

Morven Offshore Wind Farm

Morven Hawthorn Pit Grid Connection Project

Preliminary Environmental Information Report

Volume 2, Chapter 4: Fish and Shellfish Ecology

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Annexes

Annex number	Annex title
4.1	Herring and Sandeel Assessment
4.2	Marine EMF Assessment

Glossary

Term	Meaning
B-field	Magnetic field (magnetic flux density) component of an Electromagnetic Field (EMF).
Commitments	Measures (embedded mitigation and secondary) to be adopted during the construction, operation and maintenance, and decommissioning phases of the MHPGC Project.
Cumulative effect	The combined effect of the MHPGC Project in combined with the effects from other proposed developments, on the same receptor or resource.
Cumulative effects assessment	Assessment of the likely effects arising from the MHPGC Project alongside the likely effects arising from other proposed developments on the same receptor or resource.
Development Consent Order (DCO)	An order made under the Planning Act 2008, as amended, granting development consent.
E-field	Electric field component of an electromagnetic field (EMF).
Embedded mitigation	Measures included as part of the project design. Includes both primary a tertiary mitigation.
Environmental Impact Assessment (EIA)	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
High Voltage Alternating Current (HVAC)	A HVAC electric power transmission system uses alternating current for electric power transmission that periodically reverses direction at regular intervals.
High Voltage Direct Current (HVDC)	A HVDC electric power transmission system uses direct current for electric power transmission, in contrast to the more common alternating current systems. Most HVDC links use voltages between 100 kilovolts (kV) and 800kV.
iE-field	Induced electric field generated by interaction between magnetic fields and conductive seawater.
Inter-related effects	Effects that may arise from the interactions between different EIA topic effects considered within the project-alone assessment, potentially leading to more significant effects than if they were to be considered in isolation.
Landfall	The area in which the offshore export cables make landfall (come onshore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area between the trenchless technique exit pits and the transition joint bay inclusive of all construction works.
Magnitude	A combination of the spatial extent, duration, frequency and reversibility of an impact
Marine Directorate Licensing Operations Team (MD-LOT)	The part of the Scottish Government's Marine Directorate responsible for assessing and administering applications for marine licences for Scottish waters and Section 36 consent (offshore) in Scotland.
Marine Management Organisation (MMO)	The MMO, as a UK government body, is responsible for licensing, regulating and overseeing activities in the marine environment for English waters. For a DCO and deemed marine licence, the MMO acts as a statutory consultee,

Term	Meaning
	advising on marine planning, environmental impacts, habitats and compliance with marine licensing regulations.
Maximum Design Scenario (MDS)	The realistic worst case scenario, selected on a topic-specific and impact specific basis, from a range of potential parameters for the MHPGC Project.
Mean High Water Springs (MHWS)	The most inshore level location reached by the sea at high tide during mean high water spring tide. This is defined as the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	The average height of the low water levels of each pair of successive low waters during the periods of about 24 hours when the tidal range is at its greatest.
MHPGC Project Environmental Statement (ES)	The document presenting the results of the Environmental Impact Assessment process.
MHPGC Project Preliminary Environmental Information Report (PEIR)	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (EIA) Regulations 2017. This is information that enables consultees to understand the likely significant environmental effects of a project and which helps to inform consultation responses.
MHPGC Project Scoping Report	A Scoping Report for the MHPGC Project, scoping the likely significant effects (LSE) of the project on the environment, was submitted and accepted by Planning Inspectorate (PINS) and submitted to the Scottish Ministers, via MD-LOT in February 2025.
MHPGC Project Scoping Opinions	Separate scoping opinions received from PINS (on behalf of the Secretary of State (SoS)) and MD-LOT (on behalf of the Scottish Ministers) in response to the MHPGC Project Scoping Report. The MHPGC Project Scoping Opinions contain the range of issues that PINS, and MD-LOT in consultation with statutory stakeholders, have identified should be considered within the EIA process.
Morven Hawthorn Pit Grid Connection Project ('MHPGC Project')	The MHPGC Project is comprised of the offshore export cables in Scottish and English waters from the Morven North or the Morven South offshore substation platform(s) (OSP(s)), landfall, onshore export cables, the onshore land substation (LSS) and AC connection cables. Also referred to in this report as the MHPGC Project, for ease of reading.
Morven North Boundary	Boundary within which the wind turbines and foundations, Offshore Substation Platforms and foundations, inter-array and interconnector cables and associated infrastructure for Morven North will be located.
Morven North Offshore Wind Array Project (hereafter 'Morven North')	The Morven North Offshore Wind Array Project which includes the wind turbines and foundations, OSP(s) and foundations, inter-array and interconnector cables and associated infrastructure located within the Morven North Boundary.
Morven South Boundary	Boundary within which the wind turbines foundations, OSP(s) and foundations, inter-array and interconnector cables and associated infrastructure for Morven South will be located.
Morven South Offshore Wind Array Project (hereafter 'Morven South')	The Morven South Offshore Wind Array Project, which includes the wind turbines and foundations, OSP(s) and foundations, inter-array and

Term	Meaning
	interconnector cables and associated infrastructure located within the Morven South Boundary.
National Grid Hawthorn Pit Substation	The National Grid substation at Hawthorn Pit, County Durham, which the AC connection cables will connect into from the Onshore Land Substation.
Offshore substation platforms (OSPs)	OSP(s) comprise the support structure, topside and electrical components used for collecting the electricity generated by the wind turbine generators, in Scottish waters, for the passage or transmission to landfall. These OSP(s) can be divided into two types: – HVAC collector substations; – HVDC converter substations.
Operations and maintenance phase (O&M)	The operational and maintenance phase of the MHPGC Project.
Planning Inspectorate (PINS)	The PINS is an executive agency of the UK Government responsible for administering and examining DCO applications for NSIPs in England. PINS manages the application process, oversees consultation and examination, and makes a recommendation to the relevant Secretary of State on whether consent should be granted.
Primary mitigation	Measures included as part of the location or design of the MHPGC Project made during the pre-application phase that are an inherent part of the MHPGC Project and do not require additional action to be taken. This includes modifications arising through the iterative design process. These measures will be secured through the consent itself through the description of the MHPGC Project, the parameters and associated commitments secured by the DCO and marine licence, or both.
Residual effects	Effects that continue to exist after mitigation has been applied.
Secondary mitigation	Actions that will require further activity to achieve the anticipated outcome and may be imposed as part of the planning consent, or through inclusion in the ES. These include measures required to reduce the significance of environmental effects and may be secured through an environmental management plan. For secondary mitigation measures, both pre-mitigation and residual effects are presented.
Significance	Effect factor that is determined by the magnitude of impact along with the sensitivity of the receptor.
Tertiary mitigation	Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.
the Study Area	For each environmental topic, the baseline environment will be characterised, and the likely significant effect will be described within a topic-specific Study Area. Specific Study Areas are defined for each topic and are based on the maximum spatial extent across which LSE of the MHPGC Project may be experienced by the relevant receptors (i.e. Zone of Influence (ZoI)).
Transboundary impact	Potential impacts resulting from MHPGC Project and affecting another European Economic Area (EEA) state.
Transboundary effects	Assessment of LSE resulting from MHPGC Project on the interests of another EEA state(s).

Term	Meaning
Zone of influence (ZoI)	The area within which impacts arising from the MHPGC Project could occur upon receptors.

Acronyms

Acronym	Meaning
AC	Alternating Current
As	Arsenic
BNG	Biodiversity Net Gain
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effect Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFE	Controlled Flow Excavation
CIEEM	Chartered Institute for Ecology and Environmental Management
CLV	Cable Laying Vessels
CMS	Construction Method Statement
CoCP	Code of Construction Practice
COLREG	International Regulations for Preventing Collisions at Sea
CPS	Cable Protection Systems
CSIP	Cable Specification and Installation Plan
CSV	Construction Support Vessel
CTV	Crew Transport Vessel
DC	Direct Current
DCO	Development Consent Order
DDSFB	Dee District Salmon Fishery Board
DDV	Drop Down Video
DECC	Department of Energy and Climate Change
Defra	Department for Environment and Rural Affairs
DML	Deemed Marine Licence
DSV	Dive Support Vessels
E-fields	Electric Fields
EA	Environment Agency
EAR	Environmental Appraisal Report
ECC	Export Cable Corridor
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMODnet	European Marine Observation and Data Network

Acronym	Meaning
EMP	Environmental Management Plan
EQS	Environmental Quality Standards
ERL	Effects Range Low
ES	Environmental Statement
EU	European Union
EUNIS	European Nature Information System
EWG	Expert Working Group
FDI	Fisheries Dependent Information
FeAST	Feature Activity Sensitivity Tool
FU	Functional Units
FWPM	Freshwater Pearl Mussel
GES	Good Environmental Status
GIS	Geographic Information System
GV	Guard Vessels
HDD	Horizontal Directional Drilling
HPMA	Highly Protected Marine Area
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAC	Inter-Array Cable
ICES	International Council for the Exploration of the Sea
IUCN	International Union for Conservation of Nature
iE-Fields	Induced Electric Fields
IEMA	Institute of Environmental Management and Assessment
IHLS	International Herring Larvae Survey
IMO	International Marine Organisation
INNS	Invasive Non-Native Species
ISEP	Institute of Sustainability and Environmental Professionals
ISV	Installation Support Vessels
JNCC	Joint Nature Conservation Committee
KP	Kilometre Point
LAT	Lowest Astronomical Tide
LOD	Limit of Detection

Acronym	Meaning
LSE	Likely Significant Effect
MarESA	Marine Evidence-based Sensitivity Assessment
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-Beam Echosounder
MBP	Marine Biosecurity Plan
MCRS	Minimum Conservation Reference Size
MCZ	Marine Conservation Zone
MD-LOT	Marine Directorate – Licensing Operations Team
MDS	Maximum Design Scenario
MFE	Mass Flow Excavation
MHPGC	Morven Hawthorn Pit Grid Connection
MHWS	Mean High Water Springs
MLA	Marine Licence Application
MLWS	Mean Low Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MTD	Marine Technical Directorate Ltd.
NBN	National Biodiversity Network
NEQ	Net Explosive Quantity
NERC	Natural Environment and Rural Communities
NFPD	National Fish Populations Database
NPPF	National Planning Policy Framework
NPS	National Policy Statements
NPS EN-1	National Policy Statement for Energy (EN-1)
NPS EN-3	National Policy Statement for Renewable Energy Infrastructure (EN-3)
NPS EN-5	National Policy Statement for Electricity Networks Infrastructure (EN-5)
NSAS	North Sea Autumnal Spawning
NS-IBTS	North Sea International Bottom Trawl Survey
NSIP	Nationally Significant Infrastructure Project

Acronym	Meaning
O&M	Operations and Maintenance
OEMP	Offshore Environmental Management Plan
OSP	Offshore Substation Platform
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWC	Offshore Wind Consultants
OWF	Offshore Wind Farm
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PLGR	Pre-Lay Grapnel Run
PMF	Priority Marine Features
PrePARED	Predators and Prey Around Renewable Energy Developments
PSA	Particle Size Analysis
RIAA	Report to Inform Appropriate Assessment
RMS	Root Mean Square
SAC	Special Area of Conservation
SBES	Single-Beam Echosounder
SBP	Sub-Bottom Profiler
ScotMER	Scottish Marine Energy Research
sCPT	seismic Cone Penetration Testing
SFF	Scottish Fisherman's Federation
SNCB	Statutory Nature Conservation Body
SoS	Secretary of State
SOV	Service Operation Vessel
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
SSS	Side-Scan Sonar
SSSI	Site of Special Scientific Interest
STECF	Scientific, Technical and Economic Committee for Fisheries

Acronym	Meaning
TAC	Total Allowable Catch
TraC	Transitional and Coastal
TSV	Trench Support Vessels
TTS	Temporary Threshold Shift
UHRS	Ultra-High-Resolution Seismic
UK	United Kingdom
USBL	Ultra-Short Baseline
USV	Unmanned Service Vessel
UXO	Unexploded Ordnance
VER	Valued Ecological Receptor
VTMP	Vessel Traffic Management Plan
ZoI	Zone of Influence

Units

Unit	Meaning
°C	degrees Celsius
cm	Centimetres
dB	Decibels
Hz	Hertz
km	kilometres
kV	kilovolts
m	Metre
mG	Milligauss
mg/l	Milligrams per litre
NM	Nautical Mile
µT	microtesla

4 Fish and Shellfish Ecology

4.1 Introduction

4.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary findings of the Environmental Impact Assessment (EIA) work undertaken to date for the Morven Hawthorn Pit Grid Connection Project (hereafter 'MHPGC Project'), as described in **Volume 1, Chapter 2: Project Description, of the PEIR**.

4.1.1.2 The chapter considers the potential impacts and effects on Fish and Shellfish that could result from the construction, operation and maintenance (O&M) and decommissioning phases of the MHPGC Project. Specifically, it relates to the offshore elements of the MHPGC Project from the offshore substation platform(s) (OSPs) within Morven North Offshore Wind Array Project or Morven South Offshore Wind Array Project (hereafter 'Morven North and Morven South') located within Scottish offshore waters, transiting through English offshore and inshore waters, to Mean High Water Springs (MHWS) at the landfall in County Durham.

4.1.1.3 This chapter describes the methodology, datasets that have informed the preliminary assessment, baseline conditions, including future baseline, any required mitigation measures and the preliminary residual significant effects on Fish and Shellfish receptors that could result from the MHPGC Project.

4.1.1.4 The assessment is informed by the following chapters of the PEIR:

- **Volume 1, Chapter 2: Project Description;**
- **Volume 1, Chapter 3: Site Selection & Consideration of Alternatives;**
- **Volume 1, Chapter 4: Approach to Environmental Impact Assessment;**
- **Volume 1, Chapter 5: Policy and Legislation;**
- **Volume 2, Chapter 1: Physical Processes;**
- **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology;**
- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 2, Chapter 6: Marine Ornithology;**
- **Volume 2, Chapter 7: Commercial Fisheries;**
- **Volume 4, Chapter 5: Inter-related Effects.**

4.1.1.5 The chapter also draws on information contained within the following annexes of the PEIR:

- **Volume 1, Annex 4.1: Draft Commitments Register;**
- **Volume 1, Annex 4.2: Transboundary Screening Annex;**
- **Volume 1, Annex 4.3: Cumulative Screening and Location Plan;**
- **Volume 2, Annex 1.1: Physical Processes Technical Report;**
- **Volume 2, Annex 3.1: Benthic Ecology Technical Report;**
- **Volume 2, Annex 4.1: Herring and Sandeel Assessment;**
- **Volume 2, Annex 4.2: Morven HVDC EMF Study;**
- **Volume 2, Annex 5.1: Underwater Sound Technical Report.**

4.1.1.6 The chapter also draws on information contained within the following reports prepared to accompany the PEIR:

- **MHPGC Project Habitats Regulations Appraisal/Habitats Regulations Assessment (HRA) Screening Report;**
- **MHPGC Project Habitats Regulations Appraisal/HRA Report to Inform Appropriate Assessment (RIAA).**

4.1.1.7 This PEIR offers a comprehensive overview of the MHPGC Project's preliminary likely significant environmental effects and mitigation measures, presenting data to stakeholders for review and

feedback. The PEIR will also be informed by the ongoing pre-application consultation process (**Section 4.3**).

4.1.1.8 Following statutory consultation, comments will be reviewed and considered, where appropriate, in preparation of the Environmental Statement (ES) that will accompany the application to the Planning Inspectorate (PINS) for development consent and a marine licence application to the Marine Directorate Licensing Operations Team (MD-LOT).

4.2 Legislative and policy context

4.2.1 Overview

4.2.1.1 The full relevant legislation and policy context for the MHPGC Project has been detailed in **Volume 1, Chapter 5: Policy and Legislation, of the PEIR**. This section identifies the relevant legislation, policy and other documentation that is relevant to Fish and Shellfish ecology.

4.2.2 Legislation

4.2.2.1 Relevant international, United Kingdom, Scottish and English legislation provides the statutory framework for the protection and sustainable management of marine habitats and species and has informed the assessment of Fish and Shellfish ecology for the MHPGC Project. The legislative framework includes requirements relating to marine planning and licensing, the protection of internationally and nationally designated sites, and the conservation of habitats, species and biodiversity.

4.2.2.2 **Table 4.1** provides a summary of the legislation relevant to Fish and Shellfish ecology and identifies how and where the requirements of the legislation have been considered within the PEIR.

Table 4.1: Summary of legislation relevant to Fish and Shellfish ecology

Legislation/Convention	Summary of relevant requirements	How and where considered in the PEIR
International		
Marine Strategy Framework Directive (2008/56/EC)	The overarching aim of the Marine Strategy Framework Directive (MSFD) is to protect Europe's marine waters by applying an ecosystem-based approach to the management of human activities while enabling the sustainable use of the marine environment for present and future generations. The MSFD establishes a legal framework for the development of marine strategies designed to achieve Good Environmental Status (GES) in the marine environment by, at the latest, the year 2020.	Relevant commitments to avoid and reduce impacts on biodiversity are provided in **Section 4.7**. Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, with assessment of potential impacts presented in **Section 4.8.**
Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1979	The obligations of the Convention are transposed into United Kingdom (UK) law by means of the Wildlife and Countryside Act (1981 as amended), Nature Conservation (Scotland) Act 2004 (as amended). The principal aims of the Convention are to ensure conservation and protection of wild plant and animal species and their natural habitats including migratory fish species.	Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, with assessment of potential impacts presented in **Section 4.8.**

Legislation/Convention	Summary of relevant requirements	How and where considered in the PEIR
Convention on Biological Diversity 1993	The Convention on Biological Diversity provides the global framework for the conservation and sustainable use of biological diversity through an ecosystem approach, including the conservation of marine species, habitats and ecosystem functioning.	Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, with assessment of potential impacts presented in **Section 4.8.**
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) 1998	OSPAR includes the OSPAR List of Threatened and/or declining species and habitats for which the OSPAR Commission sets priorities for the conservation and protection of marine biodiversity.	Relevant OSPAR habitats and species are identified within the baseline (**Section 4.4**) and considered within the impact assessment (**Section 4.8).**
National Legislation		
Marine and Coastal Access Act 2009	Establishes the marine licensing regime and provides for the designation and protection of Marine Conservation Zones (MCZs). Part 3 of the Act introduced a marine planning system, while Part 4 introduced a marine licensing system for regulating activities in the marine environment. The Act requires a marine licence to be obtained for certain activities and works carried out in the marine area. Part 5 of the Act enables the designation of MCZs in England and Wales, as well as in offshore waters within the UK marine area.	The MHPGC Project will be subject to marine licensing requirements. Relevant MCZs are identified in **Section 4.4.7** and impacts on protected Fish and Shellfish features are assessed in **Section 4.8**. A detailed Marine Protected Area (MPA)/MCZ and Highly Protected Marine Area (HPMA) assessment will be provided to support the Development Consent Order (DCO) application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**.
Wildlife and Countryside Act 1981 (as amended)	The Wildlife and Countryside Act 1981 is a UK law that protects wildlife and natural habitats. Some fish species are protected under this Act including migratory fish species.	Relevant designated sites and protected ecological features, including migratory fish receptors, are identified within **Section 4.4.7** and considered within the impact assessment in **Section 4.8**.
Marine Strategy Regulations 2010 (transposes the EU Marine Strategy Framework Directive (MSFD) 2008/56/EC into UK legislation)	The UK Marine Strategy Regulations 2010 require the UK to take the necessary measures to achieve or maintain GES through the development of a UK Marine Strategy. The relevant descriptors include: Descriptor 3 (Commercial fish), Descriptor 4 (Food webs), Descriptor 6 (Seafloor integrity), and Descriptor 11 (Underwater sound).	Relevant commitments to avoid and reduce impacts on biodiversity are provided in **Section 4.7**. Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, with assessment of potential impacts presented in **Section 4.8.**
Fisheries Act 2020	The Fisheries Act 2020 provides the legislative framework for fisheries management following the UK's exit from the European Union (EU). The Act sets out a series of fisheries objectives, including the sustainability objective, precautionary objective, ecosystem objective, scientific evidence objective and bycatch objective. The Act is therefore relevant to the assessment of Fish and Shellfish receptors, particularly commercially	Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, which considers important spawning and nursery grounds (**Section 4.4.5**) and relevant species of commercial importance (**Section 4.4.6**). An assessment of potential impacts to Fish and Shellfish receptors (including those of commercial importance) and supporting marine ecosystems are presented in **Section 4.8.** The potential for impacts to

Legislation/Convention	Summary of relevant requirements	How and where considered in the PEIR
	exploited species and species supporting wider marine ecosystem function.	commercial fisheries are presented in **Volume 2, Chapter 7: Commercial Fisheries.**
Section 41 of the Natural Environment and Rural Communities (NERC) 2006	Lists species of principal importance in England, including fish species, for the purpose of biodiversity conservation where relevant to the English landfall.	Relevant Section 41 species are identified within the baseline (**Section 4.4**) and considered within the impact assessment (**Section 4.8**)
The Conservation of Offshore Habitats and Species Regulations 2017 (as amended) (transposes the offshore elements of the EU Habitats Directive (92/43/EC) into UK legislation)	Provides protection for internationally designated sites within UK offshore waters and requires assessment of plans or projects which may affect Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).	Relevant designated sites are identified in **Section 4.4.7** and assessed in **Section 4.8.** Detailed consideration is provided within the **MHPGC Project Habitat Regulations Appraisal/HRA Screening Report, prepared to accompany the PEIR.**
Scottish waters		
Nature Conservation (Scotland) Act 2004	Places duties on public bodies in relation to the conservation of biodiversity and strengthens wildlife enforcement legislation.	The MHPGC Project has been developed in accordance with relevant marine planning and licensing requirements. Baseline characterisation of Fish and Shellfish ecology is provided in **Section 4.4**, with assessment of potential impacts presented in **Section 4.8.**
Marine (Scotland) Act 2010	Establishes marine planning, marine licensing and MPA provisions in Scottish waters out to 12nm.	The MHPGC Project has been developed in accordance with relevant marine planning and licensing requirements. Relevant MPAs and protected Fish and Shellfish features are assessed in **Section 4.4.7**.
Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003	Provides the legislative framework for the management, conservation and protection of salmon and freshwater fisheries in Scotland, including the regulation of fishing methods and the protection of salmon stocks.	Species of commercial importance and Valued Ecological Receptors (VERs), including salmon, are considered within **Section 4.4.6** and **Section 4.4.7**, respectively. Potential impacts to these receptors are subsequently assessed in **Section 4.8.**
The Conservation of Salmon (Scotland) Regulations 2016	Introduces measures for the conservation of Atlantic salmon (*Salmo salar*) in Scotland, including the classification of salmon rivers and restrictions on the retention of salmon to support the recovery and sustainable management of salmon populations.	Relevant designated sites for salmon are identified in **Section 4.4.7** and salmon are recognised as a VER within **Section 4.4.7**. Potential impacts on salmon populations are assessed within **Section 4.8.**
Sandeel (Prohibition of Fishing) (Scotland) Order 2024	Prohibits fishing for sandeel (*Ammodytidae*) in Scottish waters (0-200nm) to support the conservation of sandeel stocks and the wider marine ecosystem.	The distribution of supporting habitats for sandeel within the Study Area are presented in **Volume 2, Annex 4.1: Herring and Sandeel Assessment.** Relevant designated sites for sandeel are identified in **Section 4.4.7** and sandeel are recognised as a VER within **Section 4.4.7**. Potential impacts on sandeel populations are assessed within **Section 4.8.**
Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)	Provides protection for SACs and SPAs within Scottish territorial waters and requires Habitats Regulations	Relevant SACs and SPAs are identified in **Section 4.4.7**, assessed in **Section 4.8** and considered further within the

Legislation/Convention	Summary of relevant requirements	How and where considered in the PEIR
	Assessment where significant effects may occur.	**MHPGC Project Habitats Regulations Appraisal/HRA Screening Report, prepared to accompany the PEIR.**
English waters		
Conservation of Habitats and Species Regulations 2017 (as amended)	Provides protection for SACs and SPAs in English waters and requires HRA where likely significant effects (LSE) cannot be excluded.	Relevant designated sites for Fish and Shellfish receptors are identified in **Section 4.4.7** and assessed in **Section 4.8**. Further consideration is provided within the **MHPGC Project Habitats Regulations Appraisal/HRA Screening Report, prepared to accompany the PEIR**.
The Eels (England and Wales) Regulations 2009	Implement measures to protect European eels (*Anguilla anguilla*) by setting rules on eel fishing, restocking, and trade to ensure eel populations are sustainably managed. The Regulations enforce compliance with both national conservation objectives and EU eel management requirements.	Eels are considered as a VER within **Section 4.4.7**. Potential impacts on eel populations are assessed within **Section 4.8.**
The Salmon and Freshwater Fisheries Act 1975	Provides the legal framework for the management and protection of salmon and freshwater fisheries in England and Wales. It regulates fishing methods, licensing, and conservation measures to ensure sustainable fish populations. It also gives authorities powers to prevent illegal fishing and protect fish habitats.	Relevant designated sites for salmon are identified in **Section 4.4.7** and salmon are recognised as VERS within **Section 4.4.7**. Potential impacts on salmon populations are assessed within **Section 4.8.**
Environment Act 2021	Establishes statutory environmental targets and supports biodiversity recovery and enhancement. Focuses on four priority areas: air quality, biodiversity, water, and waste, and includes the introduction of Biodiversity Net Gain (BNG) (HM Government, 2021).	Relevant commitments to avoid and reduce impacts on biodiversity are provided in **Section 4.7**, with the full list of commitments relevant to Fish and Shellfish ecology provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.

4.2.3 National Policy Context

National Policy Statements

4.2.3.1 National Policy Statements (NPS) set out the primary policy framework for a DCO under which the MHPGC Project will be considered. This framework includes guidelines, requirements and criteria that the MHPGC Project must meet to obtain consent and proceed with development. **Table 4.2** provides details of the following key NPS relevant to Fish and Shellfish ecology and how and where they are covered in the PEIR:

- NPS for energy (EN-1) (Department of Energy and Climate Change (DECC), 2024a);
- NPS for renewable energy infrastructure (EN-3) (DECC, 2024b);
- NPS for electricity networks infrastructure (EN-5) (DECC, 2024c).

