturbance during the Operation and Maintenance phase. With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.3.24 The sensitivity of all VER groups known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, using the most sensitive biotope within the receptor group to determine the overall VER group sensitivity. Where relevant, sensitivity to surface abrasion, subsurface abrasion/penetration and physical removal (extraction of substratum) was determined for each VER group and the realistic worst-case was determined as overall sensitivity to temporary habitat loss or disturbance. **Table 9-25** summarises the sensitivity of each VER group to habitats loss or disturbance form Operation and Maintenance activities.

9.11.3.25 The sensitivity of rock habitats (VER A-D) to temporary habitat disturbance (surface abrasion) during Operation and Maintenance activities was assessed as **Medium**. The main characterising species of the rock habitats (**VER B-D**) include brittlestars (predominantly *Ophiothrix fragilis*, *Ophiocomina nigra* and *Ophiura albida*), kelp (*L. 124yperborean*) and *S. spinulosa*. Brittlestars are epifaunal and have fragile arms so are likely to be directly exposed and damaged by abrasion, however brittlestars can tolerate considerable damage to arms and even the disk without suffering mortality and are capable of regeneration (Sköld, 1998). *L. 124yperborean* is also capable of regeneration following impacts from abrasion (Christie *et al.*, 1998). Surface abrasion is considered likely to damage the *S. spinulosa* tubes and result in sub-lethal and lethal damage to the worms, however colonies are expected to recover (Tillin *et al*., 2018ab).

9.11.3.26 The sensitivity of sedimentary habitats (**VER E-J**) to temporary habitat loss or disturbance (surface and subsurface abrasion and physical removal of substratum) from Operation and Maintenance activities has been assessed as **High**. Sedimentary communities are likely 'highly' intolerant of substratum removal which will lead to partial or complete defaunation (Dernie *et al*., 2003). Newell *et al.* (1998) state that removal of 0.5 m depth of sediment is likely to eliminate benthos from the affected area. Any remaining species, given their new position at the sediment/water interface, may be exposed to unsuitable conditions. Recovery of the sedimentary habitat would occur via infilling, although some recovery of the biological assemblage may take place before the original topography is restored, if the exposed, underlying sediments are similar to those that were removed.

9.11.3.27 Ocean quahog (**VER K**) was assessed by FeAST to have high sensitivity to subsurface abrasion was determined as low, however sensitivity to physical removal (extraction of substratum) and sub-surface abrasion/penetration was determined as high. Despite having a thick, solid and heavy shell, ocean quahog is known to be vulnerable to physical abrasion. Living in the sediment, ocean quahog would be removed with the extraction of the substratum. As such, ocean quahog has been assessed to have **High** sensitivity to temporary habitat loss or disturbance.

Magnitude

9.11.3.28 As with other offshore infrastructure projects, there will be a requirement for planned and unplanned maintenance activities throughout the Operation and Maintenance phase. These activities may vary in nature, however the maintenance activities considered likely to cause short-term temporary habitat disturbance impacts are export and inter-array cable repairs and cable protection remediation as well as mooring and anchor replacement events (**Table 9-15**). It is expected that the nature of the repairs will cause a similar disturbance as those outlined for temporary habitat loss or disturbance during the Construction phase (**Section 9.11.2**) but on a smaller spatial scale. As such, the impact assessment will reflect and summarise this assessment, but with consideration of differing spatial scales between these two phases. The Project Design Envelope assumes that there will be up to 14 cable repair and replacement events along 7.4 km of export and inter-array cables. Under the worst-case scenario total area of seabed disturbance from cable repair and maintenance during the Operation and Maintenance phase has been estimated to total 1,574,800 m² (1.6 km²) (**Table 9-15**).

9.11.3.29 The movement of the mooring lines (catenary or semi-taut) and dynamic cable ends within the Offshore Array Area may cause temporary periodic habitat disturbance (**Table 9-15**). With either a catenary or semi-taut mooring system, and dynamic cable ends, at any time only a portion of the system will lay upon the seabed and the remaining portion will be suspended in the water column. The amount of mooring line and dynamic cable end suspended at any time is in response to external forces such as wind, waves and tides. There will not be permanent contact of the entire mooring system on the seabed over the entire Operation and Maintenance period. Under the realistic worst-case scenario (catenary) and untethered cable, the total swept area of seabed is 4,620,000 m² (4.6 km²) (**Table 9-15**).

9.11.3.30 **Overall:** Temporary habitat loss or disturbance from these activities during the Operation and Maintenance phase is predicted to be 6,194,800 m² (5.1 km²) (**Table 9-15**), over the 25-35 year Operation and Maintenance period. The total area of the Near-field Study Area is 80.7 km², therefore, the realistic worst-case scenario would result in the temporary disturbance of 7.7% of the habitats within the Offshore Development Area and 0.52% of the habitats in the Far-field Study Area (total 1,196 km²). Due to the relatively limited spatial extent and the widespread distribution of the habitats and characterising biotopes, temporary habitat loss or disturbance is assessed as discernible and the magnitude is assessed as **Low**.

9.11.3.31 **Kelp beds PMF (VER B)** is recognised as having potential to be present along the Nearshore ECC between KP0-1. Due to the lack of site-specific information, under Scenario 1 its presence is predicted and under Scenario 2 Kelp beds PMF are predicted to have a larger coverage, overlapping the construction footprint. This PMF is likely to occur in either low (Scenario 1) or high condition (Scenario 2). Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands and is considered to be nationally important (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from a cable repair and remedial works and the large national resource of Kelp beds PMF, loss of this PMF is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.32 **Kelp and seaweed communities on sublittoral sediment PMF (VER G)** have the potential to be present along the Nearshore ECC (KP0-1) (Scenario 1) or present with a high coverage (Scenario 2). This PMF is particularly widespread along the west coast of Scotland and in sheltered area at Orkney and Shetland, with occasional records on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from a cable repair and remedial works and the large national resource to this PMF, loss of this feature is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.33 **Annex I geogenic reef (VER's B, C, D)** is recognised as having potential to be present along the north of the Nearshore ECC between KP0-4. Due to lack of site-specific information, 'low' reefiness Annex I geogenic reef (Scenario 1) and 'medium' reefiness (Scenario 2) could overlap with the construction footprint. This would represent a very small percentage of the total area of potential geogenic reef within the Study Area. Due to the localised impact of a cable repair and remedial works, and the presence of potential Annex I geogenic reef in the wider region, temporary habitat loss or disturbance is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.34 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the localised impact of habitat loss or disturbance during the Operation and Maintenance phase and the widespread presence of *S. spinulosa* aggregations on mixed sediment in the wider region, temporary habitat loss or disturbance of **VER F** has been assessed as discernible, and the magnitude as **Low**. In contrast, due to low potential overlap with *S. spinulosa* on rock (**VER D**), magnitude has been considered **Negligible** under Scenario 1 and **Low** under the more precautionary Scenario 2.

9.11.3.35 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific survey, however, the total area of temporary habitat loss or disturbance is considered to represent a very small percentage loss (<0.01%) of the total area of the OSPAR Region II (Greater North Sea) within which ocean quahog is listed as under threatened and/or declining. The magnitude of the impact on ocean quahog is **Negligible**.

Significance of Effect

9.11.3.36 Overall, the sensitivity of rock and sedimentary biotopes to the impacts associated with temporary habitat loss or disturbance during Operation and Maintenance has been assessed as High. Total area of disturbance from Operation and Maintenance activities was marginally lower than during the Construction phase, as such magnitude was similar and ranged from Negligible to Low for rock habitats and was Low for sedimentary habitats. High sensitivity combined with Low magnitude of impact would result in an effect of **Minor** effect. As such, temporary habitat loss or disturbance from Operation and Maintenance is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.37 No further mitigation is required following the assessment of temporary habitat loss or disturbance from Operation and Maintenance activities as having Minor effect, which is **Not Significant** in EIA terms.

Table 9-25 Summary of Impact Assessment for temporary habitat loss or disturbance during the Operation and Maintenance phase

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14**.	Negligible	Stamp, 2015
			2	Medium	Low	Minor		Minor	
VER C	Circalittoral Rock	MC12243	1	Medium	Negligible	Negligible		Negligible	De-Bastos and Hill, 2016a
			2	Medium	Low	Minor		Minor	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Medium	Negligible	Negligible		Negligible	Till *et al.*, 2018a
			2	Medium	Low	Minor		Minor	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	High	Low	Minor		Minor	De-Bastos and Marshall, 2016
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	High	Low	Minor		Minor	Tillin *et al.*, 2018b
			2	High	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	High	Negligible	Negligible		Negligible	Stamp *et al.*, 2022
			2	High	Low	Minor		Minor	
VER H	Littoral Sand	MC6211	N/A	High	Low	Minor		Minor	Tillin, 2016

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER I	Sublittoral Sand	MC5211	N/A	High	Low	Minor		Minor	Tillin, 2022
VER J	Circalittoral Mud	MC6211	N/A	High	Low	Minor		Minor	De-Bastos and Hill, 2016b
VER K	Ocean quahog	N/A	N/A	High	Negligible	Negligible		Negligible	The Scottish Government, 2013

Increased risk of introduction and spread of Invasive Non-Native Species

Background

9.11.3.38 The long-term placement of subsea hard infrastructure (submersible floating platforms, mooring chains, anchors, scour protection etc.) may provide suitable artificial habitat for INNS settlement and / or further risk of introduction to the area, from Operation and Maintenance vessels undertaking maintenance and remedial works. The impact of 'colonisation of hard infrastructure' by native, non-INNS taxa during the Operation and Maintenance phase, that may in part be beneficial, is assessed separately to the assessment presented here for INNS (**Sections 9.11.3.81 – 9.11.3.92**).

9.11.3.39 Although the frequency of project related vessels operating during the Operation and Maintenance period may be less than that occurring during the Construction phase, other vessel movements in the area may provide a source of INNS, whereby any introductions from other vectors may then exploit the newly available artificial subsea habitats provided by the infrastructure of the Salamander Project. Offshore wind infrastructure can act as 'stepping stones' for INNS, providing an increased connectivity of hard substrate across areas where sedimentary habitats often dominate. For example, INNS have been reported to exploit the intertidal zone of an OWF structure, such as monopiles or floating platforms (Teunis *et al.,* 2020).

9.11.3.40 Large Scottish ports and marinas have been reported to be important sites for the presence and rapid spread of INNS (Ashton *et al*., 2006). The Offshore ECC of the Salamander Project is located approximately 3 km to the north of Peterhead Port, and with the Offshore Array Area approximately 35 km due east at its closest point. Peterhead Port is a medium sized deep-water port, which is one of Europe's largest fishing ports, and with a wide range of vessels using it including sailing and fishing vessels, trawlers and offshore supply ships etc. (MarineTraffic, 2023; Peterhead Port Authority, 2023). A study by Ashton *et al*. (2006) found that at Peterhead Port, the Japanese skeleton shrimp species *Caprella mutica* and green sea fingers macroalgal species *Codium fragile* had both been recorded species listed by NatureScot as marine invasive species that threaten Scotland and are widespread and well established (NatureScot, 2023).

9.11.3.41 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Study Area, the increased risk of introduction and spread of INNS on receptors that may occur during the Operation and Maintenance phase have therefore been assessed for all VERs:

- VER B Infralittoral Rock;
- VER C Circalittoral Rock;
- VER D *Sabellaria* on Atlantic Rock;
- VER E Circalittoral Mixed Sediment;
- VER F *Sabellaria* on Mixed Sediment;
- VER G Sublittoral Coarse Sediment;
- VER H Littoral Sand;
- VER I Sublittoral Sand;
- VER J Circalittoral Mud; and
- VER K Ocean quahog.

9.11.3.42 All VER groups are recorded as present within the Near-field Study Area and thus may spatially overlap project infrastructure in place during the Operation and Maintenance phase, and therefore be exposed to the potential risk of INNS introduction, with the exception of ocean quahog (VER K), where only a small number of individuals was recorded from the Wider Survey Area. However, on a precautionary basis VER K is also considered here.

9.11.3.43 The assessment for sensitivity and magnitude will be combined, however, with separate assessments, where relevant, on habitats and species of conservation value that may be representative of these VERs.