Table 4.2: Summary of the NPS provisions relevant to Fish and Shellfish ecology

Summary of relevant NPS provisions	How and where considered in the PEIR
NPS EN-1	

Summary of relevant NPS provisions	How and where considered in the PEIR
Paragraph 5.4.18: Where the development is subject to EIA, the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England and Wales), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats.	Details of designated sites and protected species are provided in **Section 4.1.1** and an assessment of impacts can be found in **Section 4.8**. Relevant designated sites are identified in **Section 4.4.7** and assessed in **Section 4.8**. Further consideration is provided within the **MHPGC Project Habitats Regulations Appraisal/HRA Screening Report, prepared to accompany the PEIR** and **MHPGC Project Habitats Regulations Appraisal/HRA RIAA, prepared to accompany the PEIR**. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**.
Paragraph 5.4.20: The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.	Relevant commitments identified to conserve and enhance biodiversity are provided in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.
Paragraph 5.4.23: The design of energy Nationally Significant infrastructure Project (NSIP) proposals will need to consider the movement of mobile/migratory species such as birds, fish and marine and terrestrial mammals and their potential to interact with infrastructure. As energy infrastructure could occur anywhere within England and Wales, both inland and onshore and offshore, the potential to affect mobile and migratory species across the UK and more widely across Europe (transboundary effects) requires consideration, depending on the location of development. Applicants should consider relevant plan policies in marine plans in England.	Details of migratory fish species considered in this assessment are provided in **Section 4.1.1.**
Paragraph 5.4.36: Applicants should include appropriate avoidance, mitigation, compensation, and enhancement measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; • The timing of construction has been planned to avoid or limit disturbance; • During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; • Habitats will, where practicable, be restored after construction works have finished; • Opportunities will be taken to enhance existing habitats rather than replace them, and where practicable, create new habitats of value within the site landscaping proposals. Where habitat creation is required as mitigation, compensation, or enhancement, the location and quality will be of key importance. In this regard habitat creation should be focused on areas where the most	As part of the project design, the proposed construction works (as detailed in **Volume 1, Chapter 2: Project Description**) have been developed to minimise the spatial footprint of seabed disturbance. The construction programme has also been developed to minimise disturbance, where practicable. The potential for impacts (both spatially and temporally) from the proposed works (based on a worst-case design scenario) have been considered with regard to Fish and Shellfish ecology in **Section 4.8**. During all stages of the proposed development, best practice measures will be followed, and implemented though management plans and procedures, including the preparation of a OEMP and MBP, to reduce potential impacts on Fish and Shellfish ecology , these are detailed in **Section 4.7**. Potential impacts to benthic and intertidal habitats and the relevant commitments identified to avoid and reduce impacts on marine habitats are provided in **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology**. Relevant embedded mitigation measures, implemented as part of the project design, are detailed in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register**, of the PEIR. The assessment in **Section 4.8** considers the residual effects following implementation of embedded mitigation and concludes whether significant residual effects remain. No

Summary of relevant NPS provisions	How and where considered in the PEIR
ecological and ecosystems benefits can be realised; • Mitigations required as a result of legal protection of habitats or species will be complied with.	additional mitigation measures have been identified as necessary for Fish and Shellfish ecology. All embedded mitigation and project commitments, together with any relevant legal requirements relating to protected habitats or species, will be complied with.
NPS EN-3	
Paragraphs 2.8.45 and 2.8.46: Given the scale of offshore wind deployment required to meet 2030 and 2050 ambitions, applicants will need to give close consideration to impacts on MPAs, either alone or in combination, and employ the mitigation hierarchy and if necessary provide compensation (both individually and in combination with other plans or projects) which may be needed to approve their projects. It is likely that mitigation may include proactive measures to reduce the impact of deployment (e.g. micrositing of offshore transmission routes to avoid vulnerable habitats, alternative piling or trenching techniques, noise abatement technology, collision avoidance methods or, if necessary, compensation for habitat loss).	Details of designated sites and protected Fish and Shellfish species are provided in **Section 4.4.7.** Relevant commitments identified to conserve and enhance biodiversity are provided in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**. The site selection process, including consideration of environmental constraints and opportunities to avoid or minimise impacts on designated sites and sensitive receptors, is presented in **Volume 1, Chapter 3: Site Selection & Consideration of Alternatives**. These assessments have informed the MHPGC Project design and the mitigation measures embedded within the project design.
Paragraph 2.8.91 and 2.8.94: In addition, Applicants should have regard to the specific ecological and biodiversity considerations that relate to proposed offshore renewable energy infrastructure developments, namely: • Fish; • Intertidal and subtidal seabed habitats and species; • Marine mammals; • Birds; • Wider ecosystem impacts and interaction, and other relevant protected migratory species. Applicants must undertake a detailed assessment of the offshore ecological, biodiversity and physical impacts of their proposed development, for all phases of the lifespan of that development, in accordance with the appropriate policy for offshore wind farm (OWF) EIAs, HRAs and MCZ assessments.	The PEIR has been prepared in accordance with the relevant policy and legislative requirements for EIA, HRA and MPA/MCZ assessment. The impact assessment has included consideration of nationally designated sites, priority habitats and species. Impacts to Fish and Shellfish ecology are considered in this chapter in **Section 4.5** onwards. Impacts for other receptors not considered within this chapter are identified and assessed in the following chapters prepared to accompany the PEIR: • **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology;** • **Volume 2, Chapter 4: Marine Mammals;** • **Volume 2, Chapter 6: Marine Ornithology;** • **Volume 2, Chapter 7: Commercial Fisheries;** • **Volume 4, Chapter 5: Inter-related Effects; and** • **Volume 2, Chapter 1: Physical Processes.** Further consideration is provided within the **MHPGC Project Habitats Regulations Appraisal/HRA Screening Report, prepared to accompany the PEIR** and **MHPGC Project Habitats Regulations Appraisal/HRA RIAA**, prepared to accompany the PEIR. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**.
Paragraph 2.8.97 to 2.8.99:	Consultation with the Marine Management Organisation (MMO) and MD-LOT was undertaken during the scoping

Summary of relevant NPS provisions	How and where considered in the PEIR
Applicants should consult at an early stage of pre-application with relevant statutory consultees and energy not-for profit organisations/non-governmental organisations as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options which should be undertaken. In developing proposals applicants must refer to the most recent best practice advice originally provided by Natural England under the Offshore Wind Enabling Action Programme and/or their relevant Statutory Nature Conservation Body (SNCB). Any relevant data that has been collected as part of post-construction ecological monitoring from existing operational OWFs should be referred to where appropriate.	stage and engagement is ongoing. Relevant comments are provided in **Section 4.3**.
Paragraphs 2.8.130 to 2.8.134: There is the potential for the construction, operation and decommissioning phases, including activities occurring both above and below the seabed, to impact fish communities, migration routes, spawning activities and nursery areas of particular species. The applicant should identify fish species that are the most likely receptors of impacts with respect to: • Spawning grounds; • Nursery grounds; • Feeding grounds; • Over-wintering areas for crustaceans; • Migration routes; and • Protected sites. Applicant assessments should identify the potential implications of underwater noise from construction and unexploded ordnance including, where possible, implications of predicted construction and soft start noise levels in relation to mortality, PTS, TTS and disturbance, and addressing both sound pressure and particle motion) and EMF on sensitive fish species.	Details of fish species identified as most likely receptors of impacts are provided in Baseline Characterisation **Section 4.4**. Impacts to Fish and Shellfish ecology from the construction, operation and decommissioning phases are considered in this chapter in **Section 4.5** onwards.
NPS EN-5	
Paragraph 2.2.10: As well as having duties under Section 9 of the Electricity Act 1989, (in relation to developing and maintaining an economical and efficient network), applicants must take into account Schedule 9 to the Electricity Act 1989, which places a duty on all transmission and distribution licence holders, in formulating proposals for new electricity networks infrastructure, to "have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and …do what [they] reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects.	Commitments relevant to Fish and Shellfish ecology that have been identified are provided in **Section 4.7**, with the full list of MHPGC Project commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.
Paragraph 2.13.21: The sensitivities of many coastal locations and of the marine environment as well as the potential environmental, community and other impacts in	The landfall design is summarised in **Volume 1, Chapter 2: Project Description, of the PEIR** and the site selection process is detailed in **Volume 1, Chapter 3: Site Selection & Consideration of Alternatives**. The identification of the cable route and landfall location was informed by an

Summary of relevant NPS provisions	How and where considered in the PEIR
neighbouring onshore areas must be considered in the identification onshore connection points.	iterative site selection process which considered the sensitivities of coastal locations and the marine environment, as well as potential environmental, community and other impacts in neighbouring onshore areas, alongside technical and engineering constraints. Commitments relevant to Fish and Shellfish ecology that have been identified are provided in **Section 4.7**, with the full list of MPHGC Project commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.
Paragraph 2.14.2: The applicant should demonstrate how environmental, community and other impacts have been considered and how adverse impacts have followed the mitigation hierarchy i.e. avoidance, reduction and mitigation of adverse impacts through good design; and how enhancements to the environment post construction will be achieved including demonstrating consideration of how proposals can contribute towards biodiversity net gain (as set out in Section 4.5 of EN-1 and the Environment Act 2021), as well as wider environmental improvements in line with the Environmental Improvement Plan and environmental targets (paragraph 4.2.29 of EN-1). In addition, all applicants are encouraged to demonstrate how the construction planning for the proposals has been coordinated with that for other similar projects in the area on a similar timeline.	Commitments relevant to Fish and Shellfish ecology that have been identified are provided in **Section 4.7**, with the full list of MHPGC Project commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**. Cumulative effects are assessed in **Section 4.9**.

National Planning Policy Framework

4.2.3.2 The National Planning Policy Framework (NPPF) has the potential to be considered important and relevant to the Secretary of State (SoS) consideration of the MHPGC Project (Ministry of Housing, Communities and Local Government, 2026).

4.2.3.3 **Table 4.3** provides details of the elements of the NPPF that are relevant to Fish and Shellfish ecology and how and where they are covered in the PEIR or will be covered within the ES.

Table 4.3 Summary of the NPPF relevant to Fish and Shellfish ecology.

NPPF Section	How and where considered in the PEIR
Policy N1: Identifying environmental opportunities and safeguards *"Development plans should safeguard and enhance the natural environment... identify the hierarchy of international, national and locally designated sites... identify opportunities for the conservation, enhancement and recovery of habitats and priority or threatened species, including habitat restoration and the creation and strengthening of ecological networks..."*	Potential impacts to Fish and Shellfish ecology are considered in this chapter from **Section 4.8** onwards. The assessment includes consideration of habitats and species of conservation importance, including ecologically important Fish and Shellfish receptors, spawning and nursery grounds, migratory species and designated sites where Fish and Shellfish are protected features. An assessment of potential impacts on internationally designated sites is provided within the HRA (see **MHPGC Project HRA/Habitats Regulations Appraisal Screening Report, prepared to support the PEIR** and **MHPGC Project Habitats Regulations Appraisal/HRA RIAA, prepared to support the PEIR**). A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**.

Policy N2: Improving the natural environment *"Development proposals should consider the environmental qualities of land proposed for development, including habitats... identify opportunities for those qualities to be conserved or enhanced... take suitable opportunities to connect to and strengthen ecological networks... minimise any adverse impacts on biodiversity..." and "If significant harm to biodiversity resulting from a development cannot be avoided, adequately mitigated or, as a last resort, compensated for, then the development should be refused."*	Potential impacts to Fish and Shellfish ecology are considered in **Section 4.8** onwards, including the application of embedded mitigation and consideration of the mitigation hierarchy where appropriate. The assessment considers potential effects on Fish and Shellfish species and their supporting habitats, including spawning, nursery, feeding and migratory areas where relevant. Measures to avoid, reduce and mitigate impacts are identified where required.
Policy N6: Areas of particular importance for biodiversity and geodiversity *"Development proposals affecting a site of international importance... should be refused unless.. An appropriate assessment has concluded that the proposal will not adversely affect the integrity of the site (either individually or in combination with other developments), or the proposal can satisfy the derogation tests." and "A site of national importance... should only be supported if..." specified tests are met.*	A full list of designated sites relevant to Fish and Shellfish ecology is provided in **Section 4.4.7**. Consideration of internationally designated sites is included within the HRA (see **MHPGC Project HRA/Habitats Regulations Appraisal Screening Report, prepared to support the PEIR** and **MHPGC Project Habitats Regulations Appraisal/HRA RIAA, prepared to support the PEIR**). A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**. The assessments will consider sites designated for Fish and Shellfish features where relevant.

4.2.4 National policy papers

4.2.4.1 The UK Government's Marine environment: unexploded ordnance (UXO) clearance Joint Position Statement (Department for environment, food and rural affairs (Defra), 2025) sets out current policy expectations for the clearance of unexploded ordnance in the marine environment, including the preference for low-noise clearance methods where feasible.

4.2.5 Marine planning policy context

4.2.5.1 The following marine plans are relevant to Fish and Shellfish ecology and have informed the assessment of preliminary effects in this chapter, their relevance to the MHPGC Project is outlined in **Table 4.4**:

- The UK Marine Policy Statement (MPS) (Defra, 2020);
- Scotland's National Marine Plan (Marine Directorate, 2015);
- Northeast Inshore and Northeast Offshore Marine Plan (MMO, 2024a).

Table 4.4: Marine planning policy relevant to Fish and Shellfish ecology

Marine plan description	How and where considered in the PEIR
UK Marine Policy Statement	
Paragraph 3.3.24: Renewable energy developments can potentially have adverse impacts on marine fish and mammals, primarily through construction noise and may displace fishing activity and have direct or indirect impacts on other users of the sea, including mariners. Certain bird species may be displaced by offshore wind turbines, which also have the potential to form barriers to migration or present a collision risk for birds. Their foundation designs are likely to have an effect on hydrodynamics and consequent sediment movement. This includes potential scouring of sediments around the bases of turbines. These and other	Potential adverse impacts to Fish and Shellfish ecology, including those associated with underwater noise, habitat disturbance, sediment suspension and changes to seabed habitat are considered in **Section 4.8**. Commitments relevant to Fish and Shellfish ecology have been identified are provided in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.**

Marine plan description	How and where considered in the PEIR
potential adverse impacts, together with potential mitigation measures, are considered in the National Policy Statement for Renewable Energy Infrastructure (EN-3).	
Paragraph 3.3.30: An increase in underwater cables in the UK marine area will cause environmental impacts. Impacts from cable installations on the sea bed are low and mainly occur due to the physical disturbance involved with their placement. They tend to be of short duration with a relatively small area being affected. The main impact will be where cable protection, for example rock armour or concrete mattresses, is required where cable burial is not feasible. This is particularly the case where cables either run through, or have landfall within, any site designated as being of national or international nature conservation importance or other sensitive areas such as designated shell fisheries, spawning or nursery grounds for economically important fish species or marine archaeological sites. It may also displace fishing activity.	Details of fish species identified as most likely receptors of impacts are provided in **Section 4.4**. Potential adverse impacts to Fish and Shellfish ecology from the export cable are considered in **Section 4.8**. Details of designated sites and associated Fish and Shellfish features of interest are provided in **Section 4.4.7.** Consideration has been given to relevant designated sites and species in the MHPGC Project design (**Volume 1, Chapter 2: Project Description**) and site selection process (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**). The site selection and cable routing process considered the distribution of sensitive Fish and Shellfish ecology receptors, including designated sites, spawning and nursery grounds and shellfish resources. Where practicable, the MHPGC export cable corridor has been routed to avoid or minimise interaction with these sensitive features, with any remaining interactions assessed within this chapter, in **Section 4.8**, and relevant embedded mitigation measures and commitments outlined in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.** Commercial fishing interests and potential displacement of fishing activity are considered separately within **Volume 2, Chapter 7: Commercial Fisheries of the PEIR**.
Paragraph 3.5.4: Potential adverse impacts include changes to the hydrodynamic regime that may alter coastal processes; loss of seabed habitat and heritage assets; impacts on fisheries and secondary impacts to marine life and habitat associated with sediment plumes; disturbance of fish spawning, migration routes, nursery and overwintering areas; overspills from dredging vessels and impacts on geodiversity.	Potential adverse impacts to Fish and Shellfish ecology are considered in **Section 4.8**, including effects associated with seabed disturbance, sediment suspension and deposition, underwater noise, and impacts on spawning, nursery and migration. Commitments relevant to Fish and Shellfish ecology have been identified are provided in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.
Paragraph 3.6.5: The primary environmental considerations include the potential risk to fish and other marine life from the release of sediments, chemical pollution and morphological changes including burial of seabed flora and fauna; hydrological effects; interference with other marine activities; increases in turbidity; increases in marine noise; possible adverse effects for designated nature conservation areas and potential destruction or destabilisation of known or unknown heritage assets. Removal of dredged material can also cause adverse impacts to the natural sedimentary systems.	Potential adverse impacts to Fish and Shellfish ecology are considered in **Section 4.8,** including the effects of sediment disturbance, changes in water quality, underwater noise, habitat alteration and potential effects on designated Fish and Shellfish features. Commitments relevant to Fish and Shellfish ecology have been identified are provided in **Section 4.7**, with the full list of commitments provided in **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**.
Paragraph 3.7.2: Impacts from cable installations on the sea bed are low and spatially minor and tend to occur due to the physical disturbance involved during placement. The main impact will be where cable protection, for example, rock armour or concrete mattresses, is required where cable burial is not feasible and potentially in the intertidal area where the cable lands. Impacts may also occur if the cable runs through any site designated as being of national or international nature or cultural heritage conservation	Potential adverse impacts to Fish and Shellfish ecology are considered in **Section 4.8**. The site selection and cable routing process considered the distribution of sensitive Fish and Shellfish ecology receptors, including designated sites, spawning and nursery grounds and shellfish resources (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**). Where practicable, the MHPGC export cable corridor has been routed to avoid or minimise interaction with these sensitive features, with any

Marine plan description	How and where considered in the PEIR
importance or other sensitive areas such as designated shell fisheries, spawning or nursery ground for economically important fish species. Other potential impacts could include disturbance to known or undiscovered archaeological sites	remaining interactions assessed within this chapter, in **Section 4.8**, and relevant embedded mitigation measures and commitments outlined in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.**
Scottish National Marine Plan	
Chapter 6: Sea fisheries, Marine Planning Policies: The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on fishing: The environmental impact on fishing grounds (such as nursery, spawning areas), commercially fished species, habitats and species more generally.	Consideration has been given to relevant designated sites, commercially important Fish and Shellfish species, spawning and nursery grounds, and other sensitive Fish and Shellfish ecology receptors in **Section 4.8.** these considerations have also informed the MHPGC Project design (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**).
Chapter 6: Sea fisheries, Paragraph 6.46: A variety of benthic habitats support important demersal fisheries providing essential habitats and nursery, feeding and recruitment areas for fish species. Nephrops (*Nephrops norvegicus*) also rely on a specific muddy habitat to construct burrows. Additionally, a healthy benthic community may be able to support the recovery of impacted habitats in other areas of the sea and ecosystem resilience will be an important asset in the face of climate change	The potential for adverse impacts to Fish and Shellfish ecology (including *Nephrops*) are considered in **Section 4.8**, including effects on habitats that support feeding, spawning, nursery and recruitment functions for Fish and Shellfish species.
Chapter 8: Wild Salmon and Diadromous Fish, Paragraph 8.4: Salmon and trout fisheries are recognised as an important and significant sector of the Scottish economy. The aim is to maintain and improve the environment within which the sustainable exploitation of salmon and trout can continue to provide economic, social and recreational benefits.	Details of diadromous fish species considered in this assessment are provided in **Section 4.1.1.** Potential adverse impacts to Fish and Shellfish ecology are considered in **Section 4.8**.
Chapter 8: Wild Salmon and Diadromous Fish, Paragraph 8.6: A number of activities and pressures in the marine environment may impact on populations of salmon and other diadromous fish species. Activities regarded as potentially having the most significant impact are: • Wind and wave and tidal energy: Whilst there is uncertainty around the likelihood and severity, potential impacts include disturbance during construction, noise associated with infrastructure such as turbine bases, electro-magnetic fields of infrastructure such as sub-sea grid and cabling and mortality through strike by tidal turbines. Delayed migration or displacement of migratory routes may have effects on salmon and other diadromous species and continued efforts to better understand potential impacts should be encouraged.	Details of migratory fish species considered in this assessment are provided in **Section 4.1.1.** Potential adverse impacts to Fish and Shellfish ecology are considered in **Section 4.8**.
General Policy 9 (Natural Heritage): Development and use of the marine environment must comply with legal requirements for protected areas and protected species, not result in significant impacts on Scottish Priority Marine Features (PMFs), and protect and, where appropriate, enhance the health of the marine area.	Potential effects on Fish and Shellfish receptors, including Scottish PMFs where present, are considered as VERs within the baseline characterisation (**Section 4.4.8**) and impact assessment (**Section 4.8**).
Northeast Inshore and Offshore Marine Plan	
NE-FISH-3:	Any potential effects on essential fish habitats, including spawning, nursery and feeding grounds are considered in

Marine plan description	How and where considered in the PEIR
Proposals that enhance essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes, should be supported. Proposals that may have significant adverse impacts on essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes, must demonstrate that they will, in order of preference: a) Avoid; b) Minimise; c) Mitigate - adverse impacts so they are no longer significant.	**Section 4.8**. The mitigation hierarchy has been applied through consideration of Fish and Shellfish receptors during site selection and cable routing (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**), implementation of embedded mitigation measures (**Section 4.7**), and assessment of residual effects (**Section 4.8**).
NE-BIO-1: Proposals that enhance the distribution of priority habitats and priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid; b) minimise; c) mitigate - adverse impacts so they are no longer significant; d) compensate for significant adverse impacts that cannot be mitigated.	Any potential effects on Fish and Shellfish receptors, essential fish habitats, including spawning, nursery and feeding grounds are considered in **Section 4.8**. The mitigation hierarchy has been applied through consideration of Fish and Shellfish receptors during site selection and cable routing (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**), implementation of embedded mitigation measures (**Section 4.7**), and assessment of residual effects (**Section 4.8**).
NE-BIO-3: Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity, or native species migration, must demonstrate that they will, in order of preference: a) avoid; b) minimise; c) mitigate - adverse impacts so they are no longer significant; d) compensate for significant adverse impacts that cannot be mitigated.	Any potential effects on native Fish and Shellfish receptors, including migration are considered in **Section 4.8**. The mitigation hierarchy has been applied through consideration of Fish and Shellfish receptors during site selection and cable routing (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives, of the PEIR**), implementation of embedded mitigation measures (**Section 4.7**), and assessment of residual effects (**Section 4.8**).

4.2.6 Local policy context

4.2.6.1 The MHPGC Project lies within the jurisdiction of Durham County Council. The Durham Local Plan (2020) was revised and does not pertain to regions or habitat important to Fish and Shellfish species. As such, this plan has not been considered further within this assessment.

4.2.7 Guidance

4.2.7.1 The Fish and Shellfish ecology assessment has been informed by the following guidance and technical documents:

- Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland – Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2024);
- Guidance on the assessment of the environmental impacts of subsea cables (OSPAR Commission, 2023), which assesses the environmental impacts of sea cables in terms of their relevance for the area covered by the Convention;
- Environmental Impact Assessment Guide to Delivering Quality Development (The Institute of Environmental Management and Assessment, 2015);

- MarineSpace Ltd guidance on environmental effect pathways between marine aggregate application areas and Atlantic herring (*Clupea harengus*) and sandeel potential spawning habitat (Kyle-Henney *et al.* (2024) and Reach *et al.* (2024) respectively);
- Seabed disturbance following high order clearance of unexploded ordnance (Cooke and Bardwell, 2025);
- Supporting minimising environmental impacts from unexploded ordnance clearance (Defra *et al.*, 2025);
- Natural England and Joint Nature Conservation Committee (JNCC) 2022 guidance 'Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters.' (Natural England and JNCC, 2022);
- Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI (Popper *et al.*, 2014);
- Hawkins, A.D. and Popper, A.N. (2017). A sound approach to assessing the impact of underwater sound on marine fishes and invertebrates;
- Scottish Government (2024) Diadromous Fish in the Context of Offshore Wind: Review of Current Knowledge & Future Research (2024);
- NatureScot (2020). PMFs in Scotland's Seas;
- Scottish Natural Heritage Descriptions of Scottish PMFs (Tyler-Walters *et al.*, 2016)
- Marine Scotland Science (2014) Prioritisation of Monitoring and Research for Diadromous Fish in the Context of Marine/Offshore Renewables;
- The Convention for the Protection of the Marine Environment of the North-East Atlantic, or OSPAR Convention (the Convention for the Protection of the Marine Environment of the North-East Atlantic), produced the OSPAR List of Threatened and/or Declining Species and Habitats, considered to be of conservation concern within the north-east Atlantic (OSPAR Commission, 2008); and
- Relevant International Council for the Exploration of the Sea (ICES) stock assessments and advice.

4.3 Consultation and engagement

4.3.1 Scoping

4.3.1.1 A Scoping Report for the MHPGC Project was issued to the Planning Inspectorate (PINS) and MD-LOT in February 2025 (RPS, 2025). Following consultation with the appropriate statutory bodies, PINS (on behalf of the SoS) and MD-LOT both provided Scoping Opinions in March 2025 (PINS, 2025; MD-LOT, 2025, respectively).

4.3.1.2 **Table** 4.5 sets out the key comments raised during the scoping process specific to Fish and Shellfish ecology, with details of how these comments have been addressed within the PEIR.

Table 4.5: Summary of scoping responses relevant to Fish and Shellfish ecology

Comment	How and where considered in the PEIR
Dee District Salmon Fishery Board (DDSFB)	
The DDSFB welcomes the opportunity to respond to the scoping opinion and would wish to be consulted further during this process with specific interest in the migratory fish species Atlantic Salmon and sea trout (*Salmo trutta trutta*). We echo the comments of our representative body for Scotland's District Salmon Fishery Boards, Fisheries Management Scotland and call for more research upon the impacts of this development on diadromous fish.	A thorough assessment has been undertaken on the potential impacts to diadromous and migratory fish, including Atlantic Salmon and sea trout. Specific consideration for the impacts arising from the MHPGC Project on diadromous species and potential impacts have been assessed in **Section 4.8**, with potential cumulative impacts considered in **Section 4.9**. As no significant effects from the MHPGC Project have been concluded for these receptors, no additional monitoring or mitigation

Comment	How and where considered in the PEIR
	measures are required (outside of those already proposed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR).**
Under Scottish Marine Energy Research (ScotMER), the Diadromous Fish Receptor Group has identified evidence gaps related to the health, distribution, and impacts on Diadromous fish (salmon, sea trout, etc.). Scottish Government has published an 'evidence map' (available for download at the above link) which identifies and scores these evidence gaps according to a specific prioritisation process. A recent report commissioned by Scottish Government titled "Diadromous Fish in the Context of Offshore Wind – Review of Current Knowledge & Future Research" highlights further strategic research opportunities and areas for consideration. It is important that the relevant evidence gaps are considered in full by the applicant, and developers should contribute to filling these evidence gaps as a specific condition of consent.	The Scottish Government's evidence review has been used to inform the baseline in **Section 4.4**, and the assessment of potential impacts to key diadromous fish receptors in **Section 4.8**. For the assessment, a precautionary approach has been adopted using a Maximum Design Scenario (MDS) detailed in **Section 4.6.2** to define the worst-case scenario for potential environmental impacts, alongside precautionary assumptions where evidence gaps and uncertainties remain. The assessment draws on site-specific survey data and desk-based information presented in **Section 4.4.3,** supplemented where appropriate by regional scale datasets and relevant published literature, providing a robust evidence base for baseline characterisation and impact assessment. No significant effects on diadromous fish receptors were identified, either alone or cumulatively, and therefore no additional mitigation or monitoring requirements are proposed.
Offshore developments have the potential to directly and indirectly impact diadromous fish. We would therefore expect developers to assess and, where necessary, mitigate the potential impacts of the development. These potential impacts have been highlighted through ScotMER, and include: • Avoidance (including exclusion from particular rivers and subsequent impacts on local populations); • Disorientation effects that could potentially affect behaviour, susceptibility to predation or by-catch; • Impaired ability to locate normal feeding grounds or river of origin; and delayed migration.	Potential impacts on diadromous fish, that have the potential to result in avoidance of rivers of importance, disorientation, impaired ability to locate normal feeding grounds or river of origin, and delayed migration are assessed in **Section 4.8**, with cumulative effects considered in **Section 4.9**. The assessment concluded that the MHPGC Project would not give rise to significant effects on diadromous fish populations, either alone or cumulatively.
The following issues should therefore be considered in full, including consideration of new research where information is lacking: • Subsea noise and vibration effects during construction. This includes noise associated with horizontal directional drilling and installation of rock armour on cable routes. Avoidance of such activities during key life stages, such as the smolt run, should be considered as a mitigation measure. • Electromagnetic fields (EMFs) arising from cabling. Electromagnetic fields from subsea cables have the potential to interact with European eels and possibly salmonids if their migration or movement routes take them over sub-sea cables. The Earth's magnetic field is a cue used for migration, so anything that interferes with this signal is an important consideration. All cables should be buried to at least a depth of 1.5m where possible, or covered with rock armour to an equivalent depth where burial is not possible. We are aware that Marine Scotland Science have undertaken some	All potential effects on diadromous fish species as relevant to the MHPGC Project are assessed in **Section 4.8,** including the potential for impacts from underwater sound, EMF, temporary habitat loss and disturbance, long-term habitat loss and colonisation of hard substrates. The potential for impacts from light patterns from turbine blades are considered in the Morven North and Morven South Fish and Shellfish Ecology Environmental Impact Assessment Reports (Tetra Tech RPS Energy, 2026a) and are not applicable to this assessment.