Sensitivity of Receptor

9.11.3.44 Sensitivity of benthic VER groups to the introduction and spread of INNS during the Operation and Maintenance phase are, as assessed and presented in **Table 9-22** for the Construction phase, with sensitivities ranging from **Low** to **High**.

Magnitude

9.11.3.45 The Salamander Project will be in operation for up to 35 years and therefore, may provide a suitable timeframe for colonisation of these structures by INNS. Furthermore, with an expected shifting climatic baseline over time, there may also be the potential risk of a greater number of southerly Lusitanian species migrating north into Scottish waters. It has been calculated that the total area available for potential colonisation by INNS on the installed marine infrastructure is 2,724,891 m^2 (2.7 km^2), which is approximately 3.38% of the 80.7 km^2 Near-field Study Area, and inclusive of the Far-field Study Area is 0.23%. Refer to **Table 9-15** for a full, detailed breakdown of estimated available surface areas of submerged artificial infrastructure that may be available for the potential colonisation by INNS during the Operation and Maintenance phase.

9.11.3.46 The opportunity for the accidental introduction of INNS into the area, directly as a result of marine Operation and Maintenance activities, such as vessels required for onsite inspections and remedial works, may be expected to be less frequent than vessel trips during the Construction phase. However, there is the long-term risk of introduction, for the duration of the Operation and Maintenance period. Vessel trips during the Operation and Maintenance phase are estimated on average to be 210 trips per year. Limited Operation and Maintenance works are expected to be required across the intertidal area during the Operation and Maintenance, following completion of the Construction phase and thus risk of introductions should be minimal.

9.11.3.47 The risk of the introduction and spread of INNS during the Operation and Maintenance phase will be reduced through adherence to best practice tertiary mitigation measures (see **Section 3.8.3**). Those relevant to reducing the risk of INNS include:

- Development of a Biosecurity as part of the Operation Environmental Management Plan (OEMP) which will set out best practice guidelines;
- All Operation and Maintenance vessels are to adhere to IMO International Convention for the Control and Management of Ships' Ballast Water and Sediment for international standards for reducing risk of spread of invasive aquatic species;
- Removal of Marine Growth. The substructures will be designed to accommodate marine growth; however, to manage weight / drag-induced fatigue, growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools if substantial accumulation is in evidence. This measure will help reduce the successful colonisation of opportunistic pioneer species that may also be INNS; and

- Removal of debris from floating lines and cables. Mooring lines and floating inter-array cables will be inspected with a risk-based frequency during the operational life-cycle of the Salamander Project, starting at a higher frequency and likely declining after a number of years, based on evidence gathered during inspections. Any inspected or detected debris on the floating lines and cables will be recovered based on a risk assessment which considers impact on environment, risk to asset integrity and cost of intervention. This measure will also contribute to minimising the initial risk of spread and establishment of INNS that may be attached and have colonising the floating lines and cables.

9.11.3.48 The risk of introduction and spread of INNS from vessels and routine Operation and Maintenance remedial and repair works will therefore, primarily be reduced through incorporation of best practice measures as set out in Biosecurity Plan(s) that will be in place. However, it will be important to consider the magnitude of impact, should it occur in areas supporting protected features (i.e. PMFs, Annex I geogenic stony reefs etc.), such as, where under Scenario 2, a potential greater extent and / or and higher 'reefiness' (for stony reefs) of these features are present in the Nearshore ECC. Under this scenario a precautionary low magnitude is assigned. This range in magnitude of **Negligible** to **Low** is determined to be, on a precautionary basis where magnitude of impact of occurring within the Near-field Study Area will be at most negligible, but with an acknowledgement of risk of occurrence and impact on potentially valuable features.

Significance of Effect

9.11.3.49 Overall, the sensitivity of benthic ecology receptors associated with the introduction and potential spread of INNS during the Operation and Maintenance phase has been assessed as between Low to High (see **Table 9-22** for reference). Magnitude was determined to be between Negligible to Low (see **Table 9-22** for reference). Overall, for a realistic worst-case, a High sensitivity and Low magnitude of impact would result in an effect of **Minor** effect overall. As such, increase introduction and spread of INNS during the Operation and Maintenance phase is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.50 No further mitigation is required following the assessment of introduction and spread of INNS as having **Minor** effect, which is **Not Significant** in EIA terms.

Impact to habitats or species as a result of pollution or accidental discharge

Background

9.11.3.51 This assessment has been informed by Water and Sediment Quality in **Volume ER.A.3, Chapter 8: Water and Sediment Qualuty.**

9.11.3.52 Throughout the Operation and Maintenance phase of the Salamander Project, planned and unplanned activities (moorings and substructure -inspection, cable repair and replacement etc.) may increase the risk of spillage or chemical contamination into the marine environment. Additionally, each WTG contains components that require lubricating oils, hydraulic oil and coolants for operation which may be accidentally discharged.

9.11.3.53 Due to the far-reaching impacts from pollution or accidental discharge all VER groups (and their representative biotopes, species and conservation features) have been assessed.

9.11.3.54 Embedded mitigation (listed in **Section 9.8.3**) includes a MPCP to mitigate the risks of accidental spills of hazardous material, measure to prevent spills, as well as remedial actions and response measures. With the range of habitats, receptors, PMFs, and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.3.55 The sensitivity of all VER groups known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, using the most sensitive biotope within the receptor group to determine the overall VER group sensitivities. The sensitivity of receptors has been assumed to be the same as for 'disturbance of contaminated sediments' discussed under Construction (**Section 9.11.2**). As such **Table 9-23** summarises the sensitivity of each VER group to pollution or accidental discharge.

9.11.3.56 In summary, infralittoral rock (VER B), *Sabellaria* on Atlantic rock (VER D) and on mixed sediment (VER G), and sublittoral coarse sediment (VER G) were determined to have **Low** sensitivity to pollution (nutrient, organic, synthetic and non-synthetic). All other VERs were assessed as having **Medium** sensitivity to pollution.

Magnitude

9.11.3.57 Vessel trips during the Operation and Maintenance phase are estimated to be on average 210 vessel trips and 140 helicopter transfers per year. Over the lifetime of the Salamander Project this is expected to equate to an average of 7,350 vessel trips and 4,900 helicopter transfers. Each WTG contains a total of 125,200 l of oil, equivalent to 876,400 l across all turbines. Refer to **Table 9-15** for a full, detailed breakdown of vessel trips by vessel type and a breakdown of oil by its constituents.

9.11.3.58 However, in consideration of the embedded mitigation (listed in **Section 9.8.3**), and adoption of best practice in addition to a strong hydrodynamic regime, the magnitude of the impact is assessed and **Negligible**.

Significance of Effect

9.11.3.59 Overall, the sensitivity of the receptors ranged from Low to Medium, while magnitude ranged from Negligible to Low. The Medium sensitivity and Negligible magnitude of impact would result in an effect of **Negligible** effect. As such, impact to habitats or species as a result of pollution or accidental discharge is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.60 No further mitigation is required following the assessment of impact to habitats or species as a result of pollution or accidental discharge as having Negligible effect, which is **Not Significant** in EIA terms.

Hydrodynamic changes leading to scour around subsea infrastructure

Background

9.11.3.61 The presence of cables, cable protection, anchoring systems and mooring systems during the Operation and Maintenance phase have the potential to cause hydrodynamic changes leading to scour around subsea infrastructure. Scour and increase in flow rates can result in a loss of sediments which directly impact the physical structure of the adjacent habitats and indirectly affect resident benthic communities. The degree of scour that can occur is influenced by local sediment type and hydrodynamics. In sandy sediments, scour can increase over years, while over mixed gravelly sediments the fractions moved will depend on strength of tidal currents (Whitehouse *et al*., 2011).

9.11.3.62 With consideration of the location of the VER groups (and their representative biotopes, species and conservation features) to areas likely to experience hydrodynamic changes leading to scour within the Study Area, the following VERs have been assessed:

- **VER B** Infralittoral Rock;
- **VER C** Circalittoral Rock;
- **VER D** *Sabellaria* on Atlantic Rock;
- **VER E** Circalittoral Mixed Sediment;
- **VER F** *Sabellaria* on Mixed Sediment;
- **VER G** Sublittoral Coarse Sediment;
- **VER I** Sublittoral Sand;
- **VER J** Circalittoral Mud; and
- **VER K** Ocean quahog.

9.11.3.63 Once cables are buried, the cables will not have any potential to impact seabed morphology unless exposed. Apart from the buried cables, no other project subsea infrastructure will be present in the littoral zone and as such littoral rock (**VER A**) and littoral sand (**VER H**) are not assessed.

9.11.3.64 Embedded mitigation (listed in **Section 9.8.3**) includes cable burial where possible and where adequate burial cannot be achieved due to seabed conditions, cable protection will be installed. With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s), and in consideration of the relevant embedded mitigation measures that will reduce the potential magnitude of impact.

Sensitivity of Receptor

9.11.3.65 The sensitivity of all VER groups known to characterise the Near-field Study Area have been assessed according to FeAST and where relevant MarESA, using the most sensitive biotope within the receptor group to determine the overall VER sensitivity. The sensitivity source for each receptor is presented in **Table 9-26.** Sensitivity to physical change (to another seabed type)[7] and surface abrasion was determined for each VER group and the realistic worst-case was determined as overall sensitivity to hydrodynamic changes leading to scour. **Table 9-26** summarises the sensitivity of each VER to hydrodynamic changes leading to scour.

9.11.3.66 The epiflora and epifauna of the representative biotopes for rock habitats (**VER B-D**) were assessed as having medium sensitivity to abrasion/disturbance, while physical change to another sediment type is considered not relevant for rock habitats. Overall, all rock habitats were assessed as having **Medium** sensitivity to hydrodynamic changes leading to scour.

9.11.3.67 All sedimentary habitats (**VER E-J**) were assessed as having a high sensitivity to physical change to another sediment type. Sediment type is a key factor structuring the biological assemblage present in these biotopes, a change in sediment type is therefore likely to change the community composition for which the biotopes are defined. Abrasion is likely to damage the epifauna and may damage a proportion of the characterising species. The degree of sensitivity is depended on the characterising species and as such sensitivity ranged

[7] FeAST does not present sensitivity to physical change (to another sediment type), where relevant sensitivity to physical change (to another sediment type) was referred from MaRESA.

from low to medium. Sensitivity to hydrodynamic changes leading to scour around subsea infrastructure was therefore assessed as **High**, based on the highest sensitivity to physical change to another sediment type and abrasion pressures.

9.11.3.68 **Ocean quahog (VER K)** is assessed by FeAST as having Low sensitivity to abrasion, however MarESA assesses this species to have High sensitivity to abrasion. Despite having a thick heavy shell, this species is known to be vulnerable to damage from physical abrasion. MarESA also assessed this species a having High sensitivity to physical change to another sediment type. As such overall sensitivity of ocean quahog to hydrodynamic changes leading to scour as **High**, assuming the most precautionary assessment.

Magnitude

9.11.3.69 A summary of the conceptual understanding of change is summarised below, for more detail refer to **Volume 3, Chapter 7: Marine Physical Process**.

9.11.3.70 **Cables:** Once buried, cables will not have any potential to impact seabed morphology unless exposed. Should this occur, the maximum depth of scour will be between one and three times the cable diameter (i.e. up to ~1 m) and the maximum horizontal extent of any scour effect will be up to 50 times the cable diameter (i.e. up to ~15 m).

9.11.3.71 **Cable protection:** By design, cable protection aims to minimise the risk of scour associated with both the cable and the protection itself. The low overall height of the rock berm relative to the water depth, along with relatively shallow gradient side slopes will limit the potential for form-related flow disturbance and scour, even when flows are perpendicular to the berm. Turbulence may become locally elevated in water flowing close to the surface of the berm, which may result in a limited depth and extent of secondary scour. This could be of the order of a few tens of centimetres deep and up a few metres from the berm where material is unconsolidated but far less in areas where mobile surficial material is absent. The seabed surface in the scoured area will generally be similar to the surrounding seabed but may develop an overall slightly coarser texture due to preferential winnowing of finer sediment grains over time.