Comment	How and where considered in the PEIR
research to investigate electro-magnetic force impacts on adult and post smolt salmon and European eels. Whilst for salmon this work did not demonstrate any significant response to the magnetic field in terms of alarm, avoidance, accelerated or decelerated swimming, it did not provide any information on interference with the salmon's ability to detect and utilise the Earth's magnetic field. • Disturbance or degradation of the benthic environment (including secondary effects on prey species). It is important to ensure that such effects are quantified and assessed in the ES. Particular consideration should be given to potential effects on important habitats for feeding and shelter for the marine phase of sea trout (a priority marine feature) and any area that might impact early feeding opportunities for all diadromous species. • Changes in light patterns from turbine blades. Potential impacts from changes in light patterns from turbine blades on fish is a very understudied field. Although there is a lack of direct studies, it is plausible that turbine blade shadow flicker and secondary light patterns from turbine structures may have a potentially negative impact on Atlantic salmon or other fish species at OWF sites. • Novel habitat construction (artificial reef effect). The construction of new offshore structures can lead to various ecological changes, including the introduction of physical barriers, shifts in community composition, altered predator-prey dynamics, increased disease risk, higher levels of suspended sediment, and changes in fishing activity. Further research is needed to understand the impact of these changes on both adult and juvenile Atlantic salmon, which migrate through OWFs, as well as sea trout, which not only migrate but also spend a significant portion of their marine life developing in these affected areas.	
Environment Agency	
The Salmon and Freshwater Fisheries Act 1975 and The Eels (England and Wales) Regulations 2009 are not included. The legal responsibility on the Applicant pertaining to this fish specific legislation has not been considered. This infers that the impacts on fish from the construction, operation and decommissioning phases have not been fully considered.	The Salmon and Freshwater Fisheries Act 1975 and The Eels (England and Wales) Regulations 2009 are included in **Table 4.1**. The Fish and Shellfish ecology assessment has considered Atlantic salmon and European eel as key receptors, with potential effects during the construction, operation and decommissioning phases assessed in **Section 4.8** and **Section 4.9**. The assessment has therefore been undertaken with regard to the relevant legislative requirements relating to these species.
Incomplete desk study conducted for presence of fish. The Scoping Report states that the desk study did not return records of any fish species within 2km of the MHPGC Project Scoping Boundary, however the National Biodiversity Network (NBN) Atlas shows a record of three-spined stickleback (*Gasterosteus aculeatus*) from Dalton beck in Seaham. Moreover, Environment Agency (EA) data	Baseline data compilation has been expanded beyond the datasets presented at Scoping stage and includes additional sources, incorporates a wider range of available information sources, including relevant environmental records, regulatory datasets, published literature (**Table 4.7**). Notwithstanding

Comment	How and where considered in the PEIR
explorer shows another record for the same species in Ryhope burn, each of which is within or <2km from the MHPGC Project Scoping Boundary. The lack of records is certainly due to a lack of sampling rather than a lack of fish and is not a strong basis for them being discounted from assessment. Whilst there are no records of eel in the becks and burns in the immediate study area, there are records from further upstream and in nearby watercourses. It should be assumed that they will be present due to the availability of suitable habitat.	the limited number of fish records returned from desk-based sources within the immediate Fish and Shellfish Ecology Study Area, the assessment does not assume absence of fish species on this basis. A precautionary approach has been adopted for diadromous and estuarine fish receptors, including Atlantic salmon, European eel and other migratory species, recognising that these species may occur within the Fish and Shellfish Ecology Study Area during migration even where site-specific records are limited. The assessment therefore considers the potential for these receptors to transit the Fish and Shellfish Ecology Study Area and evaluates relevant impact pathways accordingly. Potential effects on migratory fish species are assessed in **Section 4.8** and **Section 4.9**.
Omission of freshwater fish outside of a generic reference to species. The absence of fish records from watercourses in the study area is not adequate reason not to consider potential impacts to fish arising from the project. Due to availability of suitable habitat and nearby records for eel, eel should be assumed to be present. Impacts to fish may be missed, which may mean that the Applicant fails to comply with legislation.	As set out in the response above, the assessment does not assume absence of fish species where records are limited. A precautionary approach has been adopted, with European eel and other relevant migratory fish receptors considered within the assessment based on their potential to transit the Fish and Shellfish Ecology Study Area during their migrations to and from watercourses. Potential effects on these receptors are assessed in **Section 4.8** and **Section 4.9**.
Not all impacts to fish have not been considered. Changes to suspended sediment concentration (SSC) is not the only potential source of disturbance to fish. Noise (during construction or decommissioning and EMF) and riverbed heating during operation may also cause disturbance to migrating fish (and to other receptors sensitive to these variables).	Disturbance to fish, including the potential for impacts from underwater sound, EMF and thermal emissions from operational cables are assessed **Section 4.8** and **Section 4.9.**
MD-LOT	
Furthermore, with regard to the proposal to scope out the "effects of particle motion element of underwater sound" on marine mammals during all phases of the Proposed Works, the Scottish Ministers note that there is no mention of particle motion from underwater sound impacts on Fish and Shellfish receptors and it is unclear whether this impact is being scoped in or out for this receptor. The Scottish Ministers advise that the Applicant must provide clarification on this within the EIA Report and direct the Applicant further to the NatureScot representation in this regard.	The potential for impacts from particle motion are considered in **Section 4.8**, within the impact pathways "Underwater sound (excluding UXO)" and "Underwater sound from UXO clearance".
Section 7.5.3 of the MHPGC Project Scoping Report presents the two study areas defined for Fish and Shellfish ecology. The Scottish Ministers highlight NatureScot's representation regarding the difference in size of maximum spring tidal excursion from the Morven Offshore Wind I Array. In addition, the Scottish Ministers highlight the NatureScot representation with regards to the impacts of underwater sound that may extend beyond the Fish and Shellfish ecology study area into the regional Fish and Shellfish ecology study area and advise that underwater sound modelling must inform the Zone of Influence (ZoI) for assessing impact to Fish and Shellfish receptors.	The Fish and Shellfish Ecology Study Area (detailed in **Section 4.4.2**) has been informed by the relevant impact pathways for Fish and Shellfish receptors, including the maximum spring tidal excursion, and the predicted range of impact from underwater sound. Project-specific underwater sound modelling and sediment plume modelling, as presented in **Volume 2, Annex 1.2: Model Design, Validation and Results** and **Volume 2, Annex 5.1: Underwater Sound Technical Report** of the PEIR, have been undertaken to inform the assessment of potential effects, and the extent of the ZoI and Fish and Shellfish Ecology Study Area.

Comment	How and where considered in the PEIR
The Scottish Ministers note that an MPA screening assessment has been provided in Appendix E of the Scoping Report. The Scottish Ministers are content that the sandeel feature of Turbot Bank Nature Conservation Marine Protected Area (MPA) can be screened out from further assessment. This is a view supported by the NatureScot representation.	The sandeel feature of Turbot Bank MPA is considered in **Section 4.4.7**. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s), which will include consideration of the Turbot Bank MPA. A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to Marine Protected Area/Marine Conservation Zone and Highly Protected Marine Area Assessments, prepared to accompany the PEIR**.
The Scottish Ministers highlight the Scottish Fisherman's Federation (SFF) representation in that the maximum width of seabed disturbed by the cable footprint has not been specified and as such must be considered further in the EIA Report with regard to potential impacts to spawning and nursery grounds of important demersal and pelagic fish species.	The maximum width of seabed disturbed by the cable footprint has been detailed in **Table 4.17**, and used to inform the assessment of potential effects on Fish and Shellfish receptors, including spawning and nursery grounds in **Sections 4.8** and **Section 4.9**.
The Scottish Ministers also highlight the SFF's representation with regard to survey activities and other potential seabed disturbances being undertaken out with spawning and nursery periods to avoid juvenile fish mortality which must be considered by the Applicant.	Spawning and nursery grounds with potential to interact with the Fish and Shellfish Ecology Study Area are identified and described in **Section 4.4.5.** Potential effects on these receptors, including those arising from survey activities and seabed disturbance, are assessed in **Sections 4.8** and **Section 4.9**.
Section 7.5.4 presents the data sources and site-specific survey data to be used to inform the baseline characterisation. The Scottish Ministers are largely content with these however, direct the Applicant to the NatureScot representation recommending inclusion of the Feature Activity Sensitivity Tool (FeAST).	The Applicant welcomes this recommendation and confirms that, where applicable, the FeAST has been used to inform the sensitivity assessments of Fish and Shellfish receptors in Scottish waters in **Sections 4.8** and **Section 4.9**.
Section 7.5.5 presents the baseline for the Fish and Shellfish environment of the regional Fish and Shellfish ecology study area. The Scottish Ministers are largely content with this, however, highlight NatureScot's representation with regard to river lamprey (*Lampetra fluviatilis*) and European smelt (*Osmerus eperlanus*) in that they are likely to interact with the Proposed Works in coastal areas only.	Fish in coastal areas with the potential to occur within, or transit the Fish and Shellfish Ecology Study Area (including river lamprey and European smelt) have been identified in the baseline characterisation in **Section 4.4**, and the potential for impacts to these receptors have been assessed in **Section 4.8** and **Section 4.9**.
Comment that while they assume basking sharks (*Cetorhinus maximus*) are being scoped out due to lack of direct mention in the Scoping Report, NatureScot recommend that mitigations put in place to minimise risk to marine mammals should also be applied to basking sharks should they be present.	Basking shark has been identified as a receptor within the baseline characterisation presented in **Section 4.4**, with potential effects assessed in **Sections 4.8** and **Section 4.9**. Mitigation measures proposed for marine mammals that also provide protection to basking shark are detailed in **Section 4.7**.
Table 7.27 and 7.28 of the Scoping Report presents the impacts to be scoped in and out of the EIA Report. The Scottish Ministers would highlight NatureScot's recommendations that "temporary habitat loss and disturbance of habitats", "increased SSCs and associated sediment deposition", and "underwater sound impacting Fish and Shellfish receptors" are scoped in at this time due to lack of justification as to why these are currently considered minor in nature. The Scottish Ministers also draw attention to NatureScot's representation that "underwater sound impacting Fish and Shellfish	The potential for impacts from temporary habitat loss and disturbance, increased SSC and associated sediment deposition, and underwater sound have been assessed in **Sections 4.8** to **4.12**).

Comment	How and where considered in the PEIR
receptors" be scoped in due to potential for these activities to impact Fish and Shellfish populations.	
The Scottish Ministers also draw attention to NatureScot's representation that "underwater sound impacting Fish and Shellfish receptors" be scoped in due to potential for these activities to impact Fish and Shellfish populations.	The potential for impacts from underwater sound on sensitive Fish and Shellfish receptors have been assessed in **Section 4.8.** Underwater sound modelling has been undertaken to inform the impact assessment (see **Volume 2, Annex 5.1 Underwater Sound Modelling Report, of the PEIR**).
Section 7.5.7 presents the designed in measures and mitigation. The Scottish Ministers draw the Applicant's attention to NatureScot's representation on the use of mitigation measures MM-10 and MM-22 detailed within the Scoping Report which must be considered further within the EIA Report.	MHPGC Project confirm that all embedded mitigation measures and their relevance to fish are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.** This includes mitigation measure MM-10, which relates to the development of an outline Cable Specification and Installation Plan (CSIP), and measure MM-22 which relates to the development of an outline offshore Construction Method Statement (CMS).
Section 7.5.8 of the Scoping Report outlines the proposed assessment methodology. The Scottish Ministers direct the Applicant's attention to NatureScot's representation with regard to PMFs and advise that the assessment must quantify the likely impacts and must assess whether the Proposed Works could lead to a significant impact on national status of the PMF.	Due consideration has been given to Scottish PMFs and other species of conservation importance with the potential to occur within the Fish and Shellfish Ecology Study Area. Relevant PMFs and other conservation-important receptors are identified in **Table 4.10** and described within the baseline (**Section 4.4**). Potential effects on these receptors have been assessed in **Sections 4.8** to **4.12**, informed by the worst-case project parameters and, where applicable, project-specific modelling.
With regard to EMF, the Scottish Ministers advise that the Applicant must consult with NatureScot in advance of the application submission on the proposed methodology to ensure that potential impacts to Fish and Shellfish species from EMF effects is sufficiently assessed within the EIA Report.	The potential for impacts to sensitive Fish and Shellfish receptors from EMF have been assessed in **Sections 4.8**. MHPGC-Project specific EMF modelling has been undertaken and used to inform the assessment (see **Volume 2, Annex 4.2 EMF Assessment, of the PEIR**).
With regards to changes in prey availability, the Scottish Ministers advise that the EIA Report must clearly set out the impacts to key prey species and their habitats arising from the Proposed works alone and cumulatively.	Potential effects on prey resources and their supporting habitats have been considered within the Fish and Shellfish ecology assessment. Key prey species and supporting habitats with the potential to interact with the MHPGC Project are identified in **Section 4.4**), and potential direct and indirect effects to these receptors assessed in **Sections 4.8** to **4.12**. Potential impacts on prey species are additionally considered within the **Volume 2, Chapter 6: Marine Ornithology, of the PEIR** and **Volume 2, Chapter 5: Marine Mammals, of the PEIR**, where the implications of any changes in prey availability for higher trophic level receptors are assessed.
Section 7.5.9 of the MHPGC Project Scoping Report outlines the potential cumulative impacts from the Proposed Works. The Scottish Ministers would direct the Applicant to NatureScot's representation with regard to consideration of EMF impacts.	EMF impacts are considered in the O&M phase of the EIA (see **Section 4.8.2)**. The potential for cumulative impacts from EMF are considered in **Sections 4.9** and **4.10**. MHPGC-Project specific EMF modelling has been undertaken to inform the assessment (see **Volume 2, Annex 4.2 EMF Assessment, of the PEIR**).
The potential for transboundary impacts has been considered in Section 7.5.11 of the Scoping Report and the Scottish Ministers are content with this approach.	Transboundary effects in relation to Fish and Shellfish have been considered in **Section 4.11**.

Comment	How and where considered in the PEIR
NatureScot	
It is proposed to scope out the impact 'effects of particle motion element of underwater sound on marine mammals during all phases', the justification provided states that there is no evidence that particle motion has any effect on marine mammals. There is no mention of particle motion from underwater sound impacts on Fish and Shellfish receptors and it is unclear whether this impact is being scoped in or out for this receptor, clarity on this point would be welcomed. Also just to highlight that any potential impacts on fish could lead to indirect impacts on marine mammals and ornithology receptors. In our view, due to the likely low levels of impulsive underwater sound for this proposal (noting that geophysical surveys may use impulsive sound but this will be intermittent and short term in nature), it is unlikely that there will be significant effects of particle motion on Fish and Shellfish receptors. However, justification should be provided within the EIA Report if this potential impact is to be scoped out of the assessment.	The potential for impacts from particle motion are considered in **Section 4.8**, within the impact pathways "Underwater sound (excluding UXO)" and "Underwater sound from UXO clearance". The potential impacts on prey species are considered within the **Volume 2, Chapter 6: Marine Ornithology, of the PEIR** and **Volume 2, Chapter 5: Marine Mammals, of the PEIR**, where the implications of any changes in prey availability for higher trophic level receptors are assessed.
For fish, the underwater sound assessment proposes to use Popper *et al.* (2014) criteria, which we are content with but advise that impacts should be modelled for both stationary and fleeing receptors.	Impacts from underwater sound on Fish and Shellfish receptors are assessed in **Section 4.8**, informed by project-specific underwater sound modelling and relevant effect thresholds presented by Popper *et al.* (2014) (**Volume 2, Annex 5.1 Underwater Sound Modelling Report, of the PEIR**). Underwater sound modelling has been undertaken to inform the assessment of potential effects arising from geophysical and geotechnical surveys, vessel activity and cable installation works. In accordance with the Popper *et al.* (2014) guidelines, the assessment of these activities is based on peak and root mean square (RMS) sound pressure level (SPL) metrics. As these metrics are not dependent on exposure duration, there is no requirement to differentiate between stationary and mobile receptors. Separate assessments of stationary and mobile receptors are typically only required where cumulative sound exposure metrics are applied, such as for impact piling activities, which are not proposed as part of the MHPGC Project.
The Fish and Shellfish ecology study area has been defined as the extent of one spring tidal excursion of between 5km and 9km around the MHPGC Project Scoping Boundary and a regional Fish and Shellfish ecology study area encompassing the wider North Sea as shown in Figure 7.12 of the MHPGC Project Scoping Report. In relation to the Fish and Shellfish ecology study area, our comments on the physical processes and benthic study areas also applies – we would welcome clarification as to why the maximum spring tidal excursion distance differs to that proposed for the Morven Offshore Wind Array, which the MHPGC Project Scoping Boundary encompasses.	In the MHPGC Project Scoping Report, the Fish and Shellfish Ecology Study Area was defined as the MHPGC Project Scoping Boundary plus a buffer extending approximately 5km to 9km. Although the predicted excursion distance ranges from approximately 5km to 9km around the MHPGC Project PEIR Red Line Boundary (see **Volume 2, Chapter 1: Physical Processes of the PEIR**), the maximum value has been applied on a precautionary basis. Accordingly, a precautionary maximum tidal excursion of 9km has been used to define the Fish and Shellfish Ecology Study Area for the purposes of the impact assessment.
It is noted in Paragraph 7.5.3.2 that the Fish and Shellfish ecology study area is designed to incorporate the ZoI from indirect impacts e.g. increases in SSCs etc. Just to highlight, underwater sound impacts to fish may extend beyond the Fish and Shellfish ecology study area into the	Underwater sound modelling has been undertaken to inform the impact assessment. The modelling is supported by thresholds provided by Popper *et al.*

Comment	How and where considered in the PEIR
regional Fish and Shellfish ecology study area. Therefore, we advise that underwater sound modelling should inform the ZoI for assessing this potential impact to Fish and Shellfish receptors.	2014 (see **Section 4.8** and **Volume 2, Annex 5.1 Underwater Sound Modelling Report, of the PEIR**).
Table 7.22 captures most of the relevant baseline datasets but we also recommend inclusion of the FeAST, which now includes some Fish and Shellfish information. We also recommend a recent MSc paper by Lucie Hervé 'An evaluation of current practice and recommendations for environmental impact assessment of electromagnetic fields from offshore renewables on marine invertebrates and fish'. We can supply a copy of this paper on request.	The recommended data sources have been given due consideration where appropriate in the baseline characterisation in **Section 4.4**, and the impact assessment in **Section 4.8**.
It is noted that site-specific benthic survey data will also be used to inform the baseline for the Fish and Shellfish ecology, including Particle Size Analysis (PSA) to identify herring spawning and sandeel habitat suitability, which we welcome. In addition, Drop Down Video (DDV) and environmental DNA (eDNA) survey results will also be used to support the baseline characterisation for this receptor. Therefore, we are content that the combination of existing data (including additional sources suggested below) and site-specific surveys should provide adequate information to characterise the baseline environment for Fish and Shellfish ecology.	It is confirmed that these datasets have been interpreted using the most recent heat-mapping methodologies (Reach *et al.* 2024; Kyle-Henney., 2024), to identify and characterise the distribution of habitats and species of relevance to Fish and Shellfish ecology (**Volume 2, Annex 4.1 Herring and Sandeel Assessment, of the PEIR**). The outputs of these analyses have been used to inform both the baseline characterisation (**Section 4.4**) and the impact assessment (**Section 4.8**).
In relation to diadromous fish, Paragraph 7.5.5.14 states that all named diadromous fish species are considered to have the potential to be present within the vicinity of the MHPGC proposal, this includes Atlantic salmon, sea trout, sea lamprey (*Petromyzon marinus*), river lamprey, allis shad (*Alosa alosa*) and European smelt. We are content with these being included in the EIA assessment, noting that some of these species - river lamprey and European smelt are likely to interact with the proposal in coastal areas only. As the proposal is located entirely in offshore waters in Scotland, these could be scoped out of the portion of the proposal in Scottish waters.	All diadromous fish species considered likely to occur within, or transit through, the Fish and Shellfish Ecology Study Area have been characterised in the baseline in **Section 4.4**. The potential effects of the MHPGC Project on these species are assessed in **Section 4.8**.
We agree that freshwater pearl mussel (FWPM) (*Margaritifera margaritifera*) should be included in the assessment given that Atlantic salmon (and other salmonids) are integral to the lifecycle of this species. Therefore, any impacts to salmonids that prevent them from returning to their natal rivers may have a resulting effect on FWPM.	FWPM is considered alongside consideration of migratory salmon in the baseline (see **Section 4.4**) and impact assessment (see **Section 4.8**).
There is no mention of basking shark, also a PMF, within the MHPGC Project Scoping Report. We assume they are being scoped out from further assessment and are content with this due to the small numbers likely to be in this area. However, we recommend any mitigation put in place to minimise risks to marine mammals should also be applied to basking shark, should they be present.	Basking shark been identified as a receptor within the baseline characterisation presented in **Section 4.4**, with potential effects assessed in **Sections 4.8** to **4.12**. Where relevant, mitigation measures proposed for marine mammals that also provide protection to basking shark are detailed in **Section 4.7**.
Similarly to our advice on physical process and benthic ecology, the potential impacts 'temporary habitat loss and disturbance of habitats' and 'increased SSCs and associated sediment deposition' are proposed to be scoped out for the operation and maintenance phase as it is noted that this is expected to be minimal and associated with minor repair and reburial only. However, we advise that at this stage and without further justification or	The potential for impacts from temporary habitat loss and disturbance and increased SSC and associated sediment deposition arising from maintenance works in the operation and maintenance (O&M) phase have been assessed in **Section 4.8**.

Comment	How and where considered in the PEIR
evidence provided that repairs will be minor in nature, these impacts should be scoped into the operation and maintenance phase for further assessment. As noted previously, this is in line with advice provided for transmission cables elsewhere.	
For the potential impact 'underwater sound impacting Fish and Shellfish receptors' it is proposed to scope this out from the operation and maintenance phase as it notes that '…major maintenance activities (cable reburial and cable repair activities) will be non-routine and therefore it is proposed that this impact is scoped out of further assessment'. Although, these activities may be nonroutine, if there is a potential that they could occur and as a result cause an underwater sound impact to Fish and Shellfish then we advise this impact should be scoped in for assessment.	The potential for impacts from underwater sound in the O&M phase have been assessed in **Section 4.8**.
It is noted in Table 7.27 that the potential impact 'colonisation of hard structures' will only be assessed for the operation and maintenance phase. However, as previously highlighted in relation to decommissioning, it states in Section 3.9 of the Scoping Report that it is anticipated that all offshore cables and offshore cable protection may be left in-situ to minimise environmental impacts associated with their removal. If it is anticipated that cable infrastructure will be left in-situ post operation and maintenance phase then it should be made clear within the assessment that these impacts could be permanent.	The potential for impacts from the colonisation of hard substrates during O&M phase, has been assessed in **Section 4.8.2**. During decommissioning, the current MDS is to remove hard structures which would prevent further colonisation. If they are left in situ during decommissioning, any change would be considered negligible compared to the O&M phase.
It is noted that impacts to Fish and Shellfish ecology due to EMF effects is proposed to be scoped in during the operation and maintenance phase, which we agree with – advice is provided below regarding the proposed assessment approach.	The potential for impacts from EMF in the O&M phase has been assessed in **Section 4.8.2**.
We advise that in relation to all Fish and Shellfish PMF species, the assessment should quantify, where possible, the likely impacts and should assess whether the proposal could lead to a significant impact on the national status of the PMF.	Due consideration has been given to Scottish PMFs and other species of conservation importance with the potential to occur within the Fish and Shellfish Ecology Study Area. Relevant PMFs and other conservation-important receptors are identified in **Table 4.10** and described within the baseline (**Section 4.4**). Potential effects on these receptors have been assessed in **Sections 4.8** to **4.12**, informed by the worst-case project parameters and, where applicable, project-specific modelling.
It is noted that the impacts to Fish and Shellfish species from EMF effects will be assessed for the operation and maintenance phase but that no specific modelling will be undertaken. It does state in Table 7.27 that the assessment will be quantitative and based on information derived from the Project Design Envelope (PDE). We would usually expect modelling to inform the assessment, therefore we advise consulting us in advance of application submission on the proposed assessment methodology to ensure that the potential impacts to Fish and Shellfish species from EMF effects is sufficiently assessed.	The potential for impacts from EMF in the O&M phase has been assessed in **Section 4.8.2**. MHPGC-Project specific EMF modelling has been undertaken to inform the assessment (see **Volume 2, Annex 4.2 EMF Assessment, of the PEIR**).
The inter-related effects assessment for Fish and Shellfish is discussed within Section 7.5.10 of the Scoping Report. We advise that the EIA Report should clearly set out impacts to key prey species (such as sandeel, herring,	Potential effects on prey resources and their supporting habitats have been considered within the Fish and Shellfish ecology assessment. Key prey species and supporting habitats with the potential to

Comment	How and where considered in the PEIR
mackerel and sprat) and their habitats arising from the proposal alone and cumulatively. The Predators and Prey Around Renewable Energy Developments(PrePARED) project may be helpful in the understanding of predator-prey relationships in and around OWFs.	interact with the MHPGC Project are identified in **Section 4.4**), and potential direct and indirect effects to these receptors assessed in **Sections 4.8** to **4.12**. Potential impacts on prey species are additionally considered within the **Volume 2, Chapter 6: Marine Ornithology, of the PEIR** and **Volume 2, Chapter 5: Marine Mammals, of the PEIR**, where the implications of any changes in prey availability for higher trophic level receptors are assessed.
One aspect, previously raised in our benthic advice (Appendix C), is that EMF impacts should be considered cumulatively. There has been a tendency for wind farm proposals to dismiss impacts of EMF from a cumulative perspective. We are concerned that the spatial and temporal scale is not being sufficiently considered cumulatively across the network of cables, including those out with the proposal. We advise that the Applicant seeks agreement with MD LOT on the list of projects and/or plans to be included in the Cumulative Effects Assessment (CEA).	The potential for impacts from EMF in the O&M phase has been assessed in **Section 4.8.2**. The potential for cumulative impacts from EMF is considered in **Sections 4.9 and 4.10.** MHPGC-Project specific EMF modelling has been undertaken to inform the assessment (see **Volume 2, Annex 4.2 EMF Assessment, of the PEIR**).
As noted in our advice for other receptors – the designed in measures largely includes adherence to post-consent plans / programmes that will mitigate impacts for which no detail has yet been provided. Paragraph 7.5.7.1 states that the determination of magnitude and significance of impacts in the EIA Report will assume the implementation of these measures – care needs to be taken that there is a commitment to specific measures in order for these to be truly embedded measures that will reduce impacts and thus could be used in the assessment to reduce the magnitude and significance of effects.	The assessment of significance presented in **Section 4.8** relies on mitigation measures where there is sufficient certainty regarding their implementation and effectiveness. Such measures are secured through project commitments and are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register**. Where adherence to post-consent plans and programmes are proposed, the relevant outline plans, and the assessment presented in **Section 4.8** provide sufficient detail on the mitigation measures and their proposed implementation to provide confidence that the measures will be effective in reducing potential impacts.
Furthermore, we highlight that the justification provided for mitigation measure MM-22 is in relation to controlling specific health and safety risks – it is not to mitigate impacts to Fish and Shellfish.	MHPGC Project confirm that all embedded mitigation measure and their relevant to fish are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.** Mitigation measure MM-22 relates to the Development of an offshore CMS, which alongside controlling health and safety risks will also detail the construction procedures, good working practices for constructing the works, and how the construction-related mitigation steps are to be delivered.

Comment	How and where considered in the PEIR
Mitigation measure MM-10 relates to development and adherence to a cable plan and notes that this measure will reduce EMF and thermal impacts on Fish and Shellfish species. As previously advised for benthic ecology (Appendix C), we generally advise that the minimal target burial depth should be at least 1m to help reduce potential EMF effects and reduce the risk of re-exposure and damage to the cable.	The assessment has been undertaken in accordance with the worst-case project design parameters, which specify a minimum cable burial depth of 0.5m. As set out in Mitigation Measure MM-10, which relates to the development of an Outline CSIP, cable burial will be the preferred method of cable protection where practicable. The Outline CSIP will include a Cable Burial Risk Assessment (CBRA), which will determine appropriate burial depths and any associated safeguards based on site-specific seabed conditions, external hazards, climate change considerations and requirements to maintain cable protection and navigational and environmental safety throughout the project lifecycle. A Detailed CSIP will be developed prior to construction in accordance with the approved Outline CSIP. The Applicant acknowledges the recommendation for a target burial depth of 1m where practicable. However, the final burial depth achieved will be influenced by local seabed and engineering conditions identified through the CBRA process. The project will seek to maximise cable burial where practicable and minimise cable exposure. Furthermore, the potential for impacts from EMF and thermal exposure on Fish and Shellfish receptors has been assessed in **Section 4.8.3**. This assessment considered the worst-case design assumptions, including a minimum burial depth of 0.5m, and concluded that EMF and thermal effects on Fish and Shellfish receptors would not be significant.
The potential for transboundary impacts to Fish and Shellfish ecology is discussed in Section 7.5.11 of the EIA Scoping Report. The Applicant proposes to screen in a number of impact pathways, including underwater sound into the EIA transboundary assessment for this receptor group. We advise that there is no potential for transboundary impacts from the proposal description and information provided within the EIA Scoping Report.	Transboundary effects in relation to Fish and Shellfish have been considered in **Section 4.11**.
PINS	
3.2.3 The assessment of particle motion on Fish and Shellfish is not mentioned in the Scoping Report, the applicant should consider whether there will be any LSE on Fish and Shellfish and scope this matter in accordingly, seeking agreement with the relevant consultation bodies.	The potential for impacts from particle motion are considered in **Section 4.8**, within the impact pathways "Underwater sound (excluding UXO)" and "Underwater sound from UXO clearance".
3.5.2 Temporary habitat loss and disturbance of habitats (operation) - This matter is proposed to be scoped out based on the likely small areas of disturbance and minimal works expected during the O&M phase. As the O&M activities are not fully described, the Inspectorate does not feel that it has sufficient justification to agree to scope this matter out. The ES should include an assessment of temporary habitat loss/disturbance during operation, or information demonstrating agreement with the relevant consultation bodies and the absence of an LSE.	The potential for impacts from temporary habitat loss and disturbance arising from maintenance works in the O&M phase have been assessed in **Section 4.8.2**.
3.5.10 The applicant is directed to the comments of the EA at appendix 2 to this Opinion with regards to the potential	A precautionary approach has been adopted for diadromous and estuarine fish receptors, including European eel and other migratory species,

Comment	How and where considered in the PEIR
presence of eels in the vicinity of the proposed development.	recognising that these species may occur within the Fish and Shellfish Ecology Study Area during migration even where site-specific records are limited. The assessment therefore considers the potential for this receptor to transit the Fish and Shellfish Ecology Study Area and evaluates relevant impact pathways accordingly. Potential effects on migratory fish species are assessed in Section 4.8 and Section 4.9.
3.5.11 This chapter of the Scoping Report contains limited reference to the potential impact associated with spreading of INNS. The Inspectorate notes proposed mitigation measure MM-6, which includes a commitment to include measures within the outline Code of Construction Practice (CoCP), such as the Biosecurity Plan, to control the spread of Invasive Non-Native Species (INNS) and mitigate impacts on Fish and Shellfish receptors. The ES should include details of the mitigation and explain how its delivery is assured with reference to relevant documents.	MHPGC Project confirm that all embedded mitigation measures and their relevance to fish are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.** The CoCP applies to onshore construction activities and is therefore not relevant to offshore INNS management. Measures to prevent the introduction and spread of INNS during offshore works are secured through the development of an Offshore Environmental Management Plan (OEMP) (CoT06/MM-006), which will include a Marine Biosecurity Plan (MBP) (CoT38). Specifically, an Outline MBP will form part of the Outline OEMP and will be prepared and submitted as part of the application for development consent and Marine Licence application(s) to the Scottish Ministers. A detailed MBP will subsequently be developed in accordance with the approved Outline MBP.
3.5.2 Underwater sound impacting Fish and Shellfish receptors (operation) - The Scoping Report proposes to scope out this matter due to major maintenance activities (cable reburial and cable repair activities) being non-routine during the O&M phase. The Scoping Report proposes to assess activities that may cause underwater sound such as pre-construction site investigation surveys during construction and decommissioning activities such as removal of joint bays and cable protection. See also comment ID 3.7.1 below. However, limited information is available on the O&M activities. If repair works are required, the Inspectorate understands that such activity would generate underwater sound. The Inspectorate advises that this matter should be scoped into the assessment, or the ES should otherwise explain, with evidence of agreement from relevant consultation bodies, why significant effects are not likely to occur.	The potential for impacts from underwater sound on Fish and Shellfish receptors during the O&M phase are assessed in **Section 4.8.2**.
3.5.3 Increased SSCs and associated sediment deposition (operation) - This matter is proposed to be scoped out based on the likely minimal works and small areas of disturbance during the O&M phase, although it is also acknowledged that maintenance operations (e.g. cable repair/reburial etc) may result in indirect impacts on Fish and Shellfish communities due to temporary increases in SSCs and associated sediment deposition. The Inspectorate's comments at ID 3.5.1 apply equally to this matter. The Inspectorate advises that this matter should be scoped into the assessment, or the ES should demonstrate, with evidence of agreement from relevant consultation bodies, that LSE would not occur.	The potential for impacts from increased SSC and associated sediment deposition during the O&M phase are assessed in **Section 4.8.2**.
3.5.4 Colonisation of hard structures (construction and decommissioning) - The Scoping Report does not provide justification for scoping this matter out from these two	'Colonisation of hard structures' has only been considered for the O&M phase as colonisation occurs over a prolonged period of time after

Comment	How and where considered in the PEIR
phases of the proposed development. The Inspectorate considers that colonisation of hard structures may occur during construction and therefore the Inspectorate does not agree to scope this matter out. The construction and decommissioning phase may also result in the introduction of INNS. The ES should assess impacts of colonisation of hard structures during construction and decommissioning where significant effects are likely to occur, or demonstrate, with evidence of agreement from relevant consultation bodies, that LSE would not occur.	construction is complete and is therefore most likely to occur during the O&M phase, rather than during the construction phase. During decommissioning, the current MDS is to remove hard structures which would prevent further colonisation. If they are left *in situ* during decommissioning, any change would be considered negligible compared to the O&M phase.
3.5.5 EMF from subsea electrical cabling (construction and decommissioning) - On the basis that cables would not be live until the beginning of operation, the Inspectorate agrees to scope out impacts from EMF during construction and decommissioning, as there would be no pathway for effect.	The potential for impacts from EMF in the O&M phase has been assessed in **Section 4.8.2**. The potential for cumulative impacts from EMF is considered in **Sections 4.9** and **4.10**. MHPGC-Project specific EMF modelling has been undertaken to inform the assessment (see **Volume 2, Annex 4.2 EMF Assessment, of the PEIR**).
3.5.6 Accidental release of pollutants (all phases) - The Inspectorate agrees that this matter can be scoped out on the basis that the mitigation measures proposed within the outline management plans, including Marine Pollution Contingency Plan (MPCP), are sufficient to address the likely impacts and avoid a LSE. The ES should include details of the mitigation and explain how its delivery is assured with reference to relevant documents.	The potential for impacts from accidental release of pollutants on Fish and Shellfish are scoped out of the impact assessment and inclusion of relevant management plans including the development of an outline MPCP (CoT 37), are detailed in are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.**
3.5.7 Underwater sound from vessels (all phases) - This matter is proposed to be scoped out on the basis that vessels associated with the proposed development would not represent a likely significant change from the existing baseline noise levels of shipping in the area and thus is unlikely to add significant underwater sound over baseline levels. The MHPGC Project Scoping Report states that underwater sound generated by vessels is likely to be low and potential impacts to Fish and Shellfish receptors are only likely to occur if individuals remained within their immediate vicinity (i.e. within metres) for several hours/ days and this is stated to be highly unlikely to occur. The Inspectorate does not agree that significant effects relating to underwater sound associated with vessels is unlikely. The MHPGC Project Scoping Report does not provide information to demonstrate that noise would be localised or evidence of the level of background noise that is currently present. It is noted that information concerning the underwater sound levels associated with vessels is proposed to be analysed and assessed as part of the underwater sound modelling study to inform the underwater sound ES chapter. In the absence of confirmed construction details the Inspectorate considers that this matter should be scoped in for further assessment, or the ES should otherwise explain, with evidence of agreement from relevant consultation bodies, why significant effects are not likely to occur.	The potential for impacts from underwater sound from vessels has been assessed in **Section 4.8.** Underwater sound modelling has been undertaken to inform the assessment. The modelling is supported by thresholds provided by Popper *et al.* 2014 (see **Section 4.8** and **Volume 2, Annex 5.1 Underwater Sound Modelling Report, of the PEIR**).
3.5.8 Thermal emissions from operational cables (all phases) - As the cable would not be in operation during construction or either decommissioning phase options, the Inspectorate agrees that an assessment of thermal emissions can be scoped out of assessment for these phases of the proposed development. For reasons explained in respect of benthic receptors ID 3.4.8 above, the Inspectorate agrees that as cables are proposed to be	Although thermal emissions were proposed to be scoped out, they have been scoped into the assessment following consultation feedback, including a specific request from the Environment Agency. A precautionary approach has therefore been adopted, and the assessment of potential effects from thermal emissions from cables on Fish

Comment	How and where considered in the PEIR
buried at depths of between 0.5 and 2.5m, or where this is not practicable, be surrounded by cable protection measures (Scoping Report table 3.2 and paragraph 3.4.3.16), significant effects on Fish and Shellfish receptors due to thermal emissions are unlikely to occur. The Scoping Report includes commitments to developing and adhering to CSIP (table 7.5 of Scoping Report) and concludes there is limited scope for impacts to Fish and Shellfish due to heat from operational subsea cables. On this basis, the Inspectorate agrees this matter can be scoped out.	and Shellfish receptors are assessed in **Section 4.8.2**.
3.5.8 The table does not include any reference to the Salmon and Freshwater Fisheries Act 1975 and The Eels (England and Wales) Regulations 2009, although these are noted to be reference in chapter 8.3 of the Scoping Report. The Fish and Shellfish chapter of the ES should include references to relevant legislation.	The Salmon and Freshwater Fisheries Act 1975 and The Eels (England and Wales) Regulations 2009 are included in **Table 4.1**. The Fish and Shellfish ecology assessment has considered Atlantic salmon and European eel as key receptors, with potential effects during the construction, operation and decommissioning phases assessed in **Section 4.8** and **Section 4.9**. The assessment has therefore been undertaken with regard to the relevant legislative requirements relating to these species.
SFF	
SFF note that the MHPGC Project Scoping Boundary overlaps with the spawning and nursery grounds of some commercially important demersal and pelagic fish species (including, cod, haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), whiting, herring and sandeel). Therefore, we propose any survey activities and other seabed disturbances should be undertaken out with spawning and nursery periods of all fish species to avoid juvenile fish mortality. We also note that the Local Benthic Ecology Study Area seabed is suitable for herring spawning. As the mentioned areas are suitable for herring spawning, the SFF are concerned about the Development impacts on all commercial value fish species in the area, especially the Development impacts on the herring which are also particularly sensitive to noise impacts as they have swim bladders which are involved in hearing. We are of the view that any activities with negative impacts on herring spawning habitat are prohibited based on the 'ICES Advice on fishing opportunities, catch, and effort Greater North Sea ecoregion' published 31 May 2024. Therefore, SFF propose the above-mentioned ICES advice to be taken into account and acted upon at determination stage. The link for the ICES advice can be accessed here: North Sea herring advice.	The nursery and spawning grounds with the potential to interact with the MHPGC Project are identified in **Section 4.4.5**. The potential for impacts on key Fish and Shellfish receptors undertaking important life-history events within the Fish and Shellfish Ecology Study Area, including spawning and nursery activities, is assessed in **Section 4.8**. The assessment concludes that effects on these receptors would be not significant and, therefore, no additional mitigation measures are required beyond those embedded within the MHPGC Project design (**Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**). The potential presence of suitable spawning habitat for herring and sandeel has been assessed through analysis of a range of available data sources, including site-specific survey data. These data have been interpreted in accordance with the latest spawning habitat heat-mapping methodologies to identify areas where there is a high degree of confidence that active spawning may occur. The outputs of this assessment have been used to inform the evaluation of potential impacts on herring and sandeel, including potential impacts associated with seabed disturbance and underwater sound (See **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**). Due consideration has also been given to the ICES Advice for North Sea herring. In accordance with the advice that "*no activities on spawning habitats should be allowed unless the effects of these activities have been assessed and shown not to be detrimental*", a comprehensive assessment of potential effects on herring spawning habitat and spawning activity has been undertaken. Based on the evidence available, including site-specific data, habitat suitability analyses and impact modelling, the assessment concludes that the MHPGC Project will not result in

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	significant population level effects on herring. Accordingly, the assessment considers that the ICES advice has been appropriately considered.
MMO	
The MMO agrees that the potential impacts during the construction, operation and decommissioning phases have been scoped in/out appropriately, as summarised in the table 7.27 of the Scoping Report. However, please see point 3.7.4 regarding the scoping in of thermal emissions from operational cable.	The potential for impacts from thermal emissions from cables on Fish and Shellfish receptors are assessed in **Section 4.8.2**.
The MMO is content that the accidental release of pollutants will be scoped out of the assessment on the basis that the risk of pollution events will be managed by the implementation of an Environmental Management Plan (EMP) and MPCP. The MMO agrees that the presence of vessels during construction is unlikely to represent a significant change from baseline noise levels of shipping and therefore has no objection to underwater sound from vessels used for the project being scoped out of the assessment.	The potential for impacts from accidental release of pollutants on Fish and Shellfish are scoped out of the impact assessment and inclusion of relevant management plans including the development of an outline MPCP (CoT 37), are detailed in are detailed in **Section 4.7** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR.** Whilst the MMO agreed that underwater sound from vessels could be scoped out of the assessment, the Planning Inspectorate requested that this impact be scoped into the EIA. Accordingly, the potential for impacts from underwater sound generated by vessels has been assessed in **Section 4.8.**
The Applicant proposes to scope out thermal emissions from operational cables from their assessment and has used the findings from a study by Meißner *et al.* (2007) to support their decision The study, conducted at Nysted OWF in Denmark, found the temperature change in the top 30 centimetres (cm) of sediment above a high voltage cable (132 kilovolt (kV)) to be a maximum of 2 degrees Celsius (°C). The MMO notes that as the target burial depth for cables at MHPGC will be between 0.5 metres (m) to 2.5m, the Applicant considers that the temperature change at the seabed surface where demersal fish will be in contact with the heated sediments is likely to be minimal and therefore not lead to impacts on Fish and Shellfish receptors. The MMO is generally content that thermal emissions from operational cables is scoped out of further assessment for fish, except for sandeel which have a burrowing nature and spend their winter hibernation period buried in the sand. Sandeel burrow to depths of between 20cm to of 50cm for certain species in specific sediment types (Holland *et al.,* 2005 and Rowley, 2008), so the MMO considers that there is potential for sandeels to be exposed to the effects of thermal heating in the sediment layers they inhabit, based on the Applicant's proposed 0.5m minimum cable burial depth. The MMO appreciates that the burial depth of 0.5m is the minimum, but at this stage the exact extent of the cable burial route buried to a depth of 0.5m is not known. Therefore, the EIA is required to assess the 'worst-case' scenario that assumes the greatest potentially significant impact in terms of magnitude and significance, which is 0.5m burial. As already stated, sandeel can burrow to this depth, and deeper, therefore the MMO considers that an impact is possible and thus an impact pathway is present. Only once a discussion on this has taken place, can the likelihood of significant effects on sandeel can be predicted. The MMO therefore requests that thermal	The potential for impacts from thermal emissions from cables on Fish and Shellfish receptors (including sandeel) are assessed in **Section 4.8.2**.

Comment	How and where considered in the PEIR
emissions from cables is scoped into the EIA for the operational stage.	
The MMO notes that the Applicant intends to carry out a desk-based assessment using existing data and literature sources. Fish and elasmobranch species with spawning and nursery grounds overlapping the project's scoping boundary have been identified and mapped (Figures 7-14 to 7-18) using Coull *et al.,* 1998, Ellis *et al.,* 2012 and Aires *et al.,* 2014. These sources are appropriate.	The baseline characterisation of Fish and Shellfish ecology is presented in **Section 4.4**, including the identification of fish and elasmobranch spawning and nursery grounds with the potential to interact with the MHPGC Project. This characterisation is informed by recognised literature sources, including Coull *et al.* (1998), Ellis *et al.* (2012) and Aires *et al.* (2014), together with other relevant datasets where available.
The MMO notes that migratory fishes that are assumed likely to be present within the project's regional Fish and Shellfish ecology study area during their migrations have been identified along with the timing of their up/downstream migration periods. The source of this information appears to come primarily from the Seagreen 1 and Seagreen 1A OWF EIA and Eastern Green Link 2 Environmental Appraisal Report (EAR). The MMO requests that the Applicant should expand on how information and/or data on migratory fishes was acquired for these EIAs and EAR. For example, if the information came from fisheries survey data or peer-reviewed literature.	Baseline information for diadromous species is included in **Section 4.1.1** and further assessed in **Section 4.8.** The Seagreen 1 and Seagreen 1A OWF EIA and Eastern Green Link 2 EAR were primarily informed by peer-reviewed literature as well as publicly available fisheries catch data (e.g. ICES/Marine Scotland fishing data).
The MMO notes that PSA data collected during the project's benthic survey will be used to classify sediments to determine sandeel habitat and herring spawning habitat suitability within the project's scoping boundary, following the methods by Reach *et al.* (2013) and Latto *et al.* (2013), for herring and sandeel respectively. The Applicant should note that the MarineSpace (2013a and 2013b) methods for determining sandeel habitat suitability and potential herring spawning habitat, respectively, have recently been revised. The MMO requests that the Applicant adheres to the methods described by Reach *et al.* (2024) and Kyle-Henney *et al*. (2024) to determine habitat suitability for sandeel and herring, respectively.	It is confirmed that these datasets have been interpreted using the most recent heat-mapping methodologies (Reach *et al.* 2024; Kyle-Henney., 2024), to identify and characterise the distribution of habitats and species of relevance to Fish and Shellfish ecology (See **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**). The outputs of these analyses have been used to inform both the baseline characterisation (**Section 4.4**) and the impact assessment (**Section 4.8**).
International Herring Larvae Survey (IHLS) data will be used to identify areas of herring spawning habitat. Table 7.22 of the report implies that IHLS data from 2022 will be used. The MMO requests that the Applicant uses a minimum of ten years of IHLS data to inform their assessment. Data up to and including 2024 are available from ICES.	The assessment of herring spawning habitat has been informed by a comprehensive review of 10 years of IHLS data (**Section 4.4.5**).
The MMO considers that the approach to the CEA appears reasonable. Cumulative impacts to fish will be assessed within a 50km buffer of the MHPGC Project, except for the effects of underwater sound which will cover a 100km zone of influence due to the wider range of effect from underwater sound. Inter-related effects will be considered across the project's lifetime and for individual stages of the development for receptors. The MMO is of the opinion that the Applicant's approach to assessment appears appropriate, though further information on the screening in/out of projects within the study area is required in order to fully identify where potential risks of these effects lie.	The Applicant acknowledges the MMO's comments regarding the CEA. Since scoping, the CEA screening approach has been refined to reflect the outputs of the underwater sound modelling and sediment plume modelling. The revised screening buffer has been defined with reference to the maximum predicted spatial extent of potential effects, including the maximum tidal excursion distance, and is considered sufficient to capture all pathways through which direct and indirect cumulative effects could occur. The revised approach therefore encompasses developments with the potential to contribute to cumulative effects on Fish and Shellfish receptors. The revised CEA screening ranges were presented through the Evidence Plan Process to the Fish and Shellfish Ecology Expert Working Group

Comment	How and where considered in the PEIR
	(EWG) and have informed the identification and screening of relevant plans and projects for inclusion within the cumulative assessment. No objections to the revised screening approach were raised by the MMO through the Evidence Plan Process.
It is unclear whether UXO clearance activities will be included under the deemed marine licence (DML), or if the Applicant intends to submit a separate Marine Licence Application (MLA) for these activities. The MMO has reviewed the approach to the underwater sound assessment for fish and is generally content with the Applicant's proposal to use the hearing thresholds by Popper *et al.* (2014) in the underwater sound modelling to determine the range of impact to fish from mortality and potential mortal injury, recoverable injury, temporary threshold shift (TTS), masking and behaviour. The MMO's position is that UXO investigation can be part of the DML but a separate MLA should be sought for clearance activities.	The potential for impacts from both low order and high order UXO clearance on Fish and Shellfish receptors have been assessed in **Section 4.8.** The potential for impacts from high order clearance are assessed for information only. The MHPGC Project is committed to the use of low order clearance methods, and should high order clearance be required, a separate marine licence application would be sought.
The MMO notes that discussions in sections 7.5.5.8 and 7.5.5.9 on the catch compositions from fisheries surveys at the Teesside OWF array area and Blyth OWF area do not provide any information of the gear type/s used in these surveys. For the ES, when discussing catch composition, abundance etc, the MMO requests that the Applicant provides information on the gear types used for each survey, the timing of surveys, and the limitations associated with the survey methods.	Where applicable, information of gear type and survey details are presented alongside any catch composition data in the baseline characterisation in **Section 4.4.**
The MMO notes that potential impacts to be scoped in for shellfish ecology are described in Table 7.27. This includes, temporary habitat loss and disturbance of habitats, underwater sound, increased SSC and associated sediment deposition, long-term habitat loss, colonisation of hard structures, EMFs and release of sediment bound contaminants. The MMO agrees with the impacts scoped in for shellfish receptors.	The potential for impacts to Fish and Shellfish receptors from temporary habitat loss and disturbance of habitats, underwater sound, increased SSC and associated sediment deposition, long-term habitat loss, colonisation of hard structures, EMFs and release of sediment bound contaminants are assessed in **Section 4.8.**
The MMO considers that the approach to the scoping assessment and data gathering is appropriate. However, the MMO considers that the Applicant should include further evidence to characterise the baseline environment for shellfish.	The shellfish baseline has been characterised using a range of available evidence sources and is presented in **Section 4.4**. This includes relevant information on the distribution, abundance and ecological importance of key shellfish species with the potential to occur within the Fish and Shellfish Ecology Study Area, providing an appropriate basis for the impact assessment.
In addition to the data sources identified by the Applicant, the Applicant may want to make use of the Fisheries Dependent Information (FDI) data which provides landings, effort, catches from Member States and UK (2014-2020 (STECF, 2024) to support the characterisation of the baseline environment for shellfisheries.	The baseline characterisation for both Fish and Shellfish has been informed by MMO landings data. Landings data derived from the FDI dataset have not been analysed separately to avoid duplication, as both datasets are derived from the same underlying national fisheries data.
The MMO notes that careful consideration should be taken when interpreting results from trawl surveys as these are not designed to target shellfish species and therefore do not provide an accurate abundance estimate for shellfish. The MMO considers that presence/absence data or catch rates should only be implied for shellfish when using these gear types.	Trawl survey data have been used with appropriate caution and have not been relied upon to derive shellfish abundance estimates. Where trawl survey data have been considered, they have been used primarily to inform the presence, potential distribution and relative occurrence of shellfish species within the Fish and Shellfish Ecology Study Area, recognising the limitations of these survey methods for sampling shellfish receptors.

Comment	How and where considered in the PEIR
The MMO considers that there is an adequate description of the methodology to assess cumulative impact assessments and Inter-related effects for shellfish species.	The CEA is presented in **Section 4.9**, whilst the assessment of inter-related effects is presented in **Section 4.12**.

4.3.2 Further consultation and engagement

4.3.2.1 An EWG meeting was held in November 2025 with stakeholders to discuss points regarding the Fish and Shellfish ecology baseline. This included information on the type of surveys which feed into the assessment and the impact pathways which have been scoped in for each phase of the MHPGC Project. A second EWG meeting was held in July 2026 to discuss the progression of the Fish and Shellfish ecology assessments.