9.11.3.72 **Presence of floating turbines and associated mooring/anchoring systems:** The main body of the floating foundation is located in the upper water column and is too distant from the seabed to cause a change in the near-bed local flow field or, therefore, any local scour. Where the mooring chain links and clump weights are partially or completely exposed, increased flow turbulence may cause local scour in proportion to the size of the object. A section of each mooring chain and dynamic cable may occasionally move in response to the movement of the floating foundation. The net effect may be an area of disturbed seabed up to a maximum of 4,620,000 m^2 (4.6 km^2) within the Offshore Array Area. Any patterns formed will be gradually redistributed to a natural state by ambient sediment transport processes over time. The nature of the seabed sediments and the rate of sediment transport through the affected area are unlikely to be changed by this process. Non-buried anchors, such as gravity base anchors, may cause a greater depth of local scour in proportion to their diameter, however, the limited height of these obstacles disrupts and limits the patterns of flow acceleration that can form, reducing the likely maximum dimensions of scour to the order of a few metres depth and up to *circa* 10 m extent, which is less than would be expected from a full water column height obstacle.

9.11.3.73 **Overall:** the magnitude of impact from hydrodynamic changes leading to scour around subsea structures is considered **Low**. This is because no measurable change to the morphology of the seabed is expected more than a few metres either side of the protection and fewer changes are expected around the floating platforms and associated mooring/anchoring systems.

9.11.3.74 **Kelp beds PMF** (**VER B**) is recognised as having potential to be present along the Nearshore ECC between KP0-1, where it is unlikely to overlap with the subsea infrastructure. On a precautionary basis, this PMF is likely to occur (Scenario 1) or be present with a high coverage (Scenario 2) along the Nearshore ECC. Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands and is considered to be nationally important (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from potential scour and the large national resource of Kelp beds PMF, loss of this PMF is assessed as discernible, and the magnitude as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.75 **Kelp and seaweed communities on sublittoral sediment PMF** (**VER G**) has the potential to be present along the north of the Nearshore ECC (KP0-1) (Scenario 1) or present with a high coverage (Scenario 2). This PMF is particularly widespread along the west coast of Scotland and in sheltered areas at Orkney and Shetland, with occasional records on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from potential scour the large national resource to this PMF, magnitude has been assessed as **Negligible** under Scenario 1, and **Low** under Scenario 2.

9.11.3.76 **Annex I geogenic reef** (**VER's B**, **C**, **D**) is recognised as having potential to be present along the north of the Nearshore ECC between KP0-4. Due to the lack of site-specific information, 'low' reefiness Annex I geogenic reef (Scenario 1) and 'medium' reefiness Annex I geogenic reef (Scenario 2) could overlap with some of the cable protection. This would represent a very small percentage of the total area of potential geogenic reef within the Benthic and Intertidal Study Area. Due to the localised impact from potential scour, and the presence of potential Annex I geogenic reef in the wider region, magnitude has been assessed as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.77 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the localised impact from potential scour and the widespread presence of *S. spinulosa* aggregations on mixed sediment (VER F) in the wider region, the magnitude has been assessed as **Low**. In contrast, due to the low potential of overlap with *S. spinulosa* on rock (VER D), magnitude has been considered **Negligible** under Scenario 1 and **Low** under the more precautionary Scenario 2.

9.11.3.78 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific surveys and the potential area of scour is considered to represent a very small percentage loss of the total area of the OSPAR Region II (Greater North Sea) within which ocean quahog is listed as under threat and/or declining. The magnitude of the impact on ocean quahog is therefore **Negligible**.

Significance of Effect

9.11.3.79 Overall sensitivity of rock habitats to the impacts associated with scour has been assessed as Medium, while sensitivity of sedimentary habitats has been assessed as High. Magnitude ranged from Negligible to Low. For both rock and sedimentary habitats. High sensitivity and Low magnitude of impact would result in an effect of **Minor** effect. As such, hydrodynamic changes leading to scour around subsea structures is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.80 No further mitigation is required following the assessment of hydrodynamic changes leading to scour around subsea infrastructure as having Minor effect, which is **Not Significant** in EIA terms.

Table 9-26 Summary of Impact Assessment for hydrodynamic changes leading to scour around subsea infrastructure

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14.**	Negligible	Stamp, 2015
			2	Medium	Low	Minor		Minor	
VER C	Circalittoral Rock	MC12243	1	Medium	Negligible	Negligible		Negligible	De-Bastos and Hill, 2016a
			2	Medium	Low	Minor		Minor	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Medium	Negligible	Negligible		Negligible	Till et al., 2018a
			2	Medium	Low	Minor		Minor	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	High	Low	Minor		Minor	De-Bastos and Marshall, 2016
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	High	Low	Minor		Negligible	Tillin et al., 2018b
			2	High	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	High	Negligible	Negligible		Negligible	Stamp et al., 2022
			2	High	Low	Minor		Minor	
VER I	Sublittoral Sand	MC5211	N/A	High	Low	Minor		Minor	Tillin, 2016

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER J	Circalittoral Mud	MC6211	N/A	High	Low	Minor		Minor	Tillin, 2022
VER K	Ocean quahog	-	2	High	Negligible	Negligible		Negligible	De-Bastos and Hill, 2016b

Colonisation of hard structures

Background

9.11.3.81 The introduction and long-term placement of artificial hard subsea structures into the marine environment can provide novel newly available substrates for INNS, but also habitats for native species. The potential impact may be assessed as both beneficial and adverse on adjacent sedimentary benthic communities. For example, there may be localised increases in habitat complexity and biomass, scour protection offering an artificial 'reef' effect, attracting other benthic species such as large mobile decapods, and localised increases in food availability via faecal deposition to the surrounding seafloor (Draeger *et al.*, 2020; Langhamer, 2012). However, assemblages on structures may not necessarily be more diverse than the underlying sediments lost through their installation, and with indirect changes to functioning of adjacent communities. For the purpose of this assessment, where the negative impact from introduction and spread of INNS during Operation and Maintenance is assessed separately, the potential balance between beneficial and adverse impacts of colonisation by native species of hard structures will primarily be considered here.

9.11.3.82 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Benthic and Intertidal Ecology Study Area, the risk of colonisation of hard structures during the Operation and Maintenance phase have been assessed for:

- VER B Infralittoral Rock;
- VER C Circalittoral Rock;
- VER D *Sabellaria* on Atlantic Rock;
- VER E Circalittoral Mixed Sediment;
- VER F *Sabellaria* on Mixed Sediment;
- VER G Sublittoral Coarse Sediment;
- VER I Sublittoral Sand; and
- VER J Circalittoral Mud.

9.11.3.83 All subtidal VER groups recorded as present within the Near-field Study Area and thus those may spatially overlap project infrastructure in place during the Operation and Maintenance phase area assessed. The assessment for sensitivity and magnitude will be combined, however, with separate assessments where relevant, on habitats and species of conservation value that may be representative of these VER groups.

Sensitivity of Receptor

9.11.3.84 The majority of the Offshore Development Area is represented by extensive sedimentary habitats (e.g. VER groups E, F, G, I and J; see **Table 9-16**). These soft sediments may potentially benefit from the establishment of localised new distinct hard bottom communities, providing organic enrichment of sediments, increasing food availability for deposit and filter feeding species that may in turn increase macrofaunal density and diversity (Draeger *et al.,* 2020). These changes in sediments with increases in fines and organic matter, may conversely cause localised changes in community assemblage pending on habitat requirements of resident.

9.11.3.85 **Subtidal Sediments (VERs E, F, G, H, I, J,)** under FeAST for 'Continental shelf sands', a feature analogous to the dominant VER I of the Offshore Array Area (Sublittoral Sand), it was concluded to not be sensitive to organic enrichment. However, it was assessed to be for changes to another seabed type, and with a medium sensitivity to low rates of siltation (e.g. that may occur through faecal deposition) (The Scottish Government, 2013). Overall, a **Medium** sensitivity is concluded for subtidal sediment VERs (E-G, I-J), including their relevant PMFs from the impact of colonisation of hard structures.

9.11.3.86 **Subtidal Hard Substrates (VERs B, C, D)** under FeAST for 'Tide-swept algal communities', a feature analogous to the PMF 'Kelp beds' that may represent VER B (Infralittoral Rock), a low sensitivity for organic enrichment and siltation (low and high rates) was reported (The Scottish Government, 2013). A review of MarESA for VER B, the PMF 'Kelp beds' (representative biotope MB12151), this feature was assessed to have a low sensitivity to any organic enrichment, and not sensitive to any smothering or siltation that may occur through faecal deposition. Any spatial interaction between these rockier VERs and artificial structures will be limited within the Offshore Development Area and where cable protection has been laid in the Nearshore ECC. However, any new species (native or INNS), colonising these hard substrates may also be able to colonise adjacent natural hard bottom area, and this may have an impact on resident communities. Overall, a **Medium** sensitivity is assigned for subtidal hard substrates VERs (B, C and D), including their relevant PMFs and Annex I features, from the impact of colonisation of hard structures.

Magnitude

9.11.3.87 The installation of semi-submersible floating platforms, the subsea hubs, mooring lines and clumps, inter-array and export cables, anchors and associated scour protection etc. will provide an estimated total surface area of 2,724,891 m² (2.7 km²) available for potential colonisation, which is approximately 3.38% of the 80.7 km² Near-field Study Area, and inclusive of the Far-field Study Area is 0.23% (refer to **Table 9-15** for full breakdown of calculations).

9.11.3.88 Much of these artificial hard structures will be installed within the Offshore Array Area, where although not all structures will be on the seabed itself, they may provide habitats for characteristic intertidal and shallow water epilithic species (e.g. mussels). Along the Offshore ECC, export cable protection will provide novel surfaces for potential colonisation, however, none within the intertidal where no scour protection is required.

9.11.3.89 Project infrastructure will be in the environment for up to 35 years, and as such colonisation may be expected to occur. Colonisation of structures have been documented to pass through successional stages from a pioneer stage with only a few early colonisers, a species-rich intermediate stage, and a climax stage (Degraer *et al.,* 2020). This rate and pattern of colonisation and subsequent successful settlement will depend on the position of the structure in the water column, their orientation, texture, and overall level of complexity of these structures. Mitigation measures will be undertaken to prevent general biofouling of these structures. Although these substructures can accommodate marine growth; to manage weight / drag-induced fatigue, growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools if substantial accumulation is in evidence. This measure will help reduce the successful colonisation of INNS, but in turn, will also remove settled native assemblage of flora and fauna reducing any potential beneficial impact this may have.

9.11.3.90 Overall spatial extent of novel surfaces made available through the scale of the Salamander Project is small, relative to the overall distribution of VER groups in the Near-field Study Area, and beyond within the wider Study Area. It is therefore, concluded that the magnitude of impact (beneficial or adverse) from the colonisation of hard structures during the Operation and Maintenance phase is **Low.**

Significance of Effect

9.11.3.91 Overall, the sensitivity of benthic ecology receptors associated with the colonisation of hard structures during the Operation and Maintenance phase has been assessed as Medium and magnitude was determined to be Low. A Medium sensitivity and Low magnitude of impact would result in an effect of **Minor** effect overall. As such, colonisation of hard structures during the Operation and Maintenance phase is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.92 No further mitigation is required following the assessment of colonisation of hard structures as having **Minor** effect, which is **Not Significant** in EIA terms.

Impact of cable thermal load or electromagnetic fields on benthic ecology

Background

9.11.3.93 The electrical transmission infrastructure will generate both an electric field (E-field) and a magnetic field (B-field) when in operation, collectively termed an electromagnetic field (EMF). Subsea cables are insulated, and prevent E fields from interacting with the environment, and so EMF consists solely of the B field within the marine environment. The strength of EMFs is dependent on the electric current strength through the cable and reduces with perpendicular distance away from the cable. Therefore, interactions between organisms and EMFs are dependent on the proximity of an individual to a live cable.

9.11.3.94 Electricity transmission will also cause cables to become heated relative to the ambient environment. Cables laid on the surface may emit heat energy, however, water flow above it is likely to reduce any effect. In contrast, buried cables can warm the sediments that are in direct contact, as well as the immediate surrounding environment. There is a greater relative field of effects for cohesive sediments (several tens of centimeters). These heating effects can both directly impact benthic species, potentially causing avoidance behaviour or physiological changes, or indirectly impact them through modifying sediment properties, microorganism communities and bacterial activity (Taormina, 2019).