4.3.2.2 Additional consultation has been summarised in **Table 4.6**.

Table 4.6: Summary of further consultation and engagement

Date	Consultee and response type	Comment	How and where considered in the PEIR
November 2025	Fish and Shellfish Ecology EWG meeting with stakeholders: • Morven Offshore Wind Limited; • MMO; • Centre for Environment, Fisheries and Aquaculture Science (Cefas); • Natural England; • Environment Agency; • Yorkshire Wildlife Trust.	The MMO acknowledged the intended use and presentation of the IHLS datasets within the Kyle-Henney *et al.* (2024) herring spawning habitat assessment methodology, noting that the IHLS dataset be presented in a manner that appropriately reflects herring spawning distribution, intensity and interannual variability.	The Applicant acknowledges the MMO's recommendations regarding the updated herring spawning habitat heat-mapping methodology (Kyle-Henney *et al.*, 2024). IHLS data have been interpreted and presented in accordance with the methodology set out by Kyle-Henney *et al.* (2024), with the relevant datasets used for their intended purpose within the assessment (**Section 4.4.5**). To support interpretation of herring spawning intensity, and interannual variability in larval density and distribution patterns, the IHLS data are presented both cumulatively, showing 10 years of survey data (see **Figure 4.12** of this chapter and **Figure 4-6** of **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**) and by individual survey year (see Appendix A of **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**). For detailed information regarding data analysis see **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**.
		MMO requested confirmation that the assessment of migratory fish receptors includes movements through estuarine waters, in addition to freshwater habitats.	**Section 4.4** and **Section 4.8** consider migratory fish that transition between marine and estuarine and freshwater habitats.
		EA advised that, in the absence of quantitative underwater sound thresholds for salmonids, the assessment should explicitly acknowledge uncertainty and adopt a precautionary worst-case approach.	A precautionary approach and worst-case scenario have been used throughout this assessment, including the assessment of underwater sound in **Section 4.8.**
		EA agreed with the proposed impact assessment scope in principle and advised that the assessment should adequately consider impacts on coastal, estuarine and diadromous fish receptors.	Potential effects to diadromous fish and estuarine environments are considered in detail in **Section 4.4** and **Section 4.8.**
		Natural England agreed with the proposed underwater sound assessment approach and highlighted relevant best-practice guidance for fish data analysis, evidence presentation and assessment of underwater sound effects.	The underwater sound assessment has been undertaken with reference to relevant guidance, including Phase III of Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Activity-specific impact thresholds from Popper *et al.* (2014) have been applied within the assessment to evaluate the potential

Date	Consultee and response type	Comment	How and where considered in the PEIR
			effects of underwater sound on fish receptors. Whilst Hawkins *et al.* (2014) has been considered as part of the evidence base, the thresholds presented therein relate specifically to piling activities and are therefore not applicable to noise-generating activities associated with the MHPGC Project. Accordingly, the assessment has adopted the activity-specific criteria from Popper *et al.* (2014), which are considered appropriate for the underwater sound sources assessed.
November 2025	NatureScot written advice on EWG materials	NatureScot agreed with the proposed impact assessment scope, particularly the inclusion of consideration of fish & shellfish PMFs in the assessment and the assessment of impacts to key prey species and their habitats (such as sandeel, herring, mackerel and sprat).	Potential effects to fish & shellfish PMF, and key prey species and their habitats are considered in detail in **Section 4.4** and **Section 4.8.**
July 2026	Fish and Shellfish Ecology EWG meeting with stakeholders: • Morven Offshore Wind Limited; • MMO; • Natural England; • Yorkshire Wildlife Trust.	An overview of the following was presented: • The Fish and Shellfish Ecology Study Area, representing a 9km buffer around the MHPGC Project PEIR Red Line Boundary; • Fish and Shellfish receptors; • Fish and Shellfish related designated sites; • Approach to CEA; • Proposed project commitments; • Preliminary findings; • Pending agreements, and agreements sought.	The Fish and Shellfish Study Ecology Area is described in **Section 4.4.2**, Fish and Shellfish receptors are outlined in **Section 4.4.4**, relevant designated sites are outlined in **Section 4.4.7**, and project commitments are outlined in **Section 4.7.** The approach to the CEA is outlined in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR**, and the Fish and Shellfish CEA is reported in **Section 4.10**.
July 2026	NatureScot written advice on EWG materials	NatureScot agree with the proposed Valued Ecological Receptors (VERs), the Fish and Shellfish Ecology Study Area (which they understand includes the 9km spring tidal excursion range) and the proposed CEA approach.	NatureScot's agreement with the proposed VERs, the 9km Fish and Shellfish Ecology Study Area and CEA approach is noted. No changes are required in response to this comment.
July 2026	Fish and Shellfish Ecology EWG meeting with stakeholders:	An overview of the following was presented: • The Fish and Shellfish Ecology Study Area, representing a 9km buffer around the MHPGC Project PEIR Red Line Boundary;	Within this Chapter, baseline sources are detailed in **Section 4.4.3** and impacts of underwater sound generated by UXO clearance has been assessed in **Section 4.8** and **Section 4.9**.

Date	Consultee and response type	Comment	How and where considered in the PEIR
	• Morven Offshore Wind Limited; • Environment Agency (EA).	• Fish and Shellfish receptors; • Fish and Shellfish related designated sites; • Approach to CEA; • Proposed project commitments; • Preliminary findings; • Pending agreements, and agreements sought. The EA broadly agreed with the proposed Fish and Shellfish Ecology Study Area and receptor scope, with no additional receptors requested. Clarification was sought regarding the sediment and habitat datasets used to inform the baseline, and confirmation was requested that UXO clearance noise impacts would be assessed. The EA did not raise concerns regarding the preliminary baseline findings but reserved its position on the CEA and project commitments pending review of the PEIR and supporting documentation.	In relation to the other information presented at the EWG, the Fish and Shellfish Study Ecology Area is described in **Section 4.4.2**, Fish and Shellfish receptors are outlined in **Section 4.4.4**, relevant designated sites are outlined in **Section 4.4.7**, and project commitments are outlined in **Section 4.7.** The approach to the CEA is outlined in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR**, and the Fish and Shellfish CEA is reported in **Section 4.10**.

4.4 Baseline characterisation

4.4.1 Overview

4.4.1.1 This section describes the methods and data sources used to characterise the baseline for Fish and Shellfish ecology within the Fish and Shellfish Ecology Study Area and describes the existing baseline characteristics.

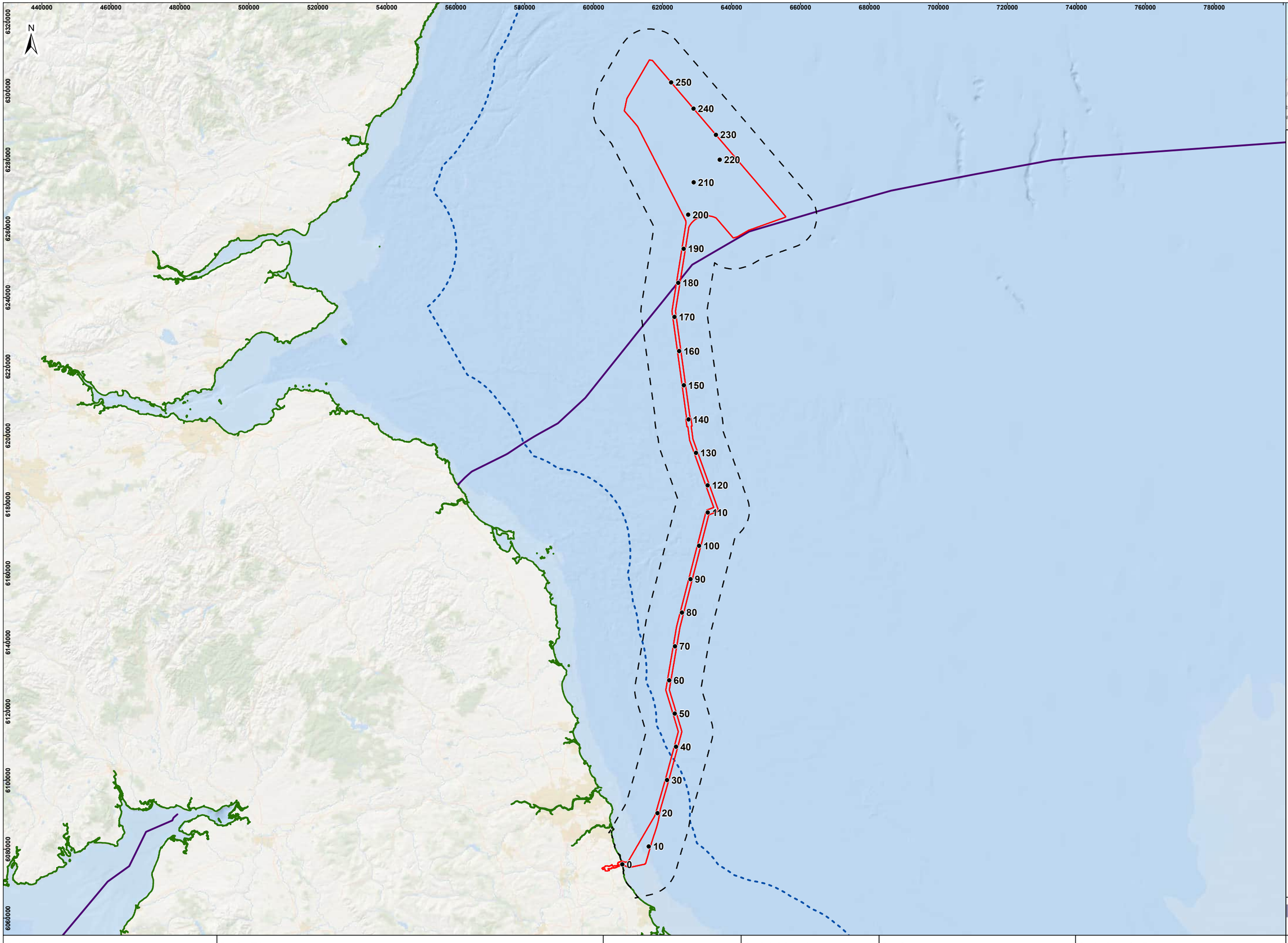
4.4.2 Fish and Shellfish Ecology Study Area

4.4.2.1 For the purposes of this report, the study areas for Fish and Shellfish ecology have been defined by the following:

- The offshore extent of the MHPGC Project PEIR Red Line Boundary up to the MHWS: The MHPGC Project PEIR Red Line Boundary extends from the landfall at MHWS in English waters (Kilometre Point (KP) 0) to the northern extent in Scottish waters. In Scottish waters, the offshore extent of the MHPGC Project PEIR Red Line Boundary includes KP180 to KP250 (KPs are linear reference markers positioned at 1km intervals along the nominal centreline and are used for reference purposes only);
- The Fish and Shellfish Ecology Study Area is defined by a 9km buffer around the offshore extent of the MHPGC Project PEIR Red Line Boundary up to MHWS. This buffer represents the distance of one spring tidal ellipse, in order to incorporate the maximum distance sediments may travel in one tidal cycle, as described in **Volume 2, Annex 2.2: Model Design Validation and Results, of the PEIR.** This buffer defines the likely maximum spatial extent of potential indirect impacts of the MHPGC Project.

4.4.2.2 Regional Fish and Shellfish ecology data from the wider North Sea have also been considered to contextualise the study areas identified above and provide a broader understanding of baseline conditions and ecological variability.

4.4.2.3 The Fish and Shellfish Ecology Study Area is shown in **Figure 4.1**.





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- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- Territorial Sea Limit
- Mean High Water Springs
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area

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Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** FISH AND SHELLIFSH ECOLOGY STUDY AREA	0 5 10 15 20 25 km Scale@A31:1,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue	**Drawing Number:** FIGURE 4-1

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4.4.3 Baseline data sources

Desk study

4.4.3.1 A number of data sources, which provide coverage of the Fish and Shellfish Ecology Study Area, were identified through an initial desk-based review of existing literature and data sources to inform this baseline. These data sources are summarised below in **Table 4.7**.

Table 4.7: Summary of key desktop datasets and reports for Fish and Shellfish ecology

Source	Summary	Coverage of Study Area
Published Offshore Wind Farm (OWF) data		
Morven North Offshore Wind Array Project EIA Report: Volume 3, Annex 8.1 Benthic Subtidal Ecology Shared Technical Report (Tetra Tech RPS Energy, 2026a)	A technical report for Morven North and Morven South that presents a baseline characterisation of the seabed habitats within these respective site boundaries. The report includes the analysis of benthic site-specific survey data from a survey undertaken from April to August 2022 by Gardline Ltd. within the Morven North and Morven South study areas (extending to 5 km to 14km around the respective boundaries). The sampling survey consisted of 100 sampling stations across the two study areas at which grab sampling and DDV surveys were undertaken, with DDV surveys also completed at an additional two stations. Three sediment samples were collected at each of the 100 grab sampling stations, with samples used for macrofaunal and eDNA analyses. Physicochemical analyses were undertaken at 52 stations, while eDNA analyses were completed for 50 of the 100 samples. These data have been used to identify the location of suitable spawning substrates for demersal spawning fish receptors, and the presence of Fish and Shellfish receptors within the Fish and Shellfish Ecology Study Area.	Partial coverage of the Fish and Shellfish Ecology Study Area in Scottish waters. Morven North and Morven South lie within the MHPGC Project PEIR Red Line Boundary.
Eastern Green Link 1 – Scotland England Green Link 1 / Eastern Link 1 – Marine Scheme (AECOM, 2022a)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Eastern Green Link 1 – Marine Scheme.	Partial coverage of the Benthic Subtidal Ecology Study Area in English waters. Intersects the MHPGC Project PEIR Red Line Boundary approximately 8 km from the proposed MHPGC Project landfall.
Eastern Green Link 2 – Marine Scheme: Environmental Appraisal Report, Volume 2, Chapter 9, Fish and Shellfish Ecology AECOM, 2022b)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Eastern Green Link 2 – Marine Scheme.	Partial coverage of the Fish and Shellfish Ecology Study Area in English offshore waters. Lies in proximity to the MHPGC Project PEIR Red Line Boundary in English waters, intersecting approximately the mid-point.
Berwick Bank Wind Farm OWF Fish and Shellfish Ecology EIA report (Volume 2, Chapter 9) (RPS, 2022a) and supporting technical baseline (Volume 3, Appendix 9.1) (RPS, 2022b)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Berwick Bank OWF.	Regional analysis provides partial coverage of the Fish and Shellfish Ecology Study Area. Berwick Bank lies approximately 18.22km east of the MHPGC Project PEIR Red Line Boundary at its closest point, in Scottish waters.

Source	Summary	Coverage of Study Area
Inch Cape OWF Natural Fish and Shellfish Ecology EIA report (Chapter 9) (Natural Power, 2017a) and supporting technical appendices (Appendix 9A Herring Spawning Study, Appendix 9C Salmon Migration Behaviour, Appendix 14B Salmon and Sea Trout Baseline) (Natural Power, 201b7)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Inch Cape OWF. Supporting studies undertaken for the EIA report, provide importance context for the behaviour of spawning herring and migratory fish receptors in the region.	Regional analysis provides partial coverage of the Fish and Shellfish Ecology Study Area. Inch Cape lies approximately 61.40km east of the MHPGC Project PEIR Red Line Boundary at its closest point, in Scottish waters.
Cambois Connection – Marine Scheme ES (Volume 2 ES Chapter 9: Fish and Shellfish Ecology) (Xodus, 2023)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Cambois Connection – Marine Scheme.	Partial coverage of the Fish and Shellfish Ecology Study Area. The Cambois Connection lies approximately 0.25km west of the MHPGC Project PEIR Red Line Boundary at its closest point, and is located adjacent to the central section of the MHPGC Project PEIR Red Line Boundary within English waters.
Ossian OWF: EIAR Chapter 9: Fish and Shellfish ecology (Tetra Tech RPS Energy, 2024a); Ossian OWF: Appendix 9.1 - Fish and Shellfish Ecology Technical Report (Tetra Tech RPS Energy, 2024b)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Ossian array area.	Partial coverage of the Fish and Shellfish Ecology Study Area. The Ossian Array Area lies approximately 5.50km east of the MHPGC Project PEIR Red Line Boundary at its closest point, in Scottish waters.
Bowdun OWF EIA Report (Volume 2, Chapter 9: Fish and Shellfish Ecology) (Thistle Wind Partners (TWP), 2026a) and supporting technical report (Volume 3, Technical Appendix 9.1: Fish and Shellfish Ecology Technical Report) (TWP, 2026b)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Bowdun OWF.	The Bowdun OWF lies approximately 10.03km northwest of the MHPGC Project PEIR Red Line Boundary at its closest point.
Seagreen Alpha and Bravo OWF (Chapter 9 Natural Fish and Shellfish resource) (Sea Green, 2018)	Provides an analysis of data collected across the wider northern North Sea biogeographic region, and a baseline characterisation of the Fish and Shellfish ecology for the Seagreen Alpha and Bravo OWF.	The Seagreen Alpha and Bravo Array Area lies approximately 25.15km west of the MHPGC Project PEIR Red Line Boundary at its closest point, in Scottish waters.
Publicly Available Datasets and Literature		
ICES North Sea International Bottom Trawl Survey (NS-IBTS) (ICES, 2021-2025a)	Data of the species caught during a North Sea Bottom Trawl survey. Surveys cover the greater North Sea regions.	Full coverage of the Fish and Shellfish Ecology Study Area.
ICES Offshore Beam Trawl Surveys (BTS) (ICES, 2021-2025b)	Data of the species caught during a beam trawl survey. Surveys cover the greater North Sea regions.	Full coverage of the Fish and Shellfish Ecology Study Area.
UK sea fisheries annual statistics reports (MMO, 2024b)	Information on landings of the UK fishing fleet, and the status of commercial fish stocks. Used to provide data related to fisheries landings and fishing effort within the area.	Full coverage of the Fish and Shellfish Ecology Study Area.

Source	Summary	Coverage of Study Area
Fisheries datasets available from the National Marine Plan Interactive (NMPi), including ScotMap data (Marine Scotland, 2026)	An interactive map providing a data overview of the Scottish marine environment.	Full coverage of the Fish and Shellfish Ecology Study Area.
British Geological Survey (BGS) Marine Sediment PSA dataset sourced from the BGS GeoIndex Offshore portal (BGS, 2015)	PSA data presented to provide an indication on the location of suitable habitat and spawning grounds for sandeel and herring.	Full coverage of the Fish and Shellfish Ecology Study Area.
European Marine Observation and Data Network (EMODnet) EUSeaMap broad-scale seabed habitat map for Europe (EMODnet, 2018).	Broad-scale predictive seabed habitat map for Europe, using European Nature Information System (EUNIS, 2022) classifications. This data has been used to identify the seabed sediments, to determine the presence of suitable spawning substrates within the Fish and Shellfish Ecology Study Area.	Full coverage of the Fish and Shellfish Ecology Study Area.
NMPi PMF datasets (Marine Directorate, 2026)	Provides mapped spatial layers of Scotland's PMFs. They collate verified species and habitat records from Marine Directorate, NatureScot and JNCC into standardised Geographic Information System (GIS) datasets that show the known distribution of PMFs and related protected-area features. This data has been used to identify PMFs likely to occur within the Fish and Shellfish Ecology Study Area.	Full coverage of the Fish and Shellfish Ecology Study Area.
Cefas OneBenthic Baseline Tool (Cefas, 2025)	Provides faunal cluster and PSA data from 0.1m^2 grab and core samples held in the OneBenthic database. It uses cluster groupings from the large, standardised benthic macrofauna database to assign each sample to a biological assemblage.	Full coverage of the Fish and Shellfish Ecology Study Area.
The International Herring Larval Survey (IHLS) data (ICES) (ICES, 2016-2025)	Herring larvae surveys were conducted across the North Sea and adjacent areas to provide quantitative estimates of herring larval abundance used as a relative index of changes in herring spawning stock biomass.	Full coverage of the Fish and Shellfish Ecology Study Area.
FeAST (NatureScot, 2020)	The FeAST developed by NatureScot is a guidance resource that helps assess the sensitivity of marine features in Scotland's seas to various human activities. Rather than simply identifying the presence or absence of marine features, the FeAST tool provides information on the sensitivity levels of these features to different types of human pressures.	Reports and publications to inform the assessment. No spatial coverage.
Environment Agency Data Explorer (Environment Agency, 2026)	An official online tool provided by the UK government to search, filter, and download publicly available environmental data.	Full coverage of the Fish and Shellfish Ecology Study Area.
Scottish Marine Energy Research (ScotMER) Evidence Map (Scottish Government, 2024)	These evidence maps are frameworks created by the Scottish Government to identify, prioritize, and address knowledge gaps regarding the environmental, social, and economic impacts of offshore wind,	Reports and publications to inform the assessment. No spatial coverage.

Source	Summary	Coverage of Study Area
	wave, and tidal renewable energy developments on the marine environment	
Literature		
Developing Essential Fish Habitat Maps for Fish and Shellfish Species in Scotland (Franco *et al.*, 2023)	Scottish Government-commissioned study mapping the marine areas essential for spawning, breeding, feeding, and growth to maturity of 29 commercially and ecologically important Fish and Shellfish species. The study uses both data-driven modelling (Fish survey data and environmental data) and habitat proxy assessments.	Full coverage of the Fish and Shellfish Ecology Study Area.
Cod and whiting spawning ground in the North Sea (González-Irusta and Wright, 2016) (González-Irusta and Wright, 2017) using modelled prediction	Both studies used North Sea International Bottom Trawl (2009-2015) survey data and environmental variables to model predictive spawning habitat maps that identify recurrent, occasional, or unsuitable areas for cod and whiting.	Full coverage of the Fish and Shellfish Ecology Study Area.
Identifying and Mapping Atlantic Herring and Sandeel Potential Spawning Habitat: An Updated Method Statements (Kyle-Henney *et al.*, 2024; Reach *et al.*, 2024)	These studies introduce a revised multi-layer scoring system, improved data resolution, and guidance for professional judgement and ground-truthing which updates the existing 2013 Marine Space Ltd protocols for mapping potential spawning (herring) and supporting (sandeel) habitats.	Full coverage of the Fish and Shellfish Ecology Study Area.
Ecology and Fish Data Explorer (Environment Agency, 2024)	A collection of benthic datasets across the UK including fish, river invertebrates and diatoms, phytoplankton.	Full coverage of the Fish and Shellfish Ecology Study Area.
Marine recorder public UK snapshot (JNCC, 2022)	Marine benthic database which holds survey data of species, biotopes and physical attributes of benthic ecosystems across the UK.	Full coverage of the Fish and Shellfish Ecology Study Area.
Scottish Sea Fisheries Statistics (Scottish Government , 2024)	National statistics that provide data of the tonnage and value of all landings of marine Fish and Shellfish by Scottish vessels, and all landings in Scotland, the rest of the UK and abroad.	Reports and publications to inform the assessment. No spatial coverage.
PrePARED(Offshore Renewables Joint Industry Programme, 2025)	Multi-year collaborative research programme studying how OWFs affects seabirds, marine mammals and fish. The programme aims to address knowledge gaps and insight into cumulative effects from large scale marine development.	Reports and publications to inform the assessment. No spatial coverage.
ICES Advice, Reports and Research Publications	International research reports and publications.	Reports and publications to inform the assessment. No spatial coverage.
Boyle and New (2018) ORJIP Impacts from Piling on Fish at Offshore Wind Sites: Collating Population Information, Gap Analysis and Appraisal of Mitigation Options.	The study report presents a spatial analysis of the IHLS herring larval data collected over a ten-year period. The methodology defined within this study was used to undertake a spatial analysis of the IHLS data in relation to the MHPGC Project to identify areas of active spawning herring grounds with overlap with the MHPGC Project PEIR Red Line Boundary.	Publication to inform the assessment. No spatial coverage.

Source	Summary	Coverage of Study Area
A verified distribution model for the lesser sandeel, *Ammodytes marinus* (Langton *et al.*, 2021)	The model focuses on the distribution patterns of this specific species, providing valuable insights into its habitat and ecological preferences	Full coverage of the Fish and Shellfish Ecology Study Area.
Diadromous Fish in the Context of Offshore Wind – Review of Current Knowledge and Future Research 14 January 2024 (Honkanen *et al.*, 2024)	This evidence map and the 2024 review by Honkanen *et al.* identify critical knowledge gaps regarding the impact of offshore wind on migratory salmon and sea trout, particularly concerning migration routes, underwater sound, and electromagnetic fields.	Reports and publications to inform the assessment. No spatial coverage.
North Sea fish spawning and nursery grounds NMPi, (2015), as categorised by Coull *et al.*, 1998 and Ellis *et al.*, 2012.	These studies map the distribution of North Sea fish and/ or shellfish species' spawning and nursery grounds using various survey data.	Full coverage of the Fish and Shellfish Ecology Study Area.
Updating Fisheries Sensitivity Maps in British Waters (Aires *et al.*, 2014)		

Site specific surveys

4.4.3.2 MHPGC Project-specific surveys relevant to Fish and Shellfish Ecology were undertaken by Gardline Ltd. as part of the MHPGC Project. An initial survey was conducted during June to November 2023, and a further site-specific subtidal survey was undertaken during August and September 2024. The sampling strategy was designed to adequately sample the area to determine seabed characteristics and faunal to characterise the baseline environment within the MHPGC Project PEIR Red Line Boundary.

4.4.3.3 These surveys comprised the collection of DDV imagery, eDNA sampling, and grab sampling for particle size and sediment chemistry analysis, and identification of macrofaunal communities. A detailed overview of the project specific benthic subtidal survey methodology can be found in **Appendix C** and **Appendix E** of **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR**, for the 2023 and 2024 surveys, respectively. The sample station locations and associated survey types are shown in **Figure 4.2** (DDV surveys were undertaken at all sampling stations but are not presented in the figure to maintain legend readability and overall figure clarity).

Habitat classification

4.4.3.4 Each seabed photograph and captured seabed image was assigned a EUNIS Habitat classification based on observed depth, sediment type and visible fauna. These data from the 2023 benthic subtidal survey (see **Appendix C** and **Appendix D** of **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR**) and the 2024 benthic subtidal survey (see **Appendix E** and **Appendix F** of **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR**), were reviewed alongside the geophysical and seabed imagery data (see **Appendix A** and **Appendix B** of **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR)** by Offshore Wind Consultants (OWC) to assign a EUNIS habitat code to each distinct macrofaunal community group identified within the MHPGC Project PEIR Red Line Boundary (see **Appendix G** of **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR)**.

4.4.3.5 In the context of the Fish and Shellfish ecology assessment, these habitat classification data have been used to characterise seabed habitats and identify the presence and distribution of habitats that may provide suitable spawning substrate for demersal spawning fish species within the MHPGC Project PEIR Red Line Boundary.

Particle Size Analysis (PSA)

4.4.3.6 Grab sampling to collect sediment samples for subsequent PSA was conducted to determine the suitability of the survey area for fish spawning. Results show the majority of sampling stations (75%) were classified as sand in accordance with the Folk and Ward (1957) method (Gardline Ltd., 2024). These data were used to inform the identification of potential herring and sandeel spawning habitats within the Fish and Shellfish Ecology Study Area . A detailed assessment of herring and sandeel spawning suitability is presented in **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**.