9.11.3.95 Due to the location of the following VER groups (and their representative biotopes, species and conservation features) within the Study Area, impact of cable thermal load or EMF on benthic ecology throughout the Operation and Maintenance phase may occur and have therefore been assessed:

- **VER B** Infralittoral Rock;
- **VER C** Circalittoral Rock;
- **VER D** *Sabellaria* on Atlantic Rock;
- **VER E** Circalittoral Mixed Sediment;
- **VER F** *Sabellaria* on Mixed Sediment;
- **VER G** Sublittoral Coarse Sediment;
- **VER H** Littoral Sand;
- **VER I** Sublittoral Sand;
- **VER J** Circalittoral Mud; and

- **VER K** Ocean quahog.

9.11.3.96 Littoral rock (**VER A**) does not overlap with the planned Offshore ECC, and as such has not been assessed.

9.11.3.97 Cable burial where technically possible and use of cable protection will have the indirect benefit of reducing proximity of the receptor to the live cable. With the range of habitats, receptors, PMFs and potential Annex I habitats across the site, separate assessments will be made against each VER group(s).

Sensitivity of Receptor

9.11.3.98 The effects of EMFs on benthic communities are poorly understood and most habitats lack assessments in FeAST and MarESA. Recent studies point towards physiological and behaviour responses to increased EMF levels (Hutchinson *et al.*, 2020a; Jakubowska *et al.*, 2019). However, experiments are typically run at EMF levels much higher than experienced in the field (>2,000 µT; Bochert and Zettler, 2006, Jakubowska-Lehrmann *et al.*, 2022). For EMF values closer to those measured at the surface of the cables (the external protection around the cable) that would be installed for the Salamander Project (approx. 750 µT), the ragworm *Hediste diversicolor* showed no avoidance or attraction to EMF at 1,000 µT but burrowing activity was enhanced (Jakubowska *et al.*, 2019). Enhanced burrowing did not affect the consumption and respiration rate but ammonia excretion rate was significantly reduced in EMF exposed animals. EMF studies on blue mussel *Mytilus edulis* revealed EMF treatment at 300 µT did not exhibit observable differences in the valve activity and filtration rate (Albert *et al.*, 2022). A more recent study demonstrated a subtle exploratory response of the America lobster *Homarus americanus* to EMF at 65.3 µT (Hutchinson *et al.*, 2020b).

9.11.3.99 Other studies suggest that benthic communities growing along cable routes are similar to those in nearby baseline areas, and where species are not found this is likely due to the physical presence of the cable and surface properties, rather than an EMF effect (Copping and Hemery, 2020).

9.11.3.100 Like with EMF, there is a lack of evidence for the potential effect of heat from subsea cables on benthic assemblages, but impacts are overall considered to not be significant (review by Taormina, 2019).

9.11.3.101 Research to date shows limited evidence on the effect of EMF and cable thermal load on benthic communities. However, it cannot be overlooked that there is evidence for some behavioural and biological impacts on benthic species. A precautionary **Low** sensitivity is assigned to rock habitats (VER B-D) and **Medium** sensitivity for the sedimentary habitats (**VER E-J**) and ocean quahog (**VER K**). **Table 9-27** summarises the sensitivity of each VER to EMF**.**

Magnitude

9.11.3.102 The Salamander Project electrical transmission (HVAC) infrastructure will generate EMFs principally at 50 Hz, which are often referred to as power frequency, or extremely low frequency (ELF) EMFs.

9.11.3.103 The Salamander Project has modelled the expected EMF levels from the offshore export and inter-array cables, based on the realistic worst-case assumption of a 3-core submarine cable with 630 mm^2 copper conductors operating at 66 kV and 715 A. Electrical fields stemming from the cable conductors are completely shielded by the solidly bonded screens, while the magnetic fields in the vicinity of the stranded 3-core cables are calculated using industry-standard methodology, based on the lay length of the power cores, the distance between power cores and the phase current loadings of the conductors. A summary of the results is provided below, for further detail refer to **Volume ER.A.2, Chapter 4: Project Description**.

9.11.3.104 For buried cables, the magnetic field at the seabed depends on the depth of lowering. The peak magnetic field at the seabed drops from c. 2 µT when buried to 1 m to c. 0.1 µT when buried to 2 m. Average static cable depths of lowering at the Salamander Project are expected to be in the range of 1 to 2 m (buried in the sediment or under cable protection), however a 1 m depth of lowering has been assumed as a realistic worst-case for EMF. Approximately tens of metres of each of the 500 m dynamic cable ends will make intermittent direct contact with the seabed. The magnetic field at the cable surface is c. 750 µT and drops to c.75 µT once a distance of 25 cm is reached, decreasing further to below 1 µT at a distance of 1.5 m from the cable. For context, Earth's natural magnetic field varies between approximately 25-65 µT (Hutchinson *et al.*, 2020).

9.11.3.105 EMF has the potential to cause localised heating of solids and interstitial porewater such as seabed sediments, however this effect is likely to be of a small magnitude (<6°C) and dissipated within tens of centimetres from the surface of the cable.

9.11.3.106 **Overall:** as a precaution, the magnitude of effects of thermal load and EMF from subsea cables is considered **Low**.

9.11.3.107 **Kelp beds PMF** (**VER B**) is recognised as having potential to be present along the Nearshore ECC between KP0-1, where it is unlikely to overlap with the cable protection. On a precautionary basis, this PMF is predicted to either be present (Scenario 1) or present with a high coverage (Scenario 2). Kelp beds PMF is widely recorded around all coasts of the Scottish mainland and islands and is considered to be nationally important (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from cable thermal load and EMF and the large national resource of Kelp beds PMF, the magnitude has been assessed as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.108 **Kelp and seaweed communities on sublittoral sediment PMF** (**VER G**) has the potential to be present along the north of the Nearshore ECC (KP0-1) (Scenario 1) or present with a high coverage presence (Scenario 2). This PMF is particularly widespread along the west coast of Scotland and in sheltered areas at Orkney and Shetland, with occasional records on the east coast (Tyler-Walters *et al.*, 2016; Scottish Government, 2022). Due to the localised impact from cable thermal load and EMF the large national resource of this PMF, magnitude has been assessed as **Negligible** under Scenario 1, and **Low** under Scenario 2.

9.11.3.109 **Annex I geogenic reef** (**VER's B**, **C**, **D**) is recognised as having potential to be present along the north of the Nearshore ECC between KP0-4. Due to the lack of site-specific information, 'low' reefiness Annex I geogenic reef (Scenario 1) or 'medium' reefiness (Scenario 2) Annex I geogenic reef could overlap with some of the cable protection. This would represent a very small percentage of the total area of potential geogenic reef within the Benthic and Intertidal Ecology Study Area. Due to the localised impact from cable thermal load and EMF, and the presence of potential Annex I geogenic reef in the wider region, magnitude has been assessed as **Negligible** under Scenario 1 and **Low** under Scenario 2.

9.11.3.110 ***Sabellaria spinulosa*** **(VER D and F)** is recognised as forming on rock (VER D) and mixed sediment (VER F) across the Wider Survey Area. The potential impact on 'bommies' will be considered as part of VER F under Scenario 2, while Scenarios 1 and 2 will also assume the presence of a low elevation encrusting *S. spinulosa* biotope. Due to the localised impact from cable thermal load and EMF and the widespread presence of *S. spinulosa* aggregations on mixed sediment (VER F) in the wider region, the magnitude has been assessed as **Low**. In contrast, due to the low potential of overlap with *S. spinulosa* on rock (VER D), magnitude has been considered **Negligible** under Scenario 1 and **Low** under the more precautionary Scenario 2.

9.11.3.111 **Ocean quahog (VER K)** was recorded in low numbers during the site-specific surveys and the potential impact from EMF is considered to represent a very small percentage loss of the total area of the OSPAR

Region II (Greater North Sea) within which ocean quahog is listed as under threat and/or declining. The magnitude of the impact on ocean quahog is therefore **Negligible**.

Significance of Effect

9.11.3.112 Overall, the sensitivity of rock habitats to the impacts associated with cable thermal load and EMF has been assessed as Low and Medium for sedimentary habitats. Magnitude ranged from Negligible to Low for both rock and sedimentary habitats. Medium sensitivity and Low magnitude of impact would result in an effect of **Minor**. As such, impact of cable thermal load and EMF on benthic and intertidal ecology is **Not Significant** in EIA terms.

Further Mitigation

9.11.3.113 No further mitigation is required following the assessment of impact of cable thermal load and EMF on benthic and intertidal ecology as having Minor effect, which is **Not Significant** in EIA terms.

Table 9-27 Summary of Impact Assessment for cable thermal load or Electronic Field on benthic ecology

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER B	Infralittoral Rock	MB12151	1	Low	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14.**	Negligible	Taormina, 2019; Copping and Hemery, 2020; Hutchinson *et al.*, 2020; Albert *et al.*, 2022
			2	Low	Low	Negligible		Negligible	
VER C	Circalittoral Rock	MC12243	1	Low	Negligible	Negligible		Negligible	
			2	Low	Low	Negligible		Negligible	
VER D	*Sabellaria* on Atlantic Rock	MC12811	1	Low	Negligible	Negligible		Negligible	
			2	Low	Low	Negligible		Negligible	
VER E	Circalittoral Mixed Sediment	MC4213	N/A	Medium	Low	Minor		Minor	Jakubowska *et al.*, 2019; Taormina, 2019; Copping and Hemery, 2020; Hutchinson *et al.*, 2020; Albert *et al.*, 2022
VER F	*Sabellaria* on Mixed Sediment	MC2211	1	Medium	Low	Minor		Minor	
			2	Medium	Low	Minor		Minor	
VER G	Sublittoral Coarse Sediment	MB3211	1	Medium	Negligible	Negligible		Negligible	
			2	Medium	Low	Minor		Minor	

Receptor	Name	Representative Biotope	Scenario	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect	Sensitivity Source
VER H	Littoral Sand	MC6211	N/A	Medium	Low	Minor		Minor	
VER I	Sublittoral Sand	MC5211	N/A	Medium	Low	Minor		Minor	
VER J	Circalittoral Mud	MC6211	N/A	Medium	Low	Minor		Minor	
VER K	Ocean quahog	N/A	N/A	Medium	Negligible	Negligible		Negligible	

9.11.4 Decommissioning

9.11.4.1 Under the decommissioning phase, the following potential impact has been assessed:

- Removal of artificial hard substrate.

9.11.4.2 With the exception of impact from removal of artificial hard substrate, the other impacts associated with the Decommissioning phase of the Salamander Project (as per **Table 9-15**) are expected to reflect the nature of impacts associated with the Construction phase, however, with some potential variation depending on the extent of Decommissioning undertaken and methods used. For example, if it is determined that assets of the Salamander Project are to be left *in situ*, such as cable protection, there will be a notable reduction in the potential for seabed habitat disturbance. Preliminary information on Decommissioning effects is provided in **Table 9-15** and detailed in **Volume A.2, Chapter 4: Project Description**.

Removal of Artificial Hard Substrate

9.11.4.3 As detailed in **Section 9.11.2**, hard substrate introduced into the Study Area will become colonised by epifauna. The removal of project infrastructure during Decommissioning would therefore remove the supporting habitats and associated communities. In the event that the project infrastructure is colonised by Annex I or PMFs, the appropriate approach to Decommissioning will be agreed with NatureScot.

9.11.4.4 Removal of the substrate will result in localised decline in biodiversity and will be limited to subtidal habitats. The sediment dominated habitats that remain will be open to recolonisation from the surrounding sedimentary habitats. It is expected that the baseline benthic communities will recover in these areas following removal of infrastructure. Sensitivity of receptors are expected to reflect that for sediment disturbance and would equate to **Medium** for hard substrate habitats (VERs B-D) and **High** for sedimentary habitats (VERs E-J) and ocean quahog (VER K).

9.11.4.5 The current assumption is that scour protection and cable rock protection will be left *in situ.* As such removal of the project infrastructure may lead to a permanent loss of 820,920 m^2 (0.82 km^2) of hard substrate, equivalent to 63%. However, the effects will be strictly localised. Therefore, based on the information available, the expected magnitude of impacts is **Low**.

9.11.4.6 The magnitude of the impact has been assessed as low, with the maximum sensitivity as high. Therefore, the significance of effects from removal of the hard substrate during Decommissioning activities is **Minor.** As such, impact of hard substrate removal on benthic and intertidal ecology is **Not Significant** in EIA terms.