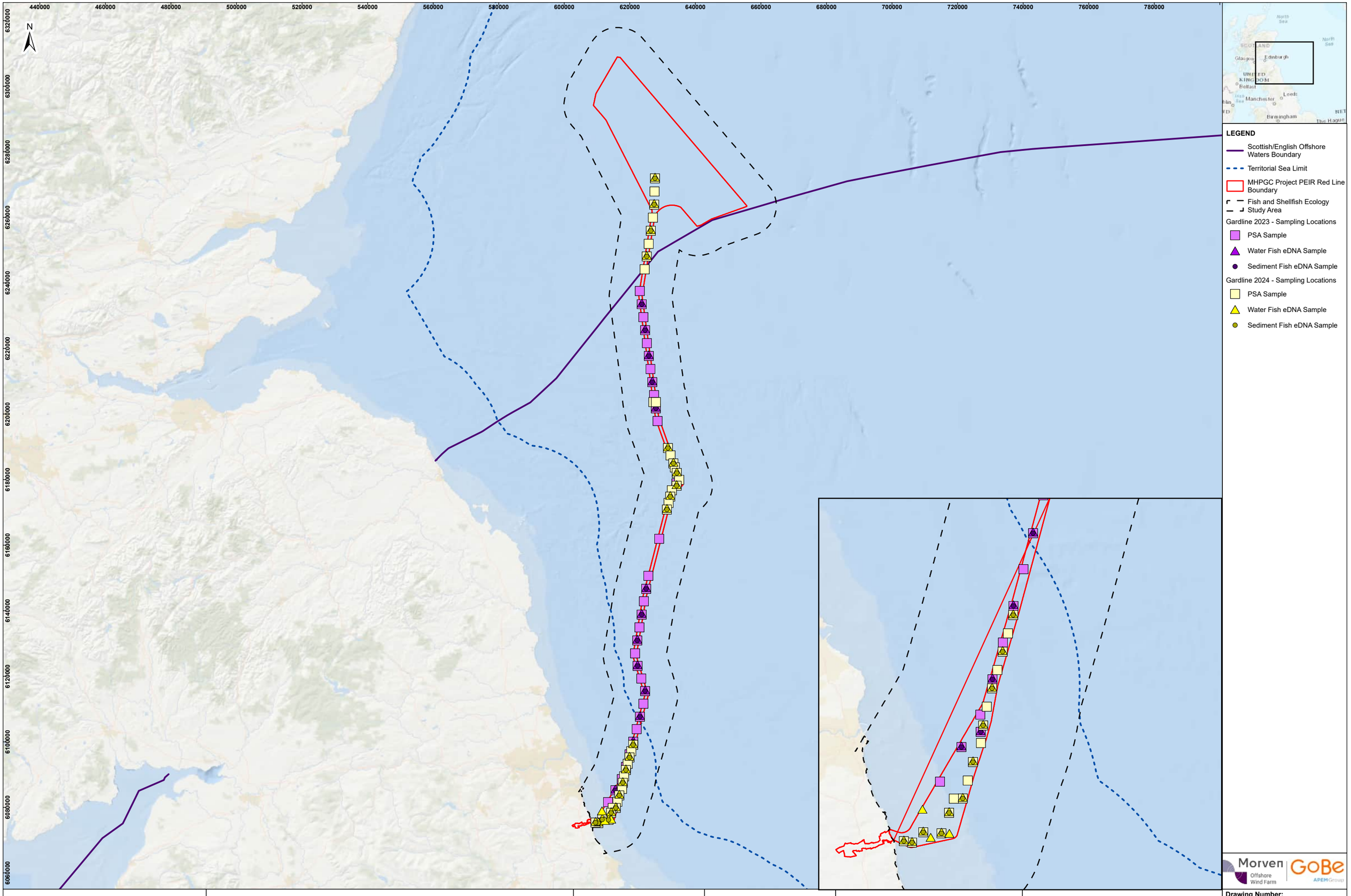
Drop-Down Video Surveys

4.4.3.7 Observations of Fish and Shellfish species recorded during the DDV surveys were used to inform the baseline characterisation of Fish and Shellfish communities within the MHPGC Project PEIR Red Line Boundary.

Environmental DNA (eDNA) Sampling

4.4.3.8 The site-specific survey included sampling for eDNA from both sediment and seawater, to determine the species composition of fish communities. DNA metabarcoding was used to support characterisation of the Fish and Shellfish baseline within the MHPGC Project PEIR Red Line Boundary.

4.4.3.9 Sediment DNA shows greater longevity than DNA within the water column, therefore may contain DNA material from organisms that were present some time ago, depending upon the depositional regime at the seabed. In contrast, seawater DNA is typically considered to be representative of specimen occurrence within the preceding tidal cycle, as material can be quickly degraded and dispersed when free-floating.



Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
OVERVIEW OF ENVIRONMENTAL SAMPLING UNDERTAKEN

0 5 10 15 20 25 km

Scale@A3:1,000,000

Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

Service Layer Credits:
World Ocean Base: OceanWise, Esri, Garmin, NaturalVue
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS

Morven Offshore Wind Farm | GoBe APEM Group

Drawing Number:
FIGURE 4-2

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Data limitations and assumptions

4.4.3.10 Mobile species like fish display varying spatial and temporal patterns. The Fish and Shellfish ecology baseline has therefore been informed by a range of regional data sources, and published studies, which provide a semi-seasonal description of Fish and Shellfish assemblages within and around the MHPGC Project PEIR Red Line Boundary and Fish and Shellfish Ecology Study Area. The efficiency of the surveys varies depending on the nature of the survey methods used and the species recorded. For example, a semi-pelagic otter trawl would not collect pelagic species (e.g., herring and sprat (*Sprattus sprattus*)) as efficiently as a pelagic trawl, and a 2-metre scientific beam trawl would not be as efficient at collecting sandeel and shellfish species as other methods used commercially in the Fish and Shellfish Ecology Study Area (e.g., sandeel or shrimp trawls and shellfish potting). This limits the data utility in capturing the relative abundances of species within the area. To minimise this limitation, Fish and Shellfish receptors identified are based on their recorded presence, rather than their relative contribution to survey catches.

4.4.3.11 Coull *et al.* (1988) and Ellis *et al.* (2012) are key references for providing broadscale overviews of the potential spatial extent of spawning grounds and the relative intensity and duration of spawning, both based on a collection of various data sources. Many of the conclusions drawn by Coull *et al.* (1988) are based on historic research and data and do not necessarily account for more recent changes in fish distributions and spawning behaviour. Ellis *et al.* (2012) is also limited by the wide scale distribution of sampling sites used for the annual international larval survey data, consequently resulting in broadscale grids of spawning and nursery grounds. The spatial extent of the spawning grounds and the duration of spawning periods indicated in these studies are therefore considered likely to represent the maximum theoretical extent of the areas and periods within which spawning will occur. Spawning grounds may therefore be smaller in extent and display shorter spawning periods, and, in some cases, spawning grounds indicated by these sources may no longer be active. Where available, additional research publications and data have been drawn upon to provide the best, most contemporary and site-specific information. When considering demersal spawners which display substrate dependency (e.g., herring and sandeel), PSA data have been used to ground truth the Coull *et al.* (1988) and Ellis *et al.* (2012) datasets.

4.4.3.12 Broadscale marine habitat data (EMODnet, 2021) have also been used to identify suitable spawning habitats. It should be acknowledged that this dataset is somewhat limited by the broadscale nature of the data, as it does not account for small-scale, localised differences in seabed sediments. To address this limitation, the EMODnet data have been considered alongside site-specific grab sampling to provide a more robust assessment of potential spawning habitats. The integration of these multiple data sources also provides supporting evidence for the broadscale spawning ground datasets of Coull *et al.* (1998) and Ellis *et al.* (2012).

4.4.3.13 The Fish and Shellfish baseline characterisation has also been informed by site-specific survey data, including the collection of eDNA data from water and sediment samples. Whilst the collection of eDNA data proves a useful direct indicator of the presence of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary, there are associated limitations. For example, eDNA detections may not always reflect immediate local presence because genetic material can be transported from surrounding areas. These datasets represent single points in time and do not capture routine or long-term monitoring, limiting the ability to characterise natural temporal and spatial variability in Fish and Shellfish communities. For some species, detailed ecological information is lacking, requiring the use of comparable fish ecology reports or broader regional studies to infer local patterns. Literature sources, while the most up to date available, may still contain outdated information given the continuously changing nature of the marine environment. Collectively, these factors introduce uncertainty into the baseline understanding and subsequent impact assessment.

4.4.3.14 Despite the data limitations detailed within this section of the report, the data as included in **Section 4.4.3** are considered a robust and sufficient evidence base to inform the Fish and Shellfish baseline characterisation and underpin the assessment process.

4.4.4 Baseline conditions

4.4.4.1 This section provides the baseline for the Fish and Shellfish environment of the Fish and Shellfish Ecology Study Area. The baseline description draws on site-specific data collected within the MHPGC Project PEIR Red Line Boundary, regional datasets and industry specific accounts and monitoring studies undertaken for several of the existing or proposed OWFs in the northern North Sea region. This is structured as follows:

- Fish and Shellfish Species Assemblage;
- Spawning and Nursery Grounds;
- Species of Commercial Importance;
- Designated Sites;
- Values Ecological Receptors; and
- Future Baseline Conditions

4.4.4.2 The seas off the east coast of Scotland and England have several protected areas designated for fish; these are summarised below and will be assessed in further detail in **MHPGC Project Habitats Regulations Appraisal/Habitats Regulations Assessment Report to Inform Appropriate Assessment (RIAA), prepared to accompany the PEIR**. As some of the receptors reported in this section are highly mobile species (e.g. migratory fish), the baseline environment has not been split into Scottish and English waters.

Fish and Shellfish Species Assemblage

Pelagic Fish Species

4.4.4.3 Pelagic fish are highly mobile species that inhabit the open water column and often form large schools. Within the Fish and Shellfish Ecology Study Area, key pelagic species include Atlantic herring (*Clupea harengus*), sprat (*Sprattus sprattus*), and mackerel (*Scomber scombrus*) (Coull *et al.,* 1998; Ellis *et al*., 2012). These species have been consistently identified as important components of fish assemblages and key ecological receptors within North Sea offshore wind and transmission project assessments, including Inch Cape OWF (Natural Power, 2017a), Seagreen OWFs (Seagreen, 2018), Berwick Bank OWF (RPS, 2022), Eastern Green Link 1 (AECOM, 2022a), Eastern Green Link 2 (AECOM, 2022b), Cambois Connection (Xodus, 2023), Ossian OWF (Tetra Tech RPS Energy, 2024a) and Bowdun OWF (TWP, 2026a). These fish hold both commercial and ecological importance, acting as a vital food resource for a range of marine mammals and seabirds (MMO, 2022, 2023) (**Volume 2, Chapter 5: Marine Mammals, of the PEIR,** and **Volume 2, Chapter 6: Marine Ornithology, of the PEIR**).

4.4.4.4 Project-specific eDNA surveys undertaken within the MHPGC Project PEIR Red Line Boundary recorded the presence of several pelagic species, including Atlantic herring, mackerel and horse mackerel (*Trachurus trachurus*), confirming the presence of a pelagic fish assemblage within the Fish and Shellfish Ecology Study Area (Gardline Ltd., 2024).

4.4.4.5 The UK Sea Fisheries Statistics Report 2024 indicates that all ICES Rectangles which overlap the Fish and Shellfish Ecology Study Area recorded a live landed weight of key pelagic species (including blue whiting (*Micromesistus poutassou*), herring and mackerel) of up to 1000 tonnes and a landed value of up to £1 million in 2024 (MMO, 2024b). Across the UK, mackerel dominated these landings, with over £300 million in landed value and over 200, 000 tonnes of landed weight in 2024. Mackerel is primarily targeted during the winter months by larger vessels, resulting in high volumes of landings in January, February, October and November each year. By December, total allowable catch quotas are nearly exhausted, so landings are consistently lower. In 2024, around 95% (116 thousand tonnes) of all mackerel landed into the UK by the UK fleet occurred during these four peak months (MMO, 2024b).

4.4.4.6 To provide additional regional context, a review of the ICES NS-IBTS data for the past 5 years (2021-2025) within the Fish and Shellfish Ecology Study Area identified a pelagic fish assemblage dominated by herring, mackerel, sprat and Atlantic horse mackerel. However, it should be noted that

the NS-IBTS uses bottom trawl gear and is therefore not designed to target pelagic species. Consequently, the abundance and distribution of pelagic species may not be fully represented within these survey data.

Herring

4.4.4.7 Herring are a commercially important pelagic fish species that are generally found in depths up to 200m. Herring are demersal spawners, releasing a large number of sticky eggs (>40,000) onto the seafloor. Suitable spawning habitat is characterised by seabed with less than 5% mud, greater than 10% gravel, and low proportions of fine sediment (Ellis *et al.*, 2012; Reach *et al.*, 2013). After approximately three weeks, the eggs hatch and the larvae drift to shallow nursery areas such as the Moray Firth, the Firth of Forth, and the western North Sea, via prevailing ocean currents (Keltx and Bailey, 2012). Juveniles aggregate into shoals, spend roughly a year in estuaries and coastal waters, and later migrate offshore to join adult populations as they mature.

4.4.4.8 There are several geographically distinct herring stocks in UK waters (Tappin, *et al.*, 2011). Within the North Sea, the principal autumn-spawning stocks comprise the Buchan and Shetland herring stock in Scottish waters, and the Banks herring stock and the Downs herring stock in English waters. These populations collectively form part of the North Sea Autumn Spawning (NSAS) population (Payne, 2010; Dickey-Collas *et al.*, 2009). The Buchan and Shetland herring stock spawns off the Scottish and Shetland coasts between August and September (Ellis *et al.,* 2012). The location of the spawning and nursery grounds is displayed in **Figure 4.3**. The Buchan element of this stock is located approximately 0.3km from the MHPGC Project PEIR Red Line Boundary in Scottish waters. The Banks stock, which is the nearest major herring spawning stock in English waters, is located approximately 6.5km from the nearest point of the MHPGC Project PEIR Red Line Boundary and spawns in the central North Sea between August and October (Ellis *et al.*, 2012). Autumn-spawning herring stocks, including the Buchan, Shetland, Banks and Downs stocks, tend to move into offshore waters to spawn on the edges of ocean banks (Tappin *et al.*, 2011). The suitability of the Fish and Shellfish Ecology Study Area for herring spawning is detailed in **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR.**

4.4.4.9 Herring were detected in the site-specific eDNA surveys and is one of the key fish species landed in 2024 by value in the relevant ICES Rectangles to the Fish and Shellfish Ecology Study Area (MMO, 2024b; Gardline Ltd., 2024; Marine Directorate, 2024). Notably, on a national scale, a two-month period (August to September) accounts for 80% (52 thousand tonnes) of herring landed into the UK by the UK fleet in 2024. Landings in June and July were mainly from the North Sea, with additional catches from the Irish Sea during August and September (MMO, 2024b). Within the Fish and Shellfish Ecology Study Area, 2,905 tonnes of herring were landed in 2024, with 2,901 tonnes of this being landed via pelagic trawls (MMO, 2024b).

4.4.4.10 Given the proximity of the Fish and Shellfish Ecology Study Area to the Buchan and Shetland stock, and the Banks stock spawning grounds, herring may utilise parts of the Study Area during spawning, feeding and migration. Early life stages may also occur within the Study Area during dispersal from nearby spawning grounds

Sprat

4.4.4.11 Sprat are an important forage fish in the North Sea, forming large schools in waters up to 150m deep (Heessen *et al.*, 2015). They spawn in batches between March to August, in coastal waters extending up to 100km offshore. The eggs and larvae are pelagic, remaining in the water column and drifting with currents toward coastal nursery grounds in the western North Sea. Sprat spawning and nursery grounds stretch along the northeast coast of England and east coast of Scotland, overlapping with the Fish and Shellfish Ecology Study Area (Coull *et al.,* 1998; See **Figure 4.4** and **Figure 4.8**). Given the overlap between mapped spawning and nursery grounds and the Fish and Shellfish Ecology Study Area, sprat have the potential to occur throughout the Study Area during multiple life stages.

Mackerel

4.4.4.12 Mackerel are among the most abundant and commercially important fish species in the North Atlantic. They are batch spawners, releasing pelagic eggs in the central North Sea between May and June (Jansen and Gislason, 2011). Mackerel present within the Fish and Shellfish Ecology Study Area originate from two stocks: the North Sea stock and the western stock (Keltx and Bailey, 2012). The North Sea stock overwinters north of Scotland and migrates to the central North Sea to spawn from May to July. In contrast, the western stock overwinters across a broad area of the continental shelf in western English and Scottish waters, spawning off southwest England and Ireland. This western stock then migrates into the North Sea to feed, where it mixes with the North Sea stock (Keltx and Bailey, 2012). Mackerel fisheries are primarily concentrated in waters around Ireland and Shetland, outside the Fish and Shellfish Ecology Study Area. A smaller fishery occurs off the Aberdeenshire coast, where Scottish fleets land approximately 1,000 tonnes of mackerel annually, near the northern boundary of the MHPGC Project PEIR Red Line boundary in Scottish waters (Keltx and Bailey, 2012). Mackerel remains the most caught species by the UK fleet, with over 233 thousand tonnes landed across the UK in 2024, accounting for 31% of the total UK catch. Of these Mackerel landings, 48% were landed abroad (MMO, 2024b). Within the Fish and Shellfish Ecology Study Area, 312 tonnes of mackerel were landed, with 233 tonnes landed via handlines (MMO, 2024b). Mackerel spawning and nursery grounds are concentrated further offshore than the MHPGC PEIR Boundary (see **Figure 4.7**), but the Fish and Shellfish Ecology Study Area overlaps with lower intensity spawning grounds off the northeast English coast (Coull *et al.,* 1998). Therefore, mackerel are expected to utilise parts of the Fish and Shellfish Ecology Study Area for feeding and migration, with more limited interaction expected during spawning.

Demersal Fish Species

4.4.4.13 Demersal species include fish and invertebrate species that live on or near the seafloor, often closely associated with seabed habitats. Within the Fish and Shellfish Ecology Study Area, a diverse assemblage of demersal fish species has the potential to occur. Species of ecological and/or commercial importance include sandeel, cod (*Gadus morhua*), whiting (*Merlangius merlangus*), ling (*Molva molva*), saithe (*Pollachius virens*), haddock (*Melanogrammus aeglefinus*), European hake (*Merluccius merluccius*), anglerfish (*Lophius piscatorius*), lemon sole (*Microstomus kitt*), European plaice (*Pleuronectes platessa*), and witch flounder (*Glyptocephalus cynoglossus*) (Coull *et al.,* 1998; Daan *et al*., 2005; Baxter *et al*., 2011; Ellis *et al.,* 2012). Comparable Fish and Shellfish ecology baselines prepared for the Berwick Bank Wind Farm, Cambois Connection, Eastern Green Link 1 / 2, Seagreen Alpha and Bravo, and Bowdun Offshore Wind Farm identified cod, haddock, whiting, plaice, sandeel and herring as characteristic components of the wider northern and central North Sea fish assemblage, reflecting the ecological importance of the region for demersal fish species (Seagreen Wind Energy Ltd., 2018; AECOM, 2022; National Grid and SSEN, 2022; SSER, 2022; Xodus, 2024; Bowdun Offshore Wind Farm, 2026).

4.4.4.14 Project-specific survey data provide evidence of the presence of several demersal fish species within the Fish and Shellfish Ecology Study Area. Observations from project-specific DDV imagery surveys recorded haddock, witch flounder, European plaice, whiting and anglerfish (Gardline Ltd., 2024). In addition, project-specific eDNA surveys detected Atlantic cod (*Gadus morhua*), anglerfish, whiting, European hake, ling and European plaice (Gardline Ltd., 2024), further confirming the presence of several commercially and ecologically important demersal species within the Fish and Shellfish Ecology Study Area.

4.4.4.15 A review of the ICES NS-IBTS over the past five years (2021-2025) within the Fish and Shellfish Ecology Study Area identified a demersal species assemblage dominated by haddock, whiting, dab, plaice and grey gurnard. In terms of landed weight, haddock dominated landings across the UK in 2024 with around 40, 000 tonnes landed in total. Cod and anglers both were in the region of 20, 000 tonnes in 2024. Landed value was much closer for these species in 2024 than landed weight, with cod, anglers and haddock having respective landed values of roughly £60 million, £50 million and £40 million (MMO, 2024b).

4.4.4.16 Additional regional context is provided by epifaunal beam trawl surveys undertaken across the Berwick Bank and Seagreen 1 and Seagreen 1A OWFs (approximately 19km and 38km from the MHPGC Project PEIR Red Line Boundary, respectively) which recorded a range of additional demersal fish species including dab (*Limanda limanda)*, long rough dab (*Hippoglossoides platessoides)*, four-bearded rockling (*Enchelyopus cimbrius)*, pogge (*Agonus cataphractus)*, butterfish (*Pholis gunnellus)*, Norwegian topknot (*Phrynorhombus norvegicus)*, reticulated dragonet (*Callionymus reticulatus)*, common dragonet (*C. lyra)*, bullrout (*Myoxocephalus corpius*) and goby species (Gobiidae spp.) (Seagreen Wind Energy Ltd, 2012, 2018; SSER, 2022).

Sandeel

4.4.4.17 Three species of sandeel are prevalent in the North Sea, including Raitt's sandeel (*Ammodytes marinus)*, lesser sandeel (*Ammodytes tobianus*) and greater sandeel (*Hyperoplus lanceolatus*). Sandeel are an important species in the North Sea ecosystem, serving as a key food source for fish, marine mammals, and seabirds (**Volume 2, Chapter 5 Marine Mammals, of the PEIR** and **Chapter 6 Marine Ornithology, of the PEIR**).

4.4.4.18 The distribution of sandeels is substrate-specific, meaning they rely on particular sediment compositions for spawning and burrowing. Suitable substrates for sandeel habitats are reported to have less than 10% mud content, more than 50% sand, and less than 80% gravel content, with a preference for areas comprising less than 4% mud and over 70% sand (Holland *et al.,* 2005). This substrate preference results in patchy distributions across the North Sea (Coull *et al*., 1998). Sandeels spend most of their lives buried in sediment, and emerge periodically for feeding and spawning activities. The timing of sandeel spawning varies by species: Raitt's sandeels spawn between November and February, lesser sandeels spawn in both spring and autumn, and great sandeels spawn between spring and summer (Heessen *et al*., 2015). A detailed assessment of sandeel supporting habitat within the Fish and Shellfish Ecology Study Area is considered in **Section 4.4.5** and in **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR.**

4.4.4.19 The MHPGC Project PEIR Red Line Boundary in Scottish waters is approximately 400m from the Firth of Forth Banks Complex MPA. This MPA is designated, in part, for subtidal sand and gravel which could provide preferred habitat for sandeel. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s), which will include consideration of the Firth of Forth Banks Complex MPA. A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to MPA/MCZ and HPMA Assessments, prepared to accompany the PEIR**.

4.4.4.20 In the northern and central North Sea, sandeel fisheries have been divided into Sandeel Areas, and the MHPGC Project PEIR Red Line Boundary lies within Sandeel Area 4 (within ICES Areas 4a and 4b). There has been a fishery closure in Sandeel Area 4 since 2000, which extends along northeast England and eastern Scotland. As of 2024, sandeel fishing in the entirety of Sandeel Area 4 is prohibited for all vessels, under the Fisheries Act 2020 in England and the Sandeel (Prohibition of Fishing) (Scotland) Order 2024 in Scotland.

4.4.4.21 Given the dependence of sandeel on suitable sandy sediments for spawning, burrowing and foraging, sandeel have the potential to occur within areas of supporting habitat throughout the Fish and Shellfish Ecology Study Area. Where suitable habitat is present, the Study Area may support multiple life stages, including spawning adults, buried overwintering individuals and foraging juveniles and adults.

Cod

4.4.4.22 Cod are a widely distributed species across the North Sea, with preference for shallow, coastal waters less than 200m deep. Cod exhibit seasonal migrations, moving offshore to spawn in the autumn and winter months (Keltx and Bailey, 2012). Spawning grounds are typically associated with water depths between 20-100m, in regions of low tidal flow and areas of coarse sand sediment, resulting in a patchy distribution of spawning grounds, with regions of overlap with the Fish and Shellfish Ecology Study Area in both English and Scottish waters (Coull *et al.,* 1998). Cod are

broadcast spawners, and both eggs and larvae have a pelagic phase of approximately six months before developing into demersal juveniles. Juveniles settle near the seabed between May and June and remain in coastal estuaries and nursery grounds for 1 to 3 years, until mature (Bastrikin *et al.*, 2014). The overlap between mapped spawning grounds and the Fish and Shellfish Ecology Study Area indicates that cod may utilise the Study Area during spawning, juvenile development and foraging.

4.4.4.23 Cod are of commercial importance within the region, with fisheries primarily concentrated in northern waters, spanning northern Scotland, Shetland, and Norway. In 2010, Scottish vessels landed 10 to 50 tonnes off the coast of Aberdeenshire (Keltx and Bailey, 2012). A Total Allowable Catch (TAC) is in place for Northern Shelf cod (reduced for 2025 from 2024 in line with ICES advice). A Minimum Conservation Reference Size (MCRS) of 35cm is also in place. A UK National North Sea Cod Avoidance Plan is in place to support recovery of the North Sea cod stock, which allows for fisheries closures. In 2024, landings of cod in the northern and central North Sea (IVa and IVb ICES Areas) equated to 13,064 tonnes of landed weight and £45,456,000 which was primarily landed via demersal trawls (MMO, 2024b).

Whiting

4.4.4.24 Whiting are a bentho-pelagic species, and are found across many sediment types, including sediment and rocky bottom regions (Barnes, 2008b). Whiting also show plasticity in spawning ground selection, with extensive suitable spawning areas across the North Sea, including the Fish and Shellfish Ecology Study Area in both English and Scottish waters (Coull *et al*., 1998; Gonzalez-Irusta and Wright, 2017). Whiting are broadcast spawners, releasing batches of eggs into the water column between February and June in waters less than 125m deep (Bastrikin *et al.,* 2014; Coull *et al.,* 1998). Larvae drift in the water column prior to settling near the seabed between June and August as benthic juveniles (Bastrikin *et al.,* 2014). Given the extensive overlap between suitable spawning habitat and the Fish and Shellfish Ecology Study Area, whiting are expected to occur throughout the Study Area during multiple life stages.

4.4.4.25 Whiting are also of commercial importance and were one of the key fish species landed in 2024 by value in the relevant ICES Areas (IVa and IVb) to the Fish and Shellfish Ecology Study Area with over 9,096 tonnes in landed which corresponded to £10,486,000 in landed value (MMO, 2024b).

Ling

4.4.4.26 Ling are a deep-water, commercially valuable demersal species. Adults are solitary, seeking refuge among rocks and other hard substrate at depths up to 600m (Rowley, 2008). Spawning occurs between March and August, at depths between 100m to 300m. Eggs float near the surface and hatch as fry after 10 days. Juvenile ling are concentrated in coastal waters for two to three years and reach maturity at six to eight years of age (Rowley, 2008). Ling were recorded in site-specific eDNA surveys (Gardline Ltd., 2024). The presence of ling within site-specific survey data confirms the potential for interaction with the Fish and Shellfish Ecology Study Area.

Saithe

4.4.4.27 Saithe are a bentho-pelagic, schooling fish that is most commonly found in waters around 200m deep. Saithe are not substrate-specific, spawning in waters surrounding northern Scotland between January and April. Eggs and larvae are pelagic, while adult saithe have associations with the seabed as they live near continental shelves and feed on bottom-dwelling species, including sandeel and herring (Keltx and Bailey, 2012). While spawning grounds are concentrated in northern waters, nursery areas extend into the Fish and Shellfish Ecology Study Area along the Scottish coast (Coull *et al.,* 1998). Taking this into account, interaction with the Fish and Shellfish Ecology Study Area is expected to be greatest during the juvenile and feeding phases.

Haddock

4.4.4.28 Haddock are a commercially important, bottom-dwelling demersal species, and are found across the eastern, northern, and northwestern Atlantic, preferring cold waters up to 300m deep (Hedger *et al.,* 2004).