9.11.4.7 Any potential differences in impacts associated with Decommissioning of the Salamander Project will be assessed within a standalone EIA (or equivalent assessment) prior to the commencement of any project-specific decommissioning works.

9.11.4.8 Therefore, in addition to impact associated with removal of artificial hard substrate, the remaining impacts (as per **Table 9-15**) are assessed akin to those associated with Construction. As such, Decommissioning impacts to Benthic and Intertidal Ecology from these impacts are **Not Significant** in EIA terms.

9.11.5 Summary of Impact Assessment

9.11.5.1 A summary of the impacts and effects identified for the Benthic and Intertidal Ecology assessment is outlined in **Table 9-28**.

Table 9-28 Summary of Impacts and Effects for Benthic and Intertidal Ecology

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Construction									
Temporary habitat loss	OAAand Offshore ECC	Co14 and Co12	VER B Infralittoral Rock (Scenario 1) VER C Circalittoral Rock (Scenario 1) VER D Sabellaria on Atlantic Rock (Scenario 1) VER G Sublittoral coarse sediment (Scenario 1) Ocean quahog	Medium – High	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAAand Offshore ECC	Co14 and Co12	VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 2) VER D Sabellaria on Atlantic Rock (Scenario 2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral coarse sediment (Scenario 2) VER H Littoral sand	Medium – High	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			VER I Sublittoral Sand VER J Circalittoral Mud				None Required		
Increase SSC and associated deposition	OAAand Offshore ECC	Co48 and Co9	VER B Infralittoral Rock (Scenario 1) VER E Circalittoral Mixed Sediment VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand VER K Ocean quahog	Low – High	Negligible – Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was	Negligible	Not Significant
	OAAand Offshore ECC	Co48 and Co9	VER A Littoral Rock VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 & 2) VER F Sabellaria on Mixed Sediment (Scenario 1 & 2)	Medium	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			VER I Sublittoral Sand VER J Circalittoral Mud				Not Significant		
Increased risk and introduction and spread of INNS	OAAand Offshore ECC	Co9 and Co44	VER B Infralittoral Rock (Scenario 1) VER C Circalittoral Rock (Scenario 1) VER D Sabellaria on Atlantic Rock (Scenario 1) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog	Low – High	Negligible – Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAAand Offshore ECC	Co9 and Co44	VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 2) VER D Sabellaria on Atlantic Rock (Scenario 2)	Medium – High	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			VER G Sublittoral Coarse Sediment (Scenario 2)						
Disturbance of contaminated sediments	OAAand Offshore ECC	Co9 and Co48	VER A Littoral Rock VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 & 2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand	Low – Medium	Negligible – Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAAand Offshore ECC	Co9 and Co48	VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog	Medium	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Operation and Maintenance									
Long-term loss to benthic habitats and species	OAAand Offshore ECC	Co14 and Co12	VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1) VER K Ocean quahog	Low – High	Negligible – Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAAand Offshore ECC	Co14 and Co12	VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 2) VER I Sublittoral Sand VER J Circalittoral Mud	High	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Temporary habitat loss or disturbance	OAAand Offshore ECC	Co14, Co12 and Co10	VER B Infralittoral Rock (Scenario 1) VER C Circalittoral Rock (Scenario 1) VER D Sabellaria on Atlantic Rock (Scenario 1) VER G Sublittoral Coarse Sediment (Scenario 1) VER K Ocean quahog	Medium – High	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAAand Offshore ECC	Co14, Co12 and Co10	VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 2) VER D Sabellaria on Atlantic Rock (Scenario 2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 2) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud	Medium	Low	Minor		Minor	Not Significant
Increased risk and introduction	OAAand Offshore ECC	Co10, Co13 and Co44	VER B Infralittoral Rock (Scenario 1) VER C Circalittoral Rock (Scenario 1) VER D Sabellaria on Atlantic Rock (Scenario 1)	Low – High	Negligible – Low	Negligible	No additional mitigation measures have been	Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
and spread of INNS			VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog				identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant		
	OAAand Offshore ECC	Co10, Co13 and Co44	VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 2) VER D Sabellaria on Atlantic Rock (Scenario 2) VER G Sublittoral Coarse Sediment (Scenario 2)	Medium – High	Low	Minor		Minor	Not Significant
Impact of habitats or species as a result of pollution or accidental discharge	OAAand Offshore ECC	Co10 and Co7	VER A Littoral Rock VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 &2) VER E Circalittoral Mixed Sediment	Low – Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the	Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog				embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant		
Impact of habitats or species as a result of pollution or accidental discharge	OAA and Offshore ECC	Co10 and Co7	VER A Littoral Rock VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 &2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand VER I Sublittoral Sand	Low – Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded	Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			VER J Circalittoral Mud VER K Ocean quahog				that the effect was Not Significant		
Hydrodynamic changes leading to scour around subsea infrastructure	OAAand Offshore ECC	N/A	VER B Infralittoral Rock (Scenario 1) VER C Circalittoral Rock (Scenario 1) VER D Sabellaria on Atlantic Rock (Scenario 1) VER G Sublittoral Coarse Sediment (Scenario 1) VER K Ocean quahog	Medium – High	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAA and Offshore ECC	N/A	VER B Infralittoral Rock (Scenario 2) VER C Circalittoral Rock (Scenario 2) VER D Sabellaria on Atlantic Rock (Scenario 2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 and 2) VER G Sublittoral Coarse Sediment (Scenario 2) VER I Sublittoral Sand VER J Circalittoral Mud	Medium – High	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Colonisation of hard structures	OAA and Offshore ECC	N/A	VER A Littoral Rock VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 &2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Impact of cable thermal load or EMF on benthic ecology	OAA and Offshore ECC	N/A	VER A Littoral Rock VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 &2) VER G Sublittoral Coarse Sediment (Scenario 1) VER K Ocean quahog	Low – Medium	Negligible – Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Negligible	Not Significant
	OAA and Offshore ECC	N/A	VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 2) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud	Medium	Low	Minor		Minor	Not Significant
Decommissioning									

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Removal of Artificial Hard Substrate	OAA and Offshore ECC	Co28	VER B Infralittoral Rock (Scenario 1 & 2) VER C Circalittoral Rock (Scenario 1 & 2) VER D Sabellaria on Atlantic Rock (Scenario 1 &2) VER E Circalittoral Mixed Sediment VER F Sabellaria on Mixed Sediment (Scenario 1 & 2) VER G Sublittoral Coarse Sediment (Scenario 1 & 2) VER H Littoral Sand VER I Sublittoral Sand VER J Circalittoral Mud VER K Ocean quahog	Medium – High	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 9-14** as it was concluded that the effect was Not Significant	Minor	Not Significant

9.12 Mitigation and Monitoring

9.12.1.1 No additional mitigation or monitoring is required, as none of the impacts assessed alone were deemed significant in EIA terms.

9.13 Cumulative Effect Assessment

9.13.1.1 A Cumulative Effects Assessment (CEA) has been made based on existing and proposed developments. Cumulative effects are defined as those effects on a receptor that may arise when the proposed Salamander Project is considered together with other projects.

9.13.1.2 The maximum spatial extent of potential effects on Benthic and Intertidal Ecology as identified within this chapter are determined by the Salamander Project footprint and the Far-field Study Area as defined by the spring tidal excursion. Areas beyond this range are unlikely to experience any measurable change. As such, only plans or projects with potential to overlap spatially or temporally will be included in the cumulative assessment.

9.13.1.3 On this basis, the projects considered within this cumulative assessment are all operational and planned OWFs and subsea cables/ interconnectors within the Far-field Study Area.

9.13.1.4 On this basis, the projects being considered for cumulative assessment are provided in **Table 9-29** and presented in **Figure 9-15**. Please note that where more than one ECC route option for a project is available the realistic worst-case scenario was presented (closest to the Offshore Development). For Marram Wind there is only an ECC area of search available which overlaps the Offshore Array Area and Offshore ECC.

Table 9-29: Projects within the Benthic and Intertidal Ecology Study Area considered within the cumulative effects assessment.

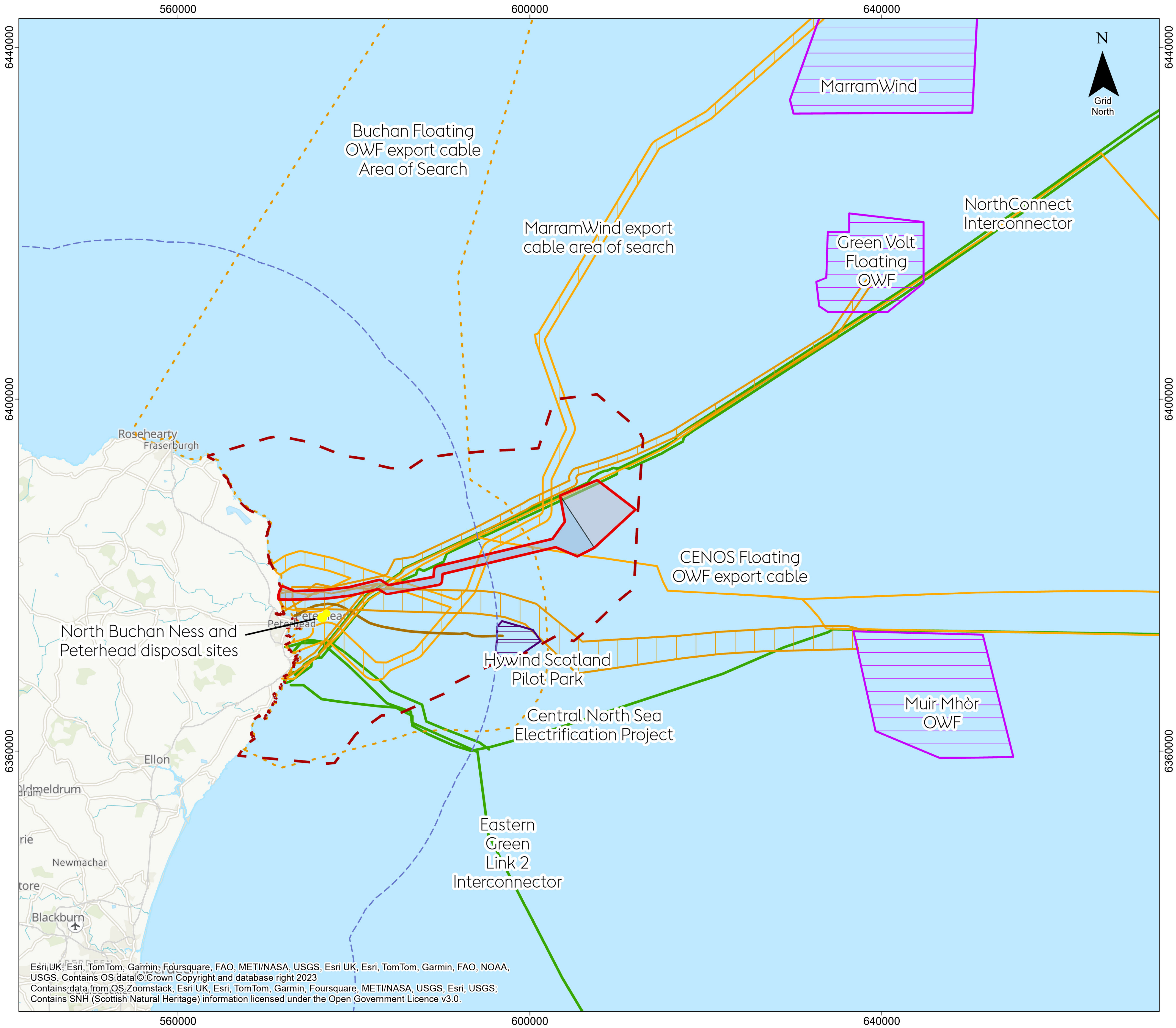
Development	Type	Project Phase	Closest distance from Project		Pathway overlap	Reason for inclusion
			Array	ECC		
Offshore Wind Farm Projects						
Hywind Scotland Pilot Park	Floating Offshore Wind Farm	Operational	11.7 km	8.1 km		Potential for construction/operation overlap and overlap with the Far-field Study Area
Green Volt Floating OWF export cable	Floating Offshore Wind Farm	Consent application Submitted	0.3 km	Overlaps (cable crossing(s) likely)		Potential for construction/operation overlap and overlap with the Near-field Study Area
Buchan Floating OWF export cable	Floating Offshore Wind Farm	Scoping submitted	1.44 km	Overlaps (however cable crossing(s) unlikely)		Potential for construction/operation overlap and overlap with the Near-field Study Area It should be noted that the export cable route for this project is delineated by the *search area* as opposed to expected route. As such, although there is a degree of

Development	Type	Project Phase	Closest distance from Project		Pathway overlap	Reason for inclusion
			Array	ECC		
						interaction with the Offshore ECC, there is not expected to be any crossing between the two cable routes
Cenos Floating OWF Export Cable	Floating Offshore Wind Farm	Scoping submitted	0 km (potential overlap with Offshore Array Area)	Overlaps (cable crossing(s) likely)		Potential for construction/operation overlap and overlap with the Near-field Study Area
MarramWind OWF export cable[8]	Floating Offshore Wind Farm	Scoping submitted	1.5 km	Overlaps		Potential for construction/operation overlap and overlap with the Near-field Study Area
Muir Mhòr OWF export cable	Floating Offshore Wind Farm	Scoping submitted	5.53 km	Overlaps		Potential for construction/operation overlap and overlap with the Near-field Study Area

[8] Distances provided for MarramWind are based on the ECC area of search, and should not be considered necessarily indicative of the route that will subsequently be proposed.