4.4.4.29 Haddock spawning and nursery grounds overlap with the Fish and Shellfish Ecology Study Area, with concentration along northeast England and eastern Scotland (Coull *et al.,* 1998). Spawning grounds are not substrate specific, with reports of haddock spawning in regions of rock, gravel, smooth sand and mud, but preference has been shown for sand and coarse sand sediment (Kleine-MacPhee, 2002; González-Irusta and Wright, 2016). Broadcast spawning occurs between March and May, when eggs are released into the water column. Eggs hatch into pelagic larvae, and juveniles settle onto the seabeds of deep waters in May (Bastrikin *et al*., 2014). While spawning grounds identified by Coull *et al*., (1998) are concentrated in northwest Scottish waters, Gonzalez-Irusta and Wright (2017) described spawning grounds extending along the eastern coasts of Scotland and England. Nursery areas extend into the Fish and Shellfish Ecology Study Area along both Scottish and English coasts.

4.4.4.30 Haddock fisheries are concentrated in the northern North Sea, with minimal overlap in the northern boundary of the Fish and Shellfish Ecology Study Area (Keltx and Bailey, 2012).

4.4.4.31 Given the overlap between the Fish and Shellfish Ecology Study Area and mapped haddock spawning and nursery grounds, haddock are expected to utilise the Study Area during spawning, juvenile development and adult foraging life stage

European hake

4.4.4.32 European hake are a commercially important demersal fish that are most found near continental shelves and slopes, in waters over 50m deep. Hake spawn in deep waters (200m to 1000m) between July to October. Eggs and larvae are pelagic, before juveniles settle near the seabed (Keltx and Bailey, 2012).

4.4.4.33 European hake spawning grounds do not overlap with the Fish and Shellfish Ecology Study Area, but nursery grounds overlap with the project, extending along eastern Scottish and English coasts (Ellis *et al*., 2012) (**Figure 4.6**). European hake were also recorded in the site-specific eDNA survey (Gardline Ltd., 2024). Taking this into account, any interaction with the Fish and Shellfish Ecology Study Area is expected to be principally associated with juvenile and adult foraging life stages rather than spawning activity.

Anglerfish

4.4.4.34 Anglerfish are an abundant, commercially important species in the North Sea, with distribution in northern English and Scottish waters. Females spawn in deep waters, releasing long egg ribbons containing more than a million eggs which develop into up to 95,000 pelagic larvae. These larvae can drift long distances before settling to the seabed as adults (Hislop *et al.,* 2001). Although specific spawning grounds are not well documented, anglerfish are thought to spawn in deep waters in northern Scotland, and nursery grounds extend along eastern Scottish and English coasts, within the Fish and Shellfish Ecology Study Area (**Figure 4.6**). Anglerfish therefore have the potential to utilise the Fish and Shellfish Ecology Study Area, particularly during juvenile and adult life stages.

4.4.4.35 Anglerfish were recorded in the site-specific eDNA surveys, and two individuals were observed in imagery across two stations in English waters during the site-specific benthic surveys (Gardline Ltd., 2024).

Lemon sole

4.4.4.36 Lemon sole is a commercially important flatfish species that is widespread across the shelf waters of the northeast Atlantic. Lemon sole spawning occurs between May and October, with peak spawning from May to August (Geffen *et al*., 2021). Spawning and nursery grounds are widespread

across the western North Sea (Coull *et al*., 1998), but recent studies suggest that peak lemon sole nurseries are concentrated offshore in deeper waters (>50m) (Geffen *et al*., 2021). Lemon sole eggs and larvae remain in the water column for several months before settling to the seafloor as juveniles. Data for habitat preference for settled juvenile lemon sole are limited, but it is thought that dispersal from spawning grounds is limited, resulting in juveniles being concentrated around rough substrata in deeper waters (Jennings *et al*., 1998). The overlap of spawning and nursery habitats indicates that lemon sole may utilise the Fish and Shellfish Ecology Study Area throughout multiple life stages.

European plaice

4.4.4.37 European plaice are commonly found across UK coasts, typically associated with sandy, muddy, and gravel seabeds (Tappin *et al*., 2011). Plaice are broadcast spawners, releasing large batches of eggs between January and April. The Fish and Shellfish Ecology Study Area is not located within high intensity spawning grounds for plaice but overlaps with widespread low intensity spawning grounds (Ellis *et al.,* 2012) (**Figure 4.8).** Nursery grounds are widespread along English and Scottish coastal and inshore waters (Coull *et al.,* 1998), overlapping with the project's landfall site (**Figure 4.8**). European plaice were recorded in the site-species eDNA surveys, and 16 individuals of plaice were observed in imagery across nine stations in the site-specific benthic survey (Gardline Ltd., 2024).

4.4.4.38 Plaice are also of commercial importance within the region, and were a key fish species landed in 2024 by value in the relevant ICES Areas with respect to the Fish and Shellfish Ecology Study Area (MMO, 2024b), with over 3,829 tonnes in landed which corresponded to £10,572,000 in landed value (MMO, 2024b).

Witch flounder

4.4.4.39 Witch flounder are a slow growing, deep water flatfish species. Spawning occurs in large aggregates in deep waters between spring and summer months, where females release pelagic eggs (Cadrin *et al*., 2022). Larvae continue to drift in the water column for up to a year prior to settling on the seabed, and adults have preference for clay, muddy sand, and mud sediment between 45m to 500m deep (Cadrin *et al*., 2022). Fifteen individuals of which flounder were observed across twelve stations during the site-specific benthic surveys (Gardline Ltd., 2024).

<u>Elasmobranchs</u>

4.4.4.40 Elasmobranchs, including sharks, rays, and skates, are a subclass of cartilaginous fish characterized by a skeleton made of cartilage and multiple gill slits. Their life history varies widely but generally includes slow growth, late maturity, and low reproductive rates. Reproduction can involve internal fertilization, with some species laying eggs (oviparous), others giving birth to live young (viviparous), and some retaining eggs inside the mother where they hatch before birth (ovoviviparous).

4.4.4.41 Based on site-specific surveys for nearby developments, it was determined that elasmobranch species that may be present within the Fish and Shellfish Ecology Study Area include thornback ray (*Raja clavata*), spotted ray (*Raja montagui*), cuckoo ray (*Leucoraja naevus*), thorny (or starry) skate (*Amblyraja radiata*), small-spotted catshark (*Schyliorhinus canicula*), spurdog (*Squalus acanthias*), tope (*Galeorhinus galeus*), and common smooth hound (*Mustelus mustelus*) (Seagreen Wind Energy Ltd., 2018; SSER, 2022; Tetra Tech RPS Energy, 2024a). Basking sharks (*Cetorhinus maximus*) are also considered, due to their conservation status and records within the Fish and Shellfish Ecology Study Area (Austin *et al.,* 2019). A review of the ICES NS-IBTS data over the past five years (2021-2025) highlighted that small-spotted catsharks were the most abundant species caught in bottom trawls over this period within the Fish and Shellfish Ecology Study Area followed by spurdog, cuckoo ray, starry smooth-hound and then the spotted ray. Additionally, the ICES NS-IBTS data review indicated presence of common and flapper skate species (*Dipturus batis* and *Dipturus intermedius*) which are both critically endangered elasmobranchs as categorised by their International Union for Conservation of Nature (IUCN) red list ecological status.

Skate and ray species

4.4.4.42 Thornback rays, spotted rays, cuckoo rays, thorny skates, common skates and flapper skates are oviparous, demersal spawning species. Females lay egg cases in inshore areas, with most species preferring sandy and muddy substrates (Heessen *et al.*, 2015), whilst flapper skate typically prefer to lay eggs between boulders or on cobble slopes (Scottish Government, 2021).

4.4.4.43 Peak spawning for thornback rays is between May and June, while peak spawning for spotted rays, cuckoo rays, and thorny skates extends later into the summer months. While distribution of Thornback rays, spotted rays, cuckoo rays and thorny skates is widespread across the North Sea, existing literature does not provide enough data to precisely identify their specific spawning grounds (Ellis, Readdy, Taylor, & Brown, 2012). Peak spawning for common and flapper skate is between early spring and summer, with mature females experiencing a two-year reproductive cycle (Neal and Pizzolla, 2006; Scottish Government, 2021). Both common and flapper skates are classified as critically endangered globally, taking up to 10 years to reach sexual maturity and eggs typically take up to 18 months to hatch, leading to slow recovery from disturbance (Ellis *et al.,* 2024; Dulvy *et al.,* 2006). The current distributions of flapper and common skate are not precisely known. However, available data indicates their distributions tend to overlap, typically occupying waters off north western Scotland and Celtic Sea, with some individuals reported in the central North Sea (Ellis *et al.,* 2024; Dulvy *et al.,* 2006).

Shark species

4.4.4.44 The small-spotted catshark (also called lesser-spotted dogfish) is widespread and abundant in the North Sea, with highest concentrations in the southern North Sea (Heessen *et al.*, 2015; Sguotti *et al.*, 2016). It is an oviparous demersal spawner, laying successive batches of eggs that are anchored to macrofauna on the seafloor. Peak spawning occurs between June and July, but existing literature does not provide enough data to precisely identify their specific spawning grounds (Heessen *et al.*, 2015). Given their widespread distribution in the North Sea, small-spotted catshark are expected to occur throughout the Fish and Shellfish Ecology Study Area.

4.4.4.45 In contrast, spurdog, tope, and common smooth hound are ovoviviparous or viviparous species. As such, embryos develop within the body, and do not require specific habitats to develop. Spurdog are commonly found throughout the North Sea and exhibit seasonal migratory behaviour, with individuals often forming large aggregations. Their population peaks in the North Sea during the winter and spring months, reflecting preference for colder waters (Sguotti *et al.,* 2016). Tope are found in low occurrence throughout the North Sea and are most commonly found in shallow waters up to 50m deep, utilising inshore waters as nursey grounds (Ellis, *et al.*, 2012). Data for distribution of common smooth hound is low, but the species shows preference for coastal waters, and mixed/coarse sediments (Sguotti *et al.,* 2016). Spurdog, tope and common smooth-hound may therefore utilise the Fish and Shellfish Ecology Study Area during seasonal movements and foraging activity, although interactions are expected to be greatest within suitable coastal habitats.

4.4.4.46 Basking sharks are filter-feeding elasmobranchs with preference for coastal waters, often within the top 50m to 200m of the water column (Doherty *et al.*, 2017). Migration patterns and timings vary, but general movement patterns of basking sharks in the North Sea indicate that most individuals travel south from August to October, and returning between March to June (Doherty *et al.,* 2017). Although historic hotspots for basking sharks in the North Sea are not within the Fish and Shellfish Ecology Study Area, there are highly suitable habitats for the species along the northeast English and eastern Scottish coasts, with occasional sightings reported within this area (Austin *et al.*, 2019). As basking sharks recover from historical exploitation by fisheries, sightings within the Fish and Shellfish Ecology Study Area may become more frequent. However, as this is a coastal species, any interactions with the Fish and Shellfish Ecology Study area are likely to be limited to the nearshore section.

Diadromous Fish Species

4.4.4.47 Diadromous fish are species which migrate between freshwater and the marine environment. Therefore, diadromous species may transit the Fish and Shellfish Ecology Study Area during certain periods of the year. Diadromous fish encompass anadromous species which spend most of their lives at sea but spawn in freshwater (e.g. Atlantic salmon (*Salmo salar*)) and catadromous species which spend most of their lives in freshwater but spawn at sea (e.g. European eel (*Anguilla anguilla*)).

4.4.4.48 Based on information on diadromous fish populations presented within a range of east coast OWF EIAs, including Berwick Bank OWF (RPS, 2022a), Seagreen OWFs (Sea Green, 2018), Ossian OWF (Tetra Tech RPS Energy, 2024a), Bowdun OWF (TWP, 2026a), Inch Cape OWF (Natural Power, 2017a), Eastern Green Link 1 (AECOM, 2022a), Eastern Green Link 2 (AECOM, 2022b), and Cambois Connection (Xodus, 2023), together with survey data collected for the Morven North and Morven South projects (Gardline, 2024), eight diadromous fish species have the potential to occur in offshore and coastal areas within the Fish and Shellfish Ecology Study Area. These species are Atlantic salmon, European eel, sea trout (*Salmo trutta trutta*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), European smelt (*Osmerus eperlanus*), allis shad (*Alosa alosa*), and twaite shad (*Alosa fallax*).

4.4.4.49 Since the MHPGC Project PEIR Red Line Boundary spans both nearshore and offshore waters, all of the above-mentioned species are considered to have the potential to transit the Fish and Shellfish Ecology Study Area during migration at key stages of their life cycles. This includes smolt migration from natal rivers and adult migration to spawning habitats. Migration timings for diadromous fish species relevant to the Fish and Shellfish Ecology Study Area are provided in **Table 4.8** below.

Table 4.8: Migration timings for key diadromous fish species

Common name	Scientific name	Timing of downstream migration	Time spent at sea before first return	Timing of upstream migration	Source
Atlantic salmon	*Salmo salar*	April to June	1 to 4 years	All year, with a peak in late summer/ early autumn	Malcolm *et al.,* (2010, 2015) and ABPMer (2019).
European eel	*Anguilla Anguilla*	June to November	May not return to freshwater, many do not	Varies spatially, typically arrives in coastal waters of the east coast in December and may migrate upstream until June	Malcolm *et al.,* (2010)
Sea trout	*Salmo trutta*	Spring	2 or more years	April to June	Malcolm *et al.,* (2010)
Sea lamprey	*Petromyzon marinus*	From late autumn onwards (to open sea) (timing varies between rivers)	1.5 – 2.5 years	April to June	NatureScot (2022a) and ABPMer (2019)
River lamprey	*Lampetra fluviatilis*	From late autumn onwards (to feed in estuaries)	18 to 24 months	April to May (to spawn in May to June)	NatureScot (2022a) and ABPMer (2019)
European smelt	*Osmerus eperlanus*	N/A (migration to estuaries only)	Spends time in estuaries	February to April (to spawn in estuaries and larger rivers)	NatureScot (2022b)

Common name	Scientific name	Timing of downstream migration	Time spent at sea before first return	Timing of upstream migration	Source
Allis and twaite shad	*Alosa alosa* and *Alosa fallax.*	Autumn (juveniles)	2 years spent in estuaries and marine areas, do not return to fresh water until they are sexually mature	April to June (to spawn in freshwater)	Maitland and Hatton-Ellis (2003) and ABPMer (2019)

Atlantic Salmon

4.4.4.50 Atlantic salmon are an anadromous species that migrate between freshwater and marine environments throughout their life cycle. Spawning typically occurs in the upper reaches of rivers during late autumn and early winter, favouring gravel substrates (Heessen *et al.*, 2015; NASCO, 2012). Following the parr stage, salmon undergo a physiological transformation into smolts, preparing them for migration to the marine environment. This migration usually occurs between spring and early summer, with most smolts leaving freshwater habitats by June (Thorstad *et al.*, 2012). After spending one to four years at sea, adult salmon return to their natal rivers to spawn, with peak migration periods typically falling between June and August, and October to December (Cowx and Fraser, 2003).

4.4.4.51 Atlantic salmon are a designated Annex II species and are a qualifying feature for several SACs adjacent to the Fish and Shellfish Ecology Study Area (See **Figure 4.18**). In Scottish waters, this includes the River Dee (57km), River South Esk (81km), River Tay (136km), and River Teith (198km) SACs. Beyond designated sites, the Fish and Shellfish Ecology Study Area is in the vicinity of several rivers in Scotland where salmon are either confirmed to be present or are likely to be found, including Water of Philhort, River Ugie, River Ythan, and River Don, with the latter being the closest to the MHPGC Project PEIR Red Line Boundary (lying approximately 60km to the northwest) (Marine Scotland, 2015).

4.4.4.52 Within Scottish waters, the River Dee SAC and River South Esk SAC are also designated for the symbiotic freshwater pearl mussel as a primary feature. The freshwater pearl mussel is listed in Annexes II and V of the EU Habitats and Species Directive and Appendix III of the Bern Convention and is also listed as Endangered on the IUCN Red List. Although the freshwater pearl mussel is found upstream from these river mouths, they depend on the smelting populations of Atlantic salmon and sea trout as a mechanism of locomotion during their parasitic larval stage, by attaching to their gills (Taeubert and Geist, 2017; Österling and Söderberg, 2015). Therefore, freshwater pearl mussel populations may be indirectly affected if Atlantic salmon or sea trout are adversely affected by the MHPGC Project.

4.4.4.53 Transitional and Coastal (TraC) monitoring collects data on fish species in estuarine, tidal, and coastal waters to assess the presence and abundance of migratory and coastal fish in English waters. These surveys are recorded in the National Fish Populations Database (NFPD) and are managed by the Environment Agency, with additional contributions from third parties as part of the TraC monitoring program. The River Tweed SAC supports an abundant salmon population, with migrations between the River Tweed and the North Sea occurring throughout most of the year. The river is estimated to support up to 15% of all salmon caught in Scotland (JNCC, 2025). As the River Tweed spans both England and Scotland, the estuarine section within English jurisdiction is included in the TraC dataset. These surveys recorded 695 salmon between 2000 and 2025, however, all available records were confined to the period 2002 to 2017 (Environment Agency, 2024). Additional rivers in England that support Atlantic salmon populations are designated as Principal Salmon Rivers if they are expected to produce an annual rod catch of at least 50 salmon (Environment Agency, 2022). Each of these rivers has a Salmon Action Plan outlining the status of its salmon stock and fishery. These rivers include the River Coquet, River Tyne, River Wear, River Tees and River Esk (Cefas, 2021).

European Eel

4.4.4.54 The European eel is a catadromous species that migrates between the marine environment and freshwater throughout its lifecycle. Eggs hatch in the Sargasso Sea, and larvae travel across the Atlantic Ocean to European shelves using the Gulf Stream. Throughout this migration, larvae transition into glass eels, who arrive along the east coast of England and Scotland between August and December, but may appear in lower concentrations throughout the entire year (Malcolm, 2010). Glass eels often migrate into fresh waters during their first year, but smaller numbers remain in the marine environment until maturity.

4.4.4.55 Glass eels grow into elvers as they enter estuaries and rivers and subsequently turn into yellow eels as they develop pigment and spend 10 to 15 years in river systems. Lastly, yellow eels will mature into silver eels as they migrate back to the marine environment and through the Atlantic Ocean to lay their eggs in the Sargasso Sea. This downstream migration takes place between June and November, and spawning takes place in the spring (Malcolm *et al.,* 2010).

4.4.4.56 Whilst undergoing their downstream on the shelves of the North Sea, silver eels have been observed undergoing vertical migration that aligns with tidal patterns and daylight cycles (Verhelst *et al.,* 2023). When water currents are in the same direction as their migration direction, eels swim higher in the water column to maximise efficiency. As currents switch direction, eels migrate close to the seabed, where the current is weakest. Similarly, silver eels exhibit circadian-driven vertical migration, swimming at depth in daylight. Reasoning for this movement is predicted to be linked to navigational cues and predator avoidance (Verhelst *et al*., 2023). European eels are critically endangered (IUCN Red List) and have a population decline of approximately 95 % over the last 40 years (Environment Agency, 2025). Reasons for this decline include illegal poaching, habitat loss and degradation, and overfishing. Within the Fish and Shellfish Ecology Study Area, the River Tweed and its tributaries provide important habitat for European eel. For example, juvenile European eel were recorded in over 74% of electrofishing surveys conducted in smaller burns of the Tweed catchment between 1992 to 1997 (The Tweed Foundation, 2014). The eDNA from the European eel was also detected in samples from the site-specific survey, further supporting their presence within the Fish and Shellfish Ecology Study Area (Gardline Ltd., 2024).

Brown Trout (Sea Trout)

4.4.4.57 Brown trout (*Salmo trutta*) exhibit a wide variety of life history strategies, which can include individuals remaining in freshwater rivers and streams for the entirety of their lives, migrating to freshwater lakes and lochs, or migrating to sea (sea trout) (Malcolm *et al.,* 2010). During the freshwater phase of their life cycle, sea trout start their lives in rivers and streams, where they hatch from eggs and grow as juveniles. Typically, sea trout spend 1 to 3 years in freshwater environments before migrating to the sea. Immature sea trout often return to freshwater to overwinter, while mature trout return annually to spawn, typically between April to June (Malcolm *et al.*, 2010). There is limited data on the swimming depths of adult sea trout, but available data suggests an average swimming depth at sea is less than 5m, with maximum dive depths rarely surpassing 30m (Sturlaugsson, 2016).

4.4.4.58 Brown trout on Scotland's east coast exhibit wide migration ranges, extending to offshore regions (Malcolm, 2010). Recaptured sea trout from tagging studies in the River Tweed have shown migrations stretching from Aberdeenshire to southwest England, as well as the coasts of Germany, Denmark, and the Netherlands (Nall, 1923). TraC data for the River Tweed lists 342 trout recorded between 2002-2024, with 60 % of these recordings being in 2015 (Environment Agency, 2024).

Sea Lamprey

4.4.4.59 Sea lamprey is an anadromous, parasitic species that migrates between marine and freshwater environments to spawn. Hatching in cobble and sandy riverbeds, sea lamprey larvae spend up to seven years in river systems. Larvae metamorphose to develop eyes and a circular mouth and migrate to the ocean as juveniles. Sea lamprey juveniles tend to be solitary feeders and are typically found dispersed throughout the open ocean as they feed on host fish. Their presence is largely

influenced by the location of their natal rivers and they are commonly encountered at significant depths in offshore marine habitats. Juvenile sea lamprey spend approximately 1.5 to 2.5 years at sea until maturity, when they return to their spawning river for a single reproductive event (Moore *et al*., 2003; Waldman *et al*., 2008; NatureScot (2022a) and ABPMer (2019)).

4.4.4.60 Sea lamprey are an Annex II species and are a qualifying feature for four SACs within the Fish and Shellfish Ecology Study Area (See **Figure 4.18**). The River Tay SAC is considered to support one of the most important sea lamprey populations in Scotland, whilst the River Teith SAC is also a crucial part of the east coast range for sea lamprey. Sea lamprey are also a qualifying feature of the River Tweed SAC and Tweed Estuary SAC.

4.4.4.61 Sea lamprey are rarely found in coastal and estuarine waters and are often found at considerable depths in deeper offshore environments (Moore *et al.,* 2003). Therefore, sea lamprey will likely be of most relevance to these sections of the MHPGC Project PEIR Red Line Boundary.

River Lamprey

4.4.4.62 River lamprey are an anadromous species that migrate from rivers to estuaries throughout their lifecycle. After hatching, the larvae remain buried in fine sediment in rivers for approximately 3-8 years before undergoing metamorphosis into the parasitic juvenile stage (Maitland, 2003). Once transformed, juveniles migrate downstream to estuarine and coastal waters, where they spend 1 to 2 years feeding parasitically on other fish species until maturity (Maitland, 2003; Quintella *et al*., 2021). In contrast to sea lamprey, river lamprey are commonly found in coastal waters, estuaries, and rivers that are easily accessible, and juveniles often gather in large groups (Maitland, 2003). Within the UK, their distribution is primarily concentrated in regions such as Wales, Northern Ireland, and southern parts of Scotland. Typically, river lamprey spend between one and two years in estuarine environments before migrating upstream during the autumn months, usually between October and December (Maitland, 2003).

4.4.4.63 River lamprey are an Annex II species and a qualifying feature for four SACs within the Fish and Shellfish Ecology Study Area (See **Figure 4.18**). The River Teith SAC supports a robust population of river lamprey. It has minimal artificial migration barriers, good water quality and suitable habitats (gravel and silt beds) to sustain the river lamprey's full life cycle. River lamprey are also a qualifying feature, but not a primary reason for site selection of the River Tay, River Tweed, and Tweed Estuary SACs.

4.4.4.64 River lamprey are primarily an estuarine and coastal species and, therefore, may interact only with the coastal areas of the Fish and Shellfish Ecology Study Area.

European Smelt (Sparling)

4.4.4.65 European smelt are an anadromous fish species that are primarily found in upper estuarine habitats, although they are occasionally recorded in nearshore coastal waters (Heesen *et al*., 2015). Smelt undertake spawning migrations in February and March, selecting sandy or gravelly river substrates for egg deposition. Individuals typically reach sexual maturity at 2 to 3 years of age, after which they return to estuarine environments where they form dense schools. Smelt play an important ecological role as forage fish, providing a key food source for larger predatory fish, seabirds, and marine mammals (See **Volume 2, Chapter 6: Marine Ornithology** and **Volume 2, Chapter 5: Marine Mammals, of the PEIR**).

4.4.4.66 European smelt distribution in the North Sea is largely concentrated around to English coasts, with few records north of Hull (Barnes, 2008a). Smelt are less common in Scottish waters, with dramatic population declines in recent decades. Smelt are only present in three rivers across Scotland; the River Cree, River Tay, and River Forth (NatureScot, 2023).

4.4.4.67 European smelt occasionally inhabit coastal waters, but they are most commonly found in estuarine environments. Therefore, European smelt may interact only with the coastal areas of the Fish and Shellfish Ecology Study Area.

Allis and Twaite Shad

4.4.4.68 Allis and twaite shad are members of the herring family (Clupeidae) and exhibit similar life history traits. Both species spend the majority of their lives in the marine environment, migrating to freshwater rivers and streams to spawn in late spring. Juvenile shad spend 3 to 4 months in river systems before migrating to sea, where they grow for at least 2 years until maturity (Maitland and Hatton-Ellis, 2003).

4.4.4.69 Allis and twaite shad are principally coastal and pelagic species, with preference for waters with depths ranging from 10m to 20m. However, there have been recorded instances of both species at depths of up to 150m (Maitland and Hatton-Ellis, 2003). It is therefore likely that allis and twaite shad will interact only with the coastal areas of the Fish and Shellfish Ecology Study Area.

4.4.4.70 Historically, allis shad spawned in several British river systems; however, the only recently confirmed spawning site in England is the Tamar Estuary (Hillman., 2020), with a probable spawning population also reported from the Solway Firth region (Maitland & Lyle., 2001). Twaite shad spawning populations in Great Britain are largely confined to rivers draining to the Severn Estuary, with no confirmed spawning populations recorded in Scotland (JNCC, 2019). Consequently, no known spawning rivers for either species occur within the Fish and Shellfish Ecology Study Area.

Shellfish

4.4.4.71 The population structure of shellfish stocks around the UK is not well understood, and subsequently, baseline characterisations are typically based on fisheries landings data (Mesquita *et al*., 2016). Landings data provides information which can be used as a principal overview of the species present within a certain area. Using fisheries catch and landings data alongside baseline data from other projects, and a review of relevant literature, an overview of the species present within the Fish and Shellfish Ecology Study Area can be established.