Development	Type	Project Phase	Closest distance from Project		Pathway overlap	Reason for inclusion
			Array	ECC		
Interconnector Cables						
Central North Sea Electrification (CNSE) Project	Platform Electrification	Scoping submitted	18.1 km	4.6 km	Long-term habitat loss. Temporary habitat loss or disturbance. Increase SSC and associated deposition. Increase risk of introduction and spread of INNS. Disturbance of contaminated sediments.	Potential for construction/operation overlap and overlap with the Far-field Study Area
NorthConnect	Interconnector	Approved	0 km	Overlaps		Potential construction/operational overlap and overlap with the Near-field Study Area.
Eastern Green Link 2 (EGL2)	Interconnector	Consented	26.8 km	2.9 km		Potential for construction/operation overlap and overlap with the Far-field Study Area
Dredge Soil Disposal						
Peterhead (CR070)	Dredge Spoil Disposal	Operational	33.9 km	3.1 km	Temporary habitat loss or disturbance. Increase SSC and associated deposition.	Potential for construction/operation overlap and overlap with the Far-field Study Area
North Buchan Ness (CR080)	Dredge Spoil Disposal	Operational	29.9 km	1.7 km		Potential for construction/operation overlap

Development	Type	Project Phase	Closest distance from Project		Pathway overlap	Reason for inclusion
			Array	ECC		
					Increase risk of introduction and spread of INNS. Disturbance of contaminated sediments.	and overlap with the Far-field Study Area



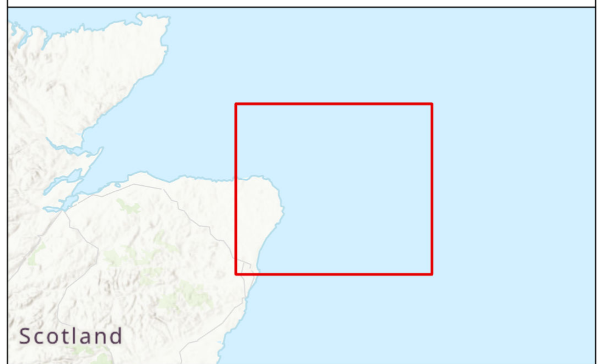
Salamander

Figure 9-15

Location of other projects likely to overlap the Study Area

Legend

- Offshore Development Area
- Offshore Array Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Far-field Study Area (Spring Tidal Excursion Buffer)
- Disposal Sites
- Offshore Wind Farms - Operational
- Offshore Wind Farms - Planned
- Offshore Wind Farm Export Cables- Operational
- Offshore Wind Farm Export Cable Corridors - Planned
- Buchan Offshore Wind Farm export cable Area of Search
- Subsea Cables
- 12nm limit



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:420,000

0 10 20 Kilometers

0 3.25 6.5 13 Nautical Miles

Rev	Description	Date
00	Final Issue	11/04/2024
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Doc. Title : Near-field cumulative projects identified for assessment
Doc. No : SWFER0382
Created by : BO
Checked by : AN
Approved by : RM

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9.13.2 Potential Cumulative Effects

9.13.2.1 The first stage of the CEA is to identify the potential for effects assessed alone to have cumulative pathways with other projects. The outcome of this stage is presented in **Table 9-30**.

Table 9-30 Potential cumulative effects relating to Benthic and Intertidal Ecology

Effect Assessed Alone	Potential for Cumulative Effect	Rationale
Construction Phase		
Temporary habitat loss or disturbance	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding the footprint of temporary habitat loss or disturbance associated with other projects.
Increase SSC and associated deposition	Yes	There is potential for sediment plumes of other projects to coincide with plumes generated during construction of the Salamander Project.
Increase risk of introduction and spread of INNS	Yes	Increase in vessel activities from other projects in the region will increase the risk of INNS introduction and spread.
Disturbance of contaminated sediments	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding the footprint of disturbance of contaminated sediments associated with other projects.
Operation and Maintenance Phase		
Long-term habitat loss	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding the footprint of long-term habitat loss associated with other projects.
Temporary habitat loss and disturbance	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding the footprint of temporary habitat loss or disturbance associated with other projects.
Increased risk of introduction and spread of INNS	Yes	Increase in vessel activities and artificial substrate from other projects in the region will increase the risk of INNS introduction and spread.

Effect Assessed Alone	Potential for Cumulative Effect	Rationale
Impact to habitats or species as a result of pollution or accidental discharge	Yes	Increase in vessel activities and WTGs in the region will increase the risk of pollution or accidental discharge.
Hydrodynamic changes leading to scour around subsea infrastructure	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding the footprint hydrodynamic changes leading to scour around subsea infrastructure associated with other projects.
Colonisation of hard structures	Yes	Limited to the Near-field Study Area, however, there is potential change in significance at a regional scale when regarding increase in hard structures in the region in association with other projects.
Impact of cable thermal load or EMF on benthic ecology	Yes	EMF effects have the potential to change the behaviour and physiology of benthic species that may also interact with other EMF-producing projects.
Decommissioning Phase		
It is expected that all effects associated with Decommissioning assessed alone, and therefore also cumulatively, are similar and of lower magnitude as those identified within the construction phase of the Salamander Project. This assumption is subject to implementation of best practice methods and technology appropriate at the time of Decommissioning.		

9.13.2.2 The second stage of the CEA is to assess the significance of each potential cumulative effect in relation to relevant external projects considered within the CEA.

9.13.2.3 Project-specific EIARs for the consented projects have been used to inform the CEA. The early planning/pre-consent application stage projects have limited available data and project details within their Scoping Reports to inform the CEA. Therefore, a high-level approach for these projects has been taken.

Construction

Temporary habitat loss or disturbance

9.13.2.4 There is the potential for the construction and/or operation period of projects listed in **Table 9-29** to overlap with the Construction period of the Salamander Project.

9.13.2.5 The nearby Hywind Scotland Pilot Park (HSPP) is operational and therefore cumulative effects via temporary habitat loss or disturbance would only arise if cable repair and reburial activities occurred at the same time as construction activities for the Salamander Project. Cable repair and remediation works that may be required by the HSPP are likely to be of a lesser impact on temporary habitat loss or disturbance than from construction activities related to the Salamander Project.

9.13.2.6 The Scotland England Green Link 2 (SEGL2) will result in approximately 15.2 km² of temporary habitat loss or disturbance (AECOM UK Ltd, 2022), however, only a small fraction of this overlaps with the Benthic and Intertidal Ecology Study Area.

9.13.2.7 The Green Volt OWF will result in a total of 4,535,000 m³ (4.5 km³) of temporary habitat disturbance (RoyalHaskoningDHV, 2023), however only a fraction of this overlaps with the Benthic and Intertidal Ecology Study Area.

9.13.2.8 The area of which may be affected by habitat loss or disturbance from the installation of the NorthConnect HDVC cable is approximately 4.6 km² (NorthConnect KS, 2018). Of this approximately 0.95 km² is expected to occur within the Benthic and Intertidal Ecology Study Area[9].

9.13.2.9 The dredge disposal sites CR070 and CR080 overlap and occupy approximately 1.5 km² of the seabed, overlapping with the Benthic and Intertidal Ecology Study Area.

9.13.2.10 The temporary habitat loss or disturbance within the Benthic and Intertidal Study Area from the remaining projects is unknown but expected to be substantial. However, construction of all these projects is unlikely to take place at the same time within the Benthic and Intertidal Study Area. The impacts will be highly localised and will comprise temporary short term habitat disturbance. As the habitats within the Study Area are common and widespread throughout the wider region, cumulative effects would be **Minor**, which is **Not Significant** in EIA terms.

Increase in suspended sediment concentrations and associated deposition

9.13.2.11 Plumes generated from the various developments listed in **Table 9-29** could meet and coalesce to form one larger plume, or sediment disturbance could occur within a plume generated by the Salamander Project (or *vice versa* from another development).

9.13.2.12 In general, sediment plume interactions have the potential to occur if the activities generating the sediment plumes are located within one spring tidal excursion ellipse from one another and occur at the same time. Under mean spring conditions the maximum tidal excursion is approximately:

- 8 km in the Offshore Array Area;
- 12-14 km in the middle of the Offshore ECC; and
- 17 km close to the Landfall.

9.13.2.13 All of the projects listed in **Table 9-29** are within a spring tidal excursion eclipse from either the Offshore Array Area and / or the Offshore ECC and thus, may generate a measurable change in SSC from sediment plume dispersion.

9.13.2.14 For the most part, the sediment disturbance activities associated with the Salamander Project are likely to involve the release of coarse-grained material, and finer material from activities at the seabed surface and drilling associated with the installation of mooring systems. Modelling has shown that coarse grained sediment will be spatially constrained to point source disturbance (0-50 m), and fine sediment will be subject to rapid dispersion and will be returned to background level within 48 hours.

9.13.2.15 The nearby HSPP is operational, therefore, cumulative effects via increase in SSC and associated deposition would only arise if cable repair and reburial activities occurred at the same time as construction activities

[9] Based on a 20 m wide disturbance corridor and approximately a length of 47.5 km of cable through the Far-field Study Area.

for the Salamander Project. Maintenance works that may be required are unlikely to be frequent enough to result in a significant change to SSC across the Study Area.

9.13.2.16 The construction timeline for SEGL2 is uncertain and therefore it is not possible to ascertain if there will be a cumulative impact from construction activities. However, assuming construction overlaps between both projects, the measurable SSC increase with relation to SEGL2 construction activities will be limited to the footprint of the construction works plus a 1.5 km buffer (AECOM UK Ltd, 2022). Due to the distance of SEGL2 and the Salamander Project (>2.9 km), the 1.5 km buffer would only overlap with the Far-field zone (500 m to the tidal excursion buffer), associated with a low to intermediate increase in SSC from construction activities related the Salamander Project. It is likely that the combination of the two plumes would be similar to the SSC expected to occur within Intermediary zone (50-500 m) from construction activities related to the Salamander Project (see **Section 9.11** and **Volume ER.A.4, Annex 7.1: Marine Physical Processes Technical Annex**). In addition, as the SEGL2 subsea interconnector route veers southwards, the potential for sediment plume overlap is limited to a small area of the Benthic and Intertidal Ecology Study Area.

9.13.2.17 The construction timeline for Green Volt OWF specific to cable installation and associated cable protection is also uncertain, however the maximum installation program is expected to be 38 days. The increase in SSC is expected to be within the range of natural variability in the system e.g. during storms (RoyalHaskoningDHV, 2023).

9.13.2.18 There is no information available on the possible concentration and extent of the sediment plume generated from rock placement and trenching activities related to the NorthConnect HDVC cable. However, sediment suspension and deposition are expected to be very localised and short-term in duration (NorthConnect KS, 2018).

9.13.2.19 When disposing of fine materials in coastal waters, the main environmental effects are associated with SSC and increases in turbidity. However, sediment suspension and deposition are expected to be localised and short-term in duration.

9.13.2.20 The construction timelines for all the other projects mentioned in **Table 9-29** are uncertain and there is little information available regarding potential increase in SSC. Therefore, it is not possible to ascertain if there will be a cumulative impact from the installation. However, assuming all projects were constructed in tandem, there is the potential for the installation of these cables to result in an increase in suspended sediment and extent of the plume. However, the most measurable increase in SSC is expected to occur in the Intermediary zone between 50 to 500 m from operations. Standard 500 m safety zones will be applied during construction, decommissioning and major maintenance. There is, therefore, a small chance of measurable sediment plume overlap to occur between the various projects. At this distance, SSC is expected to return to background levels within one hour after the end of disturbance. Likewise, the greatest likelihood of deposition is limited to 50 m from the source of disturbance.

9.13.2.21 Due to the localised footprints of both sediment deposition (50 m) and the most measurable increase in SSC (50 to 500 m), and the magnitude of the impact being short-term, intermittent the cumulative effects would be **Minor**, which is **Not Significant** in EIA terms.

Increased risk of introduction and spread of Invasive Non-Native Species

9.13.2.22 INNS can be introduced to the Near-field Study Area from increased vessel activity. Although it is not possible to ascertain if there will be cumulative effects with projects listed in **Table 9-29** there is the potential for the construction timelines to overlap and further increase in vessel activity within the Benthic and Intertidal Ecology Study Area. However, assuming all vessels adhere to embedded mitigation and industry standards, there will be no change to the magnitude of impact. Therefore, cumulative effects would be **Minor**, which is **Not Significant** in EIA terms.

Disturbance of contaminated sediments

9.13.2.23 There is the potential for the construction and/or operational period of all other projects to overlap with the Construction period of the Salamander Project.

9.13.2.24 The nearby HSPP is operational, therefore, cumulative effects via temporary habitat loss or disturbance would only arise if cable repair and reburial activities occurred at the same time as construction activities for the Salamander Project. Cable repair and remediation works that may be required by the HSPP will cause disturbance to a smaller area from construction activities than the Salamander Project.

9.13.2.25 Construction of SEGL2 will disturb approximately 15.2 km² of the seabed that could result in the release of contaminated sediments (AECOM UK Ltd, 2022), however, only a small fraction of this overlaps with the Benthic and Intertidal Ecology Study Area.

9.13.2.26 Construction of Green Volt OWF will result in a total of 4,535,000 m^3 (4.5 km^3) of temporary habitat disturbance (RoyalHaskoningDHV, 2023), however only a fraction of this overlaps with the Benthic and Intertidal Ecology Study Area.

9.13.2.27 The area of which may be affected by temporary habitat disturbance from installation of the NorthConnect HDVC cable is approximately 4.6 km² (NorthConnect KS, 2018). Of this approximately 0.95 km² is expected to occur within the Benthic and Intertidal Ecology Study Area.

9.13.2.28 At the disposal sites, FEPA pre-licensing assessment process prevent the disposal of highly contaminated sediment in the marine environment. In the UK levels of contamination in sediments that are to be deposited at sea are monitored by Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) within Scottish waters.

9.13.2.29 The area of sediment disturbance within the Benthic and Intertidal Study Area from the remaining projects is unknown but expected to be substantial. However, construction of all these projects is unlikely to take place at the same time within the Benthic and Intertidal Study Area. The impacts will be highly localised and will comprise temporary short term habitat disturbance.

9.13.2.30 Surveys within the region have reported contaminant concentrations to be generally within background levels (Statoil, 2015; Royal HaskoningDHV, 2021). As such the cumulative effects of contaminated sediment would be the same as for the impact alone; **Minor**, which is **Not Significant** in EIA terms.

Operation and Maintenance

Long-term habitat loss

9.13.2.31 Long-term habitat loss from most of the projects listed in **Table 9-29**, will be associated with cable protection, where cable burial is not technically possible. Please note that long-term habitat loss from cable crossings has been considered within **Section 9.11**. Cable burial to suitable depths is generally most feasible in sedimentary habitats, which tend to be the most sensitive to long-term habitat loss. As such, only a limited footprint of cable protection is expected to be installed across these sensitive sedimentary habitats in comparison to hard substrate habitats, which are less sensitive to habitat loss from the installation of artificial hard substrate (see **Section 9.11.3**).

9.13.2.32 HSPP OWF is a small scale OWF with a subtidal footprint of approximately 0.275 km² (Statoil, 2015).

9.13.2.33 Sedimentary habitats within the Benthic and Intertidal Ecology Study Area are broadscale and widely distributed across the region, as such cumulative effects from long-term habitat loss have been assessed as **Minor**, which is **Not Significant** in EIA terms.

Temporary habitat loss or disturbance

9.13.2.34 Temporary habitat loss or disturbance during the Operation and Maintenance phase is expected to be of a lower magnitude than during the Construction phase. As such, cumulative effects have been precautionarily assessed similar to the Construction phase as **Minor**, which is **Not Significant** in EIA terms.

Increased risk of introduction and spread of Invasive Non-Native Species

9.13.2.35 The presence of project infrastructure may provide suitable artificial habitat for INNS settlement and / or further introduction to the area, from Operation and Maintenance vessels undertaking maintenance and remedial work.

9.13.2.36 All other projects presented in **Table 9-29** will provide additional settlement surface through the provision of cable protection. Please note that long-term habitat loss from cable crossings has been considered within **Section 9.11**. As cables will be buried where possible, cable protection is not expected to be considerable. Subtidal artificial substrate presents a lesser risk of acting as 'stepping stones' as there is already naturally occurring subtidal hard substrate in the nearshore region.

9.13.2.37 Vessels during the Operation and Maintenance phase are also expected to be less frequent than during Construction.

9.13.2.38 In addition, the risk of the introduction and spread of INNS during the Operation and Maintenance phase will be reduced through adherence to best practice such as development of a Biosecurity Plan.

9.13.2.39 Overall, cumulative effects for the increased risk of introduction and spread of INNS was assessed as **Minor**, which **Not Significant** in EIA terms.

Impact of habitats or species as a result of pollution or accidental discharge

9.13.2.40 Although it is not possible to ascertain if there will be cumulative impact with other projects listed in **Table 9-29**, there is the potential for the construction and/or operational timelines to overlap with the Salamander Project Operation and Maintenance phase and further increase vessel activity in the area, and therefore risk of accidental discharge within the Benthic and Intertidal Ecology Study Area. However, assuming all vessels adhere to embedded mitigation and industry standards, there will be no change to the magnitude of impact.

9.13.2.41 With consideration of the embedded mitigation, adoption of best practice methods and the strong hydrodynamic regime in the region, the cumulative effects from pollution or accidental discharge have been assessed as **Minor**, which is **Not Significant** in EIA terms.

Hydrodynamic changes leading to scour around subsea infrastructure

9.13.2.42 Scour protection will be used around anchors and subsea hubs associated with the Salamander Project and has also been implemented around anchors associated with the HSSP infrastructure.

9.13.2.43 For all the other projects listed in **Table 9-29**, cables are expected to be buried where possible and where it is not feasible, cable protection is likely to be used. Cable protection is designed to reduce the effects of scouring around cables.

9.13.2.44 Hydrodynamic changes leading to scour around subsea infrastructure within the Benthic and Intertidal Ecology are therefore expected to be strongly localised and of small extent. As such, the cumulative effects from scour have been assessed as **Minor**, which **Not Significant** in EIA terms.

Colonisation of hard structures

9.13.2.45 The introduction and long-term placement of artificial hard subsea structures into the marine environment can provide novel newly available substrates for INNS but also for native species. The introduction of hard structures such as scour protection can lead to an increase in biomass and biodiversity which may be considered beneficial, but it also represents a change from the baseline environment which may be considered adverse.

9.13.2.46 Apart from scour protection, cable protection (including cable crossings) already assessed for the Salamander Project in **Section 9.11**, there will likely be some additional cable protection material associated with projects listed in **Table 9-29**. However, cable burial is most likely to occur in sedimentary habitats, which have the highest sensitivity to colonisation of hard structures.

9.13.2.47 The cumulative impact of colonisation of the floating substructures and scour and cable protection on benthic ecology is predicted to be of local spatial extent, long-term duration but reversible once the infrastructure is removed. In addition, burial of cable where possible will limit the extent of cable protection available for colonisation.

9.13.2.48 Overall, cumulative impact from colonisation of hard structures is expected to be **Minor**, which is **Not Significant** in EIA terms.

Impact of cable thermal load or electromagnetic fields on benthic ecology

9.13.2.49 As described in **Section 9.11.3**, Benthic and Intertidal Ecology receptors have low to medium sensitivity to EMFs or thermal load arising from the cables during Operation and Maintenance.

9.13.2.50 Where possible cables will be buried and where not feasible, cable protection will be placed over the cables. These measures will reduce the effects of EMF on the surface sediments.

9.13.2.51 For HSPP, the export cable will be armoured and buried to a depth of 1.5 m where possible and protected elsewhere (Statoil, 2015). The cables to be used are up to 33 kV, with significantly less fields surrounding the cables when compared to the 132 kV cables used in most OWFs. Directly surrounding the cable the magnetic field may be up to 6 µT. However, at 2 m from the cable this would decrease to approximately 2 µT which is well below that of the Earth's magnetic field (which is between 30 and 70 µT) and may not be detectable.

9.13.2.52 SEGL2 is committed to burying cables to a minimum depth of 0.6 m with a target depth of 1.5 m. Modelling on the level and attenuation of the EMF for SEGL2 indicated that EMF from a buried cable at 1m reduces to background levels at a distance of 20 m for cable, both vertically and horizontally (AECOM UK Ltd, 2022).

9.13.2.53 Green Volt OWF is committed to bury cables to a minimum depth of lowering of 0.6 m and non-buried cables will have rock protect to a height of 1.5 m above the seabed. A full EMF assessment found the magnetic fields produced by both cable routes were found to be highly localised, reducing rapidly from the source to the single 3-core cable used (RoyalHaskoningDHV, 2023).

9.13.2.54 NorthConnect HDVC cable will be buried to a depth of 0.4m in hard substrates and 0.5 m in soft substrates (NorthConnect KS, 2018). The magnetic field at the seabed would be at most 640 µT and would reduce to less than 300 µT within 2m of the seabed at worst-case and best case separation distances.

9.13.2.55 For the remaining projects, there is limited information but EMF is expected to be localised around the subsea cables/interconnectors.

9.13.2.56 At cable crossings the level of EMF is likely to increase, and assuming a realistic worst-case approach EMF has been assumed to be additive. The additive effect of EMF from Green Volt OWF (54.7 µT for cable buried at 0.6 m; National Grid, 2022) and the Salamander Project (2 µT for cable buried at 1 m) however is still expected to be below thresholds to impact benthic ecology receptors (see **Section 9.11.3**). Similarly, the additive effect of EMF from SEGL2 (406 µT) and the Salamander Project, will be a little higher than SEGL2 alone (404 µT; AECOM UK Ltd, 2023) and expected additive value is below most thresholds recognized to impact benthic ecology (see **Section 9.11.3**). The additive effect of EMF from NorthConnect HDVC cable (640 µT) and the Salamander Project, will be a little higher than NorthConnect HDVC cable alone (642 µT; NorthConnect KS, 2018) and expected additive value is below most thresholds to impact benthic ecology (see **Section 9.11.3**). The distance of elevated EMF will also likely increase however as EMF reduces rapidly from the source, the impact will remain highly localised.

9.13.2.57 Due to the localised impact from EMF and low sensitivity of receptors, the cumulative effects of cable thermal load and EMF has been assessed as **Minor**, which is **Not Significant** in EIA terms.

9.14 Assessment of Impacts Cumulatively with the Onshore Development

9.14.1.1 The Onshore Development components are summarised in **Volume ER.A.2, Chapter 4: Project Description**. These Project aspects have been considered in relation to the impacts assessed within this chapter.

9.14.1.2 The main components of the Onshore Development which have the potential to disturb receptors of Benthic and Intertidal Ecology include trenchless installation at the Landfall.

9.14.1.3 Receptors detailed within the impact assessment of this chapter primarily at risk of interactions with the Onshore Development include Receptor groups VER A littoral rock, VER B infralittoral rock, VER G sublittoral coarse sediment, VER H littoral sand and VER I sublittoral sand.

9.14.1.4 The impacts associated with trenchless installation at the Landfall with potential to impact Benthic and Intertidal Ecology receptors (i.e below MHWS) have been assessed in **Section 9.11**.

9.14.1.5 It is not anticipated that there will be any additional impacts from the Onshore Development on Benthic and Intertidal Ecology receptors as all other activities from the Onshore Development are fully terrestrial.

9.15 Transboundary Effects

9.15.1.1 Transboundary effects are defined as effects that extend into other European Economic Area (EEA) states. These may occur from the Salamander Project alone, or cumulatively with other plans or projects.

9.15.1.2 The Benthic and Intertidal Ecology Study Area is located over 100 km from any non-UK EEA state boundaries; as such no transboundary effects are expected with non- UK EEA states. Transboundary effects has therefore been screened out for Benthic and Intertidal Ecology.

9.16 Inter-related Effects

9.16.1.1 The following assessment considers the potential for inter-related effects to arise across the three project phases (i.e. project lifetime effects) as well as the interaction of multiple effects on a receptor (i.e. receptor-led effects).

- Project lifetime effects are considered to be effects that occur throughout more than one phase of the project, (Construction, Operation and Maintenance, And Decommissioning) to interact to potentially create a more significant effect on a receptor, than if just assessed in isolation in these three key project phases (e.g. Construction Phase, Operational and Maintenance Phase and Decommissioning).
- Receptor-led effects involve spatially or temporal interaction of effects, to create inter-related effects on a receptor or receptor group. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

9.16.1.2 It is important to note that the inter-related effects assessment considers only effects produced by the offshore elements of the Salamander Project and not from other projects, which are considered within **Section 9.13.2**.

9.16.1.3 The significance of the individual effects, as determined in **Section 9.11** is presented herein for each receptor group. A descriptive assessment of the scope for these individual effects to interact to create a different or greater effect has then been undertaken. This assessment incorporates qualitative and, where reasonably possible, quantitative assessments. It should be noted that the following assessment does not assign significance of effect for inter-related effects; rather, any inter-related effects that may be of greater significance than the individual effects acting in isolation on a given receptor are identified and discussed.

9.16.1.4 Potential inter-relationships exist between Benthic and Intertidal Ecology receptors and:

- Water quality: impacts on water quality may result in impacts on benthic and intertidal ecology;
- Fish and shellfish: impacts to benthic and intertidal ecology may affect the food resource available to fish;
- Ornithology: impacts to benthic and intertidal ecology may affect the food resource available to bottom-feeding diving birds, waders and other wildfowl; and
- Commercial fisheries: impacts on benthic communities may impact on catch and effort of commercial fisheries.

9.16.1.5 Inter-related effects assessment has been conducted in **Volume ER.A.3, Chapter 22: Inter-related Effects**. For clarity, the areas of interaction between impacts are listed below:

- Temporary habitat loss or disturbance have been assessed within this chapter (**Section 9.11.2** for Construction phase and in **Section 9.11.3** and **9.11.4** for Operation and Maintenance and Decommissioning), and in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**;

- Increased suspended sediment and associated deposition has been assessed within this chapter (**Section 9.11.2** for Construction phase and in **Section 9.11.3** and **9.11.4** for Operation and Maintenance and Decommissioning), and in **Volume ER.A.3; Chapter 7: Marine Physical Processes, Chapter 8: Water and Sediment Quality** and **Chapter 10: Fish and Shellfish Ecology**;
- Accidental release of pollutants has been assessed within this chapter (**Section 9.11.3** for the Operation and Maintenance phase, and in **Volume ER.A.3, Chapter 8: Water and Sediment Quality**;
- Accidental release of contaminants from disturbance of sediments has been assessed within this chapter (**Section 9.11.2** for the Construction phase), and in **Volume ER.A.3, Chapter 8: Water and Sediment Quality**;
- Long-term loss of habitat via project infrastructure has been assessed within **Section 9.11.3** of this chapter for the Operation and Maintenance phase, and in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**;
- Increased risk of introduction and spread of INNS has been assessed within this chapter (**Section 9.11.2** for Construction phase and in **Section 9.11.3** and **9.11.4** for Operation and Maintenance and Decommissioning); and
- Effects of EMF emissions from electrical cables has been assessed within **Section 9.11.3** of this chapter for the Operation and Maintenance phase, and in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**.

9.16.1.6 Impacts such as increased SSC and resuspension of contaminated sediments (leading to sediment and water quality changes), may affect other receptors, such as sediment and water quality and fish (indirect effects of pathways changes); however, these inter-relationships are considered in the respective topic-specific chapters.

9.16.1.7 In terms of inter-relationships and potential interaction of multiple impacts, creating a more significant effect upon one receptor, the realistic worst-case scenario of interaction between various pathways and coalescence between impacts, has been taken into account during the main assessment. The effects of the impacts identified have been considered minor adverse or negligible, therefore not producing an increased likelihood of significant inter-related impacts. Inter-related effects are mostly temporary and localised in nature over the lifetime of the OWF. A summary of these inter-relationships between impacts is presented in **Table 9-31**.

Table 9-31 Summary of the potential project lifetime inter-related effects for Benthic and Intertidal Ecology

Impacts	Residual Effects			Inter-related Effects
	Construction 18 months	*Operation and Maintenance 35 years*	*Decommissioning 18 months*	
Temporary habitat loss or disturbance	Minor	Minor	Minor	Temporary habitat loss or disturbance to benthic habitats and species will occur across all phases of the Project (Table 9-15). The total area of inter-related habitat loss or disturbance has been assumed based on the combined area of habitat loss or disturbance from Construction and Operation and

Impacts	**Residual Effects**			**Inter-related Effects**
	Construction *18 months*	*Operation and Maintenance* *35 years*	*Decommissioning* *18 months*	
				Maintenance, totalling 1,220,700 m² (1.2 km²). This is the same area expected to be lost or disturbed during Decommissioning. Given the high level of spatial overlap and the expected degree of recoverability in benthic communities it is expected that Project lifetime effects will not result in combined effects of greater significance than for the Decommissioning phase. A total of 1.2 km² cumulative habitat loss throughout the project duration represents a small proportion (0.9%) of the total habitat present within the Far-field Study Area. The habitats and characterising biotopes expected to be impacted are common and widespread throughout the wider region. Additionally, each disturbance event occurring at any one location within the Study Area will not be continuous and will be short-term. While the impact will be locally significant and comprise temporary short-term habitat loss or disturbance within the Near-field Study Area, the loss and disturbance will be highly localised. As such, although inter-related effects may be marginally greater than effects associated with individual activities, impacts are not expected to be of greater magnitude and inter-related habitat loss is not predicted to have a notable effect on benthic and intertidal ecology receptors.
Long-term habitat loss (including via project infrastructure)	Negligible	Minor	Minor	Placement of project infrastructure will result in long-term loss to benthic habitats and species. The effects from the presence of project infrastructure will commence when offshore Construction begins and increasing incrementally up to the realistic worst-case scenario, represented by the fully operational project. Across the project lifetime, the effects on benthic ecology receptors are not anticipated to be sufficiently different from those of the operational phase, as to result in combined effects of greater significance.

Impacts	Residual Effects			Inter-related Effects
	Construction *18 months*	*Operation and Maintenance* *35 years*	*Decommissioning* *18 months*	
Increased suspended sediment and associated deposition	Minor	Negligible	Minor	The effects of increased sediment suspended concentration (SSC) caused by seabed disturbance will primarily occur during the Construction and Decommissioning phases of the Salamander Project. The spatial extent of significant seabed disturbance and associated increase of SSC and deposition is expected to be localised, only within the near-field and intermediate impact zones of the activity (up to 500 m), limited by the coarser nature of the substrate at the site. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Impact to habitats or species as a result of pollution or accidental discharge	Negligible	Negligible	Negligible	The risk of accidental release of pollutants into the water column from vessels will primarily occur during the Construction and Decommissioning phases of the Salamander Project. Mitigation measures will be in place to reduce the risks and emergency response plans will be implemented in the unlikely event of an accident, further localising the extent of a spill. Furthermore, in the unlikely event of an accident, the high energy nature of the receiving environment and its ability to flush and disperse any substance entering the water column, would minimise the magnitude of the impact. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Increased risk of introduction and spread of invasive non-native species (INNS)	Minor	Minor	Minor	Increased vessel activity during all Salamander Project phases will be associated with a potential increased risk of introduction of INNS into the area, and there is the risk of colonisation by INNS on the installed marine infrastructure that provides suitable artificial habitat for settlement. Project embedded mitigation measures include the development of an INNS Plan that will provide a framework for management of biosecurity issues and invasive species for the Project duration, and will include compliance with relevant guidance regarding ballast water; these measures will reduce the overall risk of introduction. Within the impact assessment (**Section 9.11**) it is determined

Impacts	*Residual Effects*			*Inter-related Effects*
	Construction 18 months	*Operation and Maintenance* 35 years	*Decommissioning* 18 months	
				that the negligible to low magnitude of the effect, combined with low to high sensitivity of the receptor will result in impact of minor significant for each individual Project phase. Although assessment of Project lifetime effects may lead to a small increase in INNS risk, this is still likely to remain of low magnitude. Given that receptor sensitivity is unchanged over this increased temporal extent, combined effects over the project lifetime will not increase to be of greater significance than the assessments for each individual phase.
Effects of electromagnetic field (EMF) emissions from electrical cables	n/a	Minor	n/a	Cable EMFs will only be produced at the time of energy transmission. As such, this will be limited to the Operation and Maintenance phase, and there is no potential for Project lifetime inter-related effects.
Receptor Based Effects				
There is potential for interactions between the effects of habitat loss/disturbance/alteration, and effects on benthic habitats from sediment deposition associated with elevated SSC. It is considered that there is greatest risk of inter-related impacts from the combined effects of direct (both temporary and long-term) habitat loss/disturbance (from placement of anchors from vessels and jack-up events, seabed levelling and boulder clearance), indirect habitat disturbance (from cable installation/burial and due to sediment deposition), and indirect effects of changes in physical processes due to the presence of Project infrastructure within the marine environment. Each of these potential impacts was assigned an individual significance of minor. Although there is potential for effects to be amplified in areas where there is spatial and temporal overlap, it is expected that there will be a degree of spatial and temporal separation and, therefore, the combined effects will not be any more significant than the individual worst-case effects considered in isolation. Any disturbance is expected to be limited, and the benthic habitats and species seen within the baseline environment are widespread. Where temporary disturbance occurs, full recovery is predicted. In addition, any effects due to changes in physical processes are likely to be spatially limited and of small magnitude. As such, these interactions are predicted to be no greater than the individual effects assessed in isolation.				

9.17 Conclusion and Summary

9.17.1.1 This chapter has investigated the potential effects on intertidal and subtidal benthic ecology receptors arising from the Construction, Operation and Maintenance and Decommissioning phases of the Salamander

Project. The range of potential effects considered within this chapter has been informed by existing policy and guidance, Scoping Opinion and stakeholder consultation workshops.

9.17.1.2 The Salamander Project and its associated Benthic and Intertidal Ecology Study Area are located in the Central North Sea, extending from Cairnburg in the North to Whinnyfold in the south and out to approximately 40 km offshore from Peterhead. The Benthic and Intertidal Ecology Study Area in general is characterised by subtidal sands offshore, followed by mixed sediments closer to shore and a mosaic of hard substrata and sedimentary habitats have been assumed from regional data as occurring near to shore. Habitats and species of conservation interest considered to be present are Annex I geogenic reef as well as Kelp beds, Kelp and seaweed communities on sublittoral sediment, Tide-swept algal communities and Ocean quahog PMFs. In addition, *Sabellaria* 'bommies' were assumed to be present within the Study Area.

9.17.1.3 VERs were used to assess the potential effects associated with the Salamander Project. A full summary of the result of the impact assessment is presented in **Table 9-28**, including the requirement for additional mitigation and consequential residual effects. All effects associated with the Salamander Project were assessed as having No Impact to Minor effects, which are Not Significant in EIA terms. As such no additional mitigation was required.

9.17.1.4 The CEA considered all proposed and existing OWF projects and developments within the Benthic and Intertidal Ecology Study Area. Cumulative effects are expected to be Minor at worst.

9.17.1.5 Due to the distance of the Benthic and Intertidal Ecology Study Area to non-UK EEA states no transboundary effects are expected. The inter-related effects are not likely to result in a greater effect significance above that assessed for effects alone due to the small scale of the Salamander Project.

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