4.4.4.72 The key shellfish species populations of commercial, ecological or conservation importance within the Fish and Shellfish Ecology Study Area include scallop species, crab species, lobster, and *Nephrops*, and are detailed in the following sections. Species such as ocean quahog *Arctica islandica* and horse mussel (*Modiolus modiolus*) are considered as benthic ecology receptors, due to their association with benthic habitats (including protected status) and are therefore addressed within **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology, of the PEIR.**

Scallop species

4.4.4.73 King scallop (*Pecten maximus*) and queen scallop (*Aequipecten opercularis*) are commercially important species and have been recorded in site-specific surveys for the Seagreen OWF in 2011 (Seagreen Wind Energy Ltd, 2018). Commercial landings data indicate that king scallop are present within the Fish and Shellfish Ecology Study Area, while queen scallop are recorded less frequently (Mesquita et al., 2016; MMO, 2024b). Both species have also been identified as important shellfish receptors within regional OWF assessments, including Ossian OWF, where king scallop was identified as a VER and queen scallop was considered likely to occur within the study area (Tetra Tech RPS Energy, 2024a,b). Site-specific surveys for Berwick Bank Offshore Wind Farm recorded king scallop in low abundances, and surveys for Seagreen OWF also reported king scallop in epibenthic beam trawls (Seagreen Wind Energy Ltd., 2018; SSER, 2022). Both species are broadcast spawners, with larvae undergoing a planktonic phase of approximately one month where they disperse widely before settling on suitable hard surfaces, which may include hydrozoan or bryozoan species, or firm substrate. Once mature, individuals detach and settle on the seabed at depths between 10m to 110m (Marshall and Wilson, 2008; Cater, 2008).

4.4.4.74 King scallop have a lifespan of up to 20 years, reach maturity at 3 to 5 years, and spawn annually. Adult scallop favour firm sand and fine or sandy gravel but are occasionally found on muddy sand (Marshall and Wilson, 2008). Mature king scallop do not migrate and remain stationary unless disturbed. Their distribution therefore relies on effective dispersion in the larval stage and suitable environmental conditions once they have settled on the sea floor (Marshall and Wilson, 2008).

4.4.4.75 In contrast, queen scallop have a lifespan of 6 to 10 years, reach maturity after one year, and spawn multiple times annually. Queen scallop are more mobile than the king scallop, swimming to evade predators and disturbance. Preferred habitats include sand and gravel substrate, where they settle on top of the seabed rather than becoming settled in the sediment as done by the king scallop (Carter, 2008).

4.4.4.76 The presence of king and queen scallop within fisheries and survey datasets indicates that scallop species may utilise suitable seabed habitats within the Fish and Shellfish Ecology Study Area

Crabs

4.4.4.77 The edible crab (*Cancer pagurus*) is found at depths ranging from 25m to 300m and is typically associated with bedrock, mixed coarse grounds, and offshore muddy sands (Neal and Wilson, 2008). Male edible crabs generally stay in intertidal and subtidal regions, while females migrate offshore, carrying eggs under their abdomen to release their larvae. Tagging surveys off the coast of Norfolk have shown that mature females undertake long-distance migrations to the Yorkshire coast, although recent studies suggest this might be a separate population of edible crabs (Eaton *et al.,* 2013). After hatching in late spring, larvae go through a pelagic phase lasting 60 to 90 days before settling on the seafloor in intertidal environments, where they remain for about three years until reaching maturity. Edible crab has been consistently identified as an important shellfish receptor within North Sea offshore wind and transmission assessments, including Berwick Bank OWF (RPS, 2022a), Eastern Green Link 1 (AECOM, 2022a), Eastern Green Link 2 (AECOM, 2022b), Cambois Connection (Xodus, 2023), Ossian OWF (Tetra Tech RPS Energy, 2024b) and Bowdun OWF (TWP, 2026a). Given their widespread distribution and commercial importance in the region, edible crab are expected to occur within suitable habitats throughout the Fish and Shellfish Ecology Study Area.

4.4.4.78 The velvet swimming crab (*Necora puber*) shows preference for rocky substrates in shallow, subtidal areas around 70m depth. They do not undergo extensive migrations to offshore regions, so it is likely that velvet swimming crab will interact only with the coastal areas of the Fish and Shellfish Ecology Study Area.

4.4.4.79 European green crab (*Carcinus maenas*), otherwise known as the shore crab, inhabits protected areas of the intertidal zone across the North Sea. Green crabs avoid regions of exposed sandy substrate, showing preference for rocky areas in the subtidal zone, where they seek shelter between rocks, boulders, and macroalgae, or among mussel beds in mudflats (Young and Elliott, 2020). It is therefore likely that the green crab will interact only with the coastal areas of the Fish and Shellfish Ecology Study Area.

4.4.4.80 European green crab larvae spend four to six weeks as plankton in the water column before settling into protected areas of the intertidal zone. Juveniles move to lower intertidal and subtidal zones as they age, and adults are most found at depths between 6m to 7m. Green crabs are highly mobile, foraging over several kilometres without returning to specific shelters. They are highly resilient to disturbance and can tolerate significant variations in temperature, salinity and oxygen (Young and Elliott, 2020).

European Lobster

4.4.4.81 The European lobster (*Homarus gammarus*) typically inhabits areas from the intertidal zone down to depths of 60m. Individuals show strong site fidelity and tend to stay within 2km to 10km of their home range. Adults are solitary, living within holes and tunnels that they build with piles of rocks or boulders (Wilson, 2008). Females spawn either annually or bi-annually in the summer, and egg-carrying females remain in the same grounds until hatching occurs in spring and early summer. Once hatched, the planktonic larvae drift in the water column for up to one month before beginning their benthic phase, seeking shelter in burrows within the intertidal zone. Substrate and suitable shelter are thought to affect the size and population density, with lobster typically found on hard seabeds, and larger lobsters found on more exposed grounds (Keltz and Bailey, 2012). European lobster has been consistently identified as an important shellfish receptor within North Sea offshore wind and transmission assessments, including Berwick Bank OWF (RPS, 2022a), Eastern Green Link 1

(AECOM, 2022a), Eastern Green Link 2 (AECOM, 2022b), Cambois Connection (Xodus, 2023), Ossian OWF (Tetra Tech RPS Energy, 2024b) and Bowdun OWF (TWP, 2026a).

4.4.4.82 Consequently, European lobster may utilise suitable hard substrate habitats within the nearshore sections of the Fish and Shellfish Ecology Study Area.

Nephrops

4.4.4.83 Nephrops, (also known as the Norway lobster, Dublin Bay prawn, langoustine or scampi) exhibit a close association with muddy sediment, living within and around expansive burrows. This association restricts nephrops to the extent and type of sediment, with higher population densities reported in regions of sandy mud (Johnson *et al*., 2013). *Nephrops* larvae are planktonic for approximately 50 days before settling on the seabed and reaching maturity. Adult *Nephrops* then spend the majority of their life inside burrows <20cm deep, emerging to forage or mate, usually at night (Sabatini and Hill, 2008).

4.4.4.84 Nephrops is among the most frequently assessed shellfish receptors in North Sea offshore wind and marine transmission EIAs due to its commercial importance and strong association with specific sediment types (Natural Power, 2017a; Sea Green, 2018; AECOM, 2022a; AECOM, 2022b; RPS, 2022; Xodus, 2023; Tetra Tech RPS Energy, 2024a; TWP, 2026a). Although the substrate within the Ossian OWF array area (5.50 km east of the MHGPGC Project PEIR Red Line Boundary) was considered unsuitable for *Nephrops*, the species was nevertheless identified as an important receptor due to its commercial importance and the overlap of the wider area with recognised *Nephrops* spawning and nursery habitat (Coull *et al.*, 1998; Tetra Tech RPS Energy, 2024a). The Seagreen OWF Fish and Shellfish ecology chapter also refers to data supplied by Marine Directorate (formerly Marine Scotland) in 2012, demonstrating high abundances of *Nephrops* recorded through underwater imagery acquisition by the Marine Directorate (formerly Marine Scotland) in the inshore waters of the Fish and Shellfish Ecology Study Area. However, this OWF lies much further away; 25.15km west of the MHPGC Project PEIR Red Line Boundary.

4.4.4.85 The North Sea is a key habitat for *Nephrops*, due to favourable sediment composition, seafloor temperature, depth, and productivity (Johnson *et al.,* 2013). Within the North Sea, regions of suitable habitat create numerous *Nephrop*s populations. Each population is considered as separate Functional Units (FU), which collectively are subject to fishery catch limits (Letschert *et al.,* 2021). The Fish and Shellfish Ecology Study Area passes through four FUs, including FU 6, 8, 9, and 34.

4.4.4.86 The offshore export cable corridor and subsequent nearshore section of the Fish and Shellfish Ecology Study Area passes through spawning and nursery grounds for *Nephrops* (**Figure 4.5** and **Figure 4.10**, respectively), coinciding with the Farne Deeps *Nephrops* fishery. The Fish and Shellfish Ecology area also includes the Firth of Forth and Moray Firth *Nephrops* fisheries (Marine Scotland, 2012). Further information on interactions between the MHPGC Project PEIR Red Line Boundary and commercial fisheries is detailed in **Volume 2, Chapter 7: Commercial Fisheries, of the PEIR.**

4.4.4.87 The overlap between the Fish and Shellfish Ecology Study Area and known *Nephrops* fisheries, spawning grounds and nursery grounds indicates a strong potential for interaction throughout suitable offshore and nearshore habitats.

Cephalopods

4.4.4.88 Landings data within relevant Areas that overlap the Fish and Shellfish Ecology Study Area include moderate amounts of long-finned squid, which include the veined squid (*Loligo forbesii)* and European squid (*Loligo vulgaris)*.

4.4.4.89 The veined squid, which prefers shallow coastal areas, is the most commercially important squid species in the UK, with a seasonal summer fishery in Scotland. Distributed further north than the European squid, veined squid are present year-round in the Fish and Shellfish Ecology Study Area, particularly concentrated in northern waters around Scotland from July to December (Viana *et al.,* 2009). Breeding for veined squid occurs between December and May, during which individuals move

to shallow waters to spawn, as females deposit egg clusters on sandy/mud substrate. Adults return to deeper waters after the spawning season (Laptikhovsky *et al.*, 2022)

4.4.4.90 In contrast, the European squid has a more limited distribution in the North Sea and is most abundant along English and Scottish coasts in late spring to early summer (Oesterwind *et al.*, 2022). Spawning occurs in late autumn to early spring months, when females attach egg masses to hard substrate on in waters up to 120m deep. Both the veined squid and European squid are semelparous, undergoing a single reproductive event and die shortly after spawning (Oesterwind *et al.*, 2022).

4.4.4.91 Based on known distributions and life-history characteristics, both veined squid and European squid may utilise the Fish and Shellfish Ecology Study Area for foraging, migration and seasonal spawning activity.

4.4.5 Spawning and nursery grounds

4.4.5.1 Coull *et al.* (1998) identified the potential spawning and nursery areas in the North Sea for a range of species from a range of larvae, egg and benthic habitat survey data. For some species, these data were reviewed by Ellis *et al.* (2012) to provide updated information on the spatial distribution of high and low intensity spawning and nursery grounds. These datasets are useful for identifying broad spawning and nursery areas but do not provide a precise definition of habitat boundaries within the Fish and Shellfish Ecology Study Area, including within the MHPGC Project PEIR Red Line Boundary.

4.4.5.2 More recently, Aires *et al.* (2014) provided an update to fisheries sensitivity maps in British waters following results of work by Marine Scotland Science, by collating evidence regarding the distribution of 0 group fish (fish within their first year of life) and larvae of key commercially targeted species. Species with known spawning and nursery grounds identified as overlapping with the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, are summarised below in **Table 4.9**, and are shown in **Figure 4.3** to **Figure 4.10.**

4.4.5.3 Herring and sandeel are of particular relevance when considering impacts on spawning areas as they are demersal spawners. As such, they have specific requirements in terms of spawning grounds, with seabed sediment being the primary determinant (Maraveliasl *et al.,* 2000). Due to their reliance on specific substrates, sandeel and herring are more susceptible to seabed disturbance impacts. Due to the heightened sensitivity of herring and sandeel spawning activities, a thorough examination of these has been addressed in subsequent sections of this chapter.

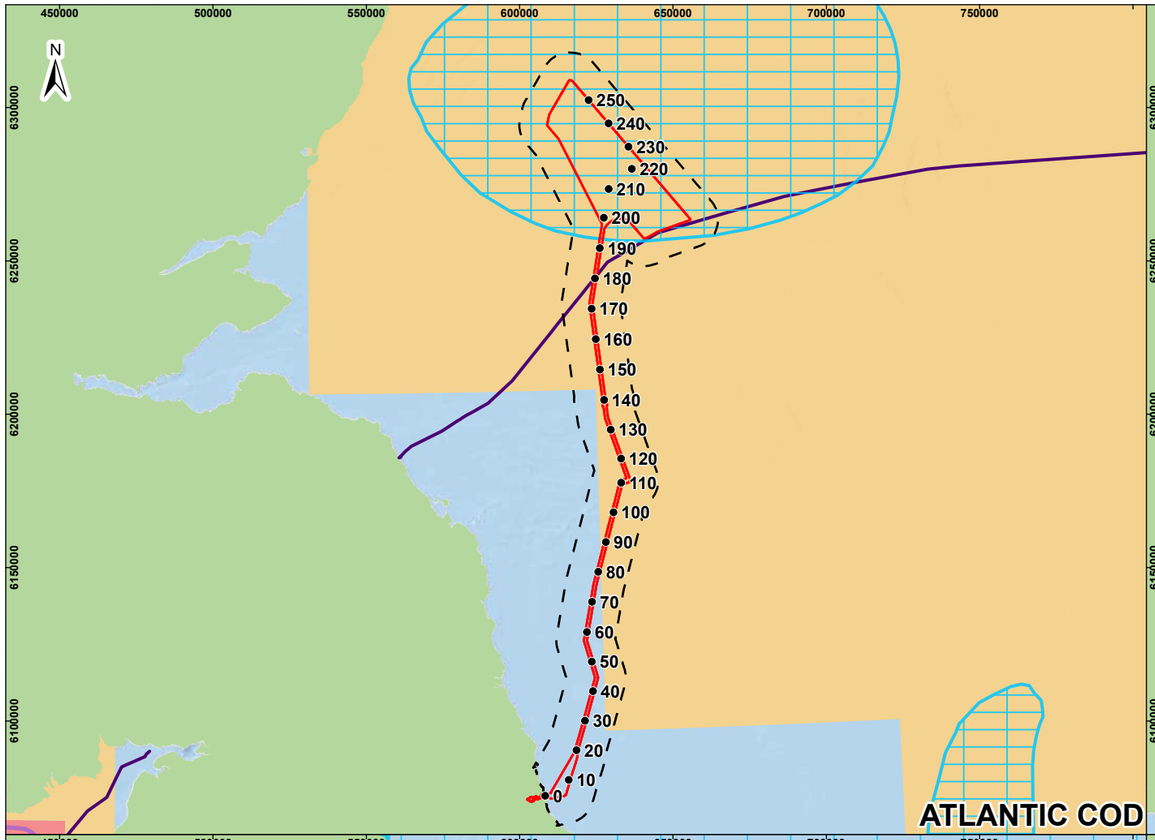
Table 4.9: Species with spawning and nursery grounds overlapping the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary (Adapted from Coull et al., 1998 and Ellis et al., 2012)

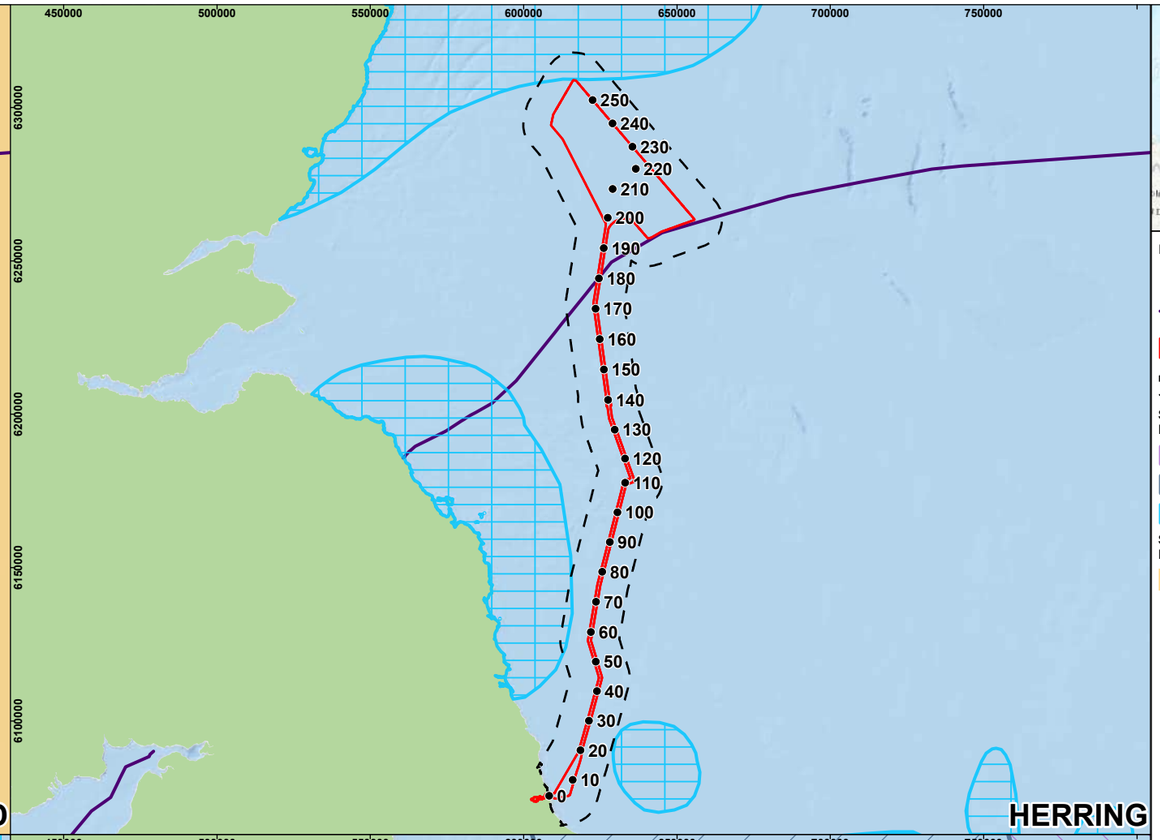
Common Name	Species Name	Spawning grounds			Nursery grounds		Source(s)
		Presence	Intensity *	Presence	Intensity		
Teleost fish							
Anglerfish	*Lophius piscatorius*	Insufficient data *			✓	Low	Ellis et al, (2012)
Blue whiting	*Micromesistius poutassou*	X			✓	Low	Ellis et al. (2012)
Atlantic Cod	*Gadus morhua*	✓		Low	✓	High and Low	Coull et al. (1998); Ellis et al. (2012)
European hake	*Merluccius merluccius*	X			✓	Low	Ellis et al. (2012)
Herring	*Clupea harengus*	✓		Undetermined	✓	High and Low	Coull et al. (1998); Ellis et al. (2012)
Lemon sole	*Microstomus kitt*	✓		Undetermined	✓	Not specified	Coull et al. (1998)
Ling	*Molva molva*	X			✓	Low	(Ellis et al. 2012)
Mackerel	*Scomber scombrus*	X			✓	Low	(Ellis et al. 2012)
Norway pout	*Trisopterus esmarkii*	✓		Low	✓	Not specified	Coull et al. (1998); Ellis et al. (2012)
Plaice	*Pleuronectes platessa*	✓		Low	✓	Low	Coull et al. (1998); Ellis et al. (2012)

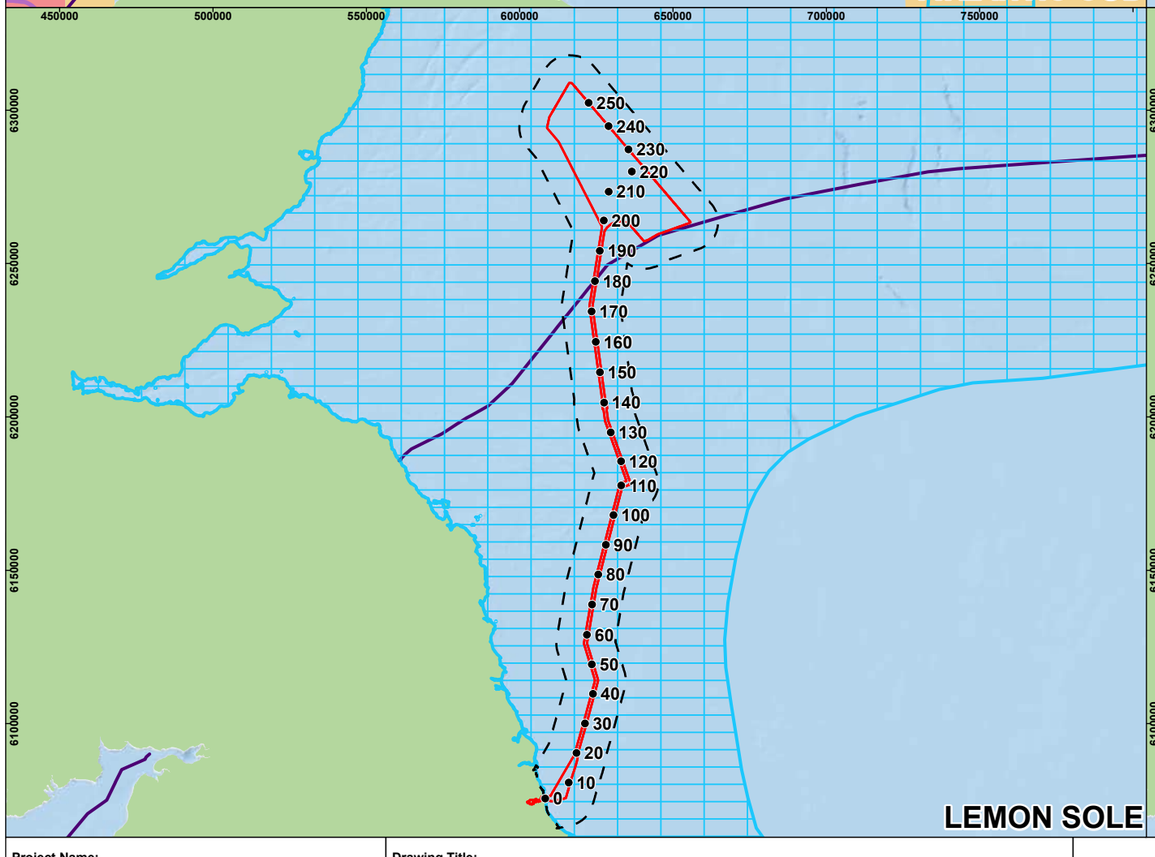
Common Name	Species Name	Spawning grounds		Nursery grounds		Source(s)
		Presence	Intensity *	Presence	Intensity	
Sandeel	*Ammodytidae*	✓		Low and High	✓	Coull et al. (1998); Ellis et al. (2012)
Sprat	*Sprattus sprattus*	✓		Undetermined	✓	Coull et al. (1998); Ellis et al. (2012)
Whiting	*Merlangius merlangus*	✓		Low	✓	High and Low	Coull et al. (1998); Ellis et al. (2012)
Elasmobranchs						
Blue skate	*Dipturus batis*	Insufficient data			✓	Low	(Ellis et al. 2012)
Spotted ray	*Raja montagui*	Insufficient data			✓	Low	(Ellis et al. 2012)
Spurdog	*Squalus acanthias*	Insufficient data			✓	Low	(Ellis et al. 2012)
Tope	*Galeorhinus galeus*	Insufficient data			✓	Low	(Ellis et al. 2012)
Shellfish						
Nephrops	*Nephrops norvegicus*	✓		Undetermined	✓	Not specified	Coull et al. (1998)

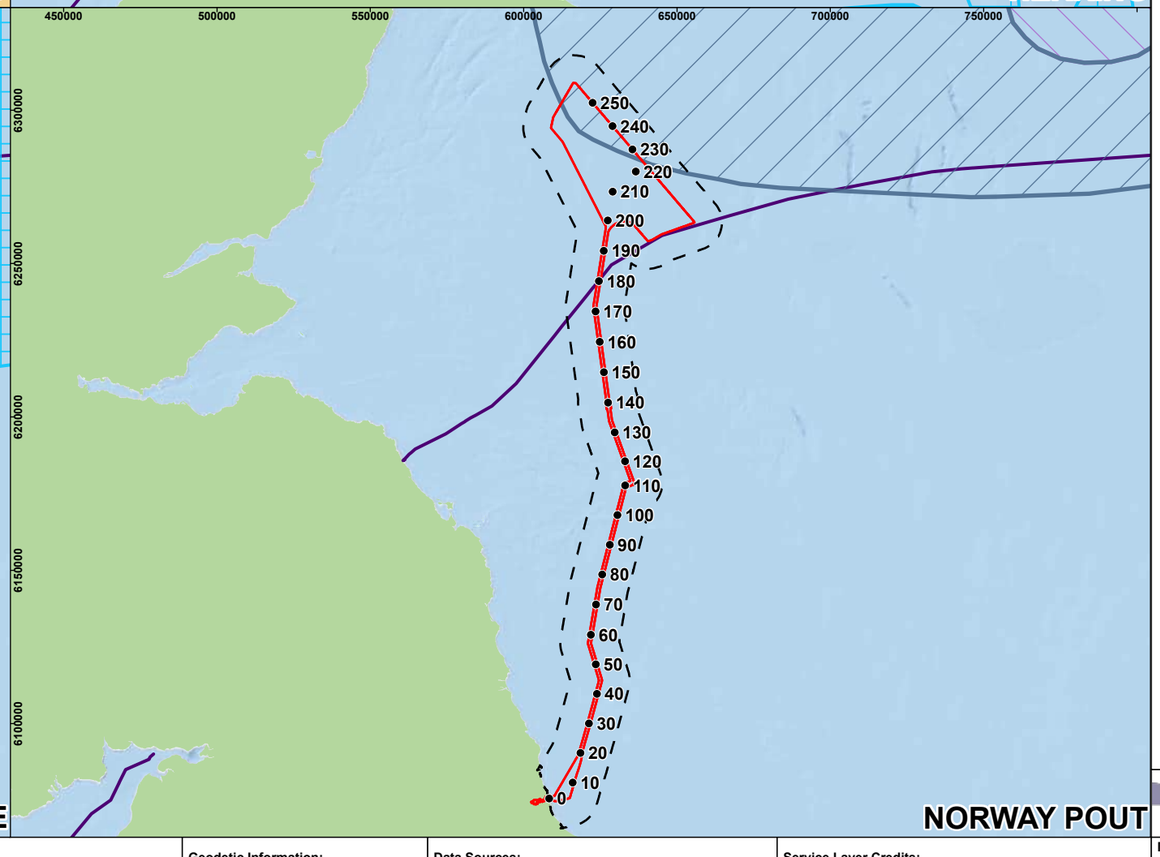
** Intensity classifications are taken preferentially from Ellis et al. (2012), which provides updated spawning and nursery ground assessments for selected species. Coull et al. (1998) data have been used where no updated intensity information was available. "Undetermined" is a designation used by Coull et al. (1998) indicating that spawning habitat has been identified and mapped, but insufficient information was available to assign a relative intensity category (e.g. high or low). "Not specified" indicates that nursery habitat has been identified by Coull et al. (1998), but no information on the relative intensity of use within the mapped area was provided.*

*** For anglerfish, blue skate, spotted ray, spurdog and tope, insufficient information is available to delineate spawning/parturition grounds within the study area (Ellis et al., 2012).*











LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area

Spawning Grounds (Coull *et al.*, 1998) Intensity

- Higher
- Lower
- Undetermined

Spawning Grounds (Ellis *et al.*, 2012) Intensity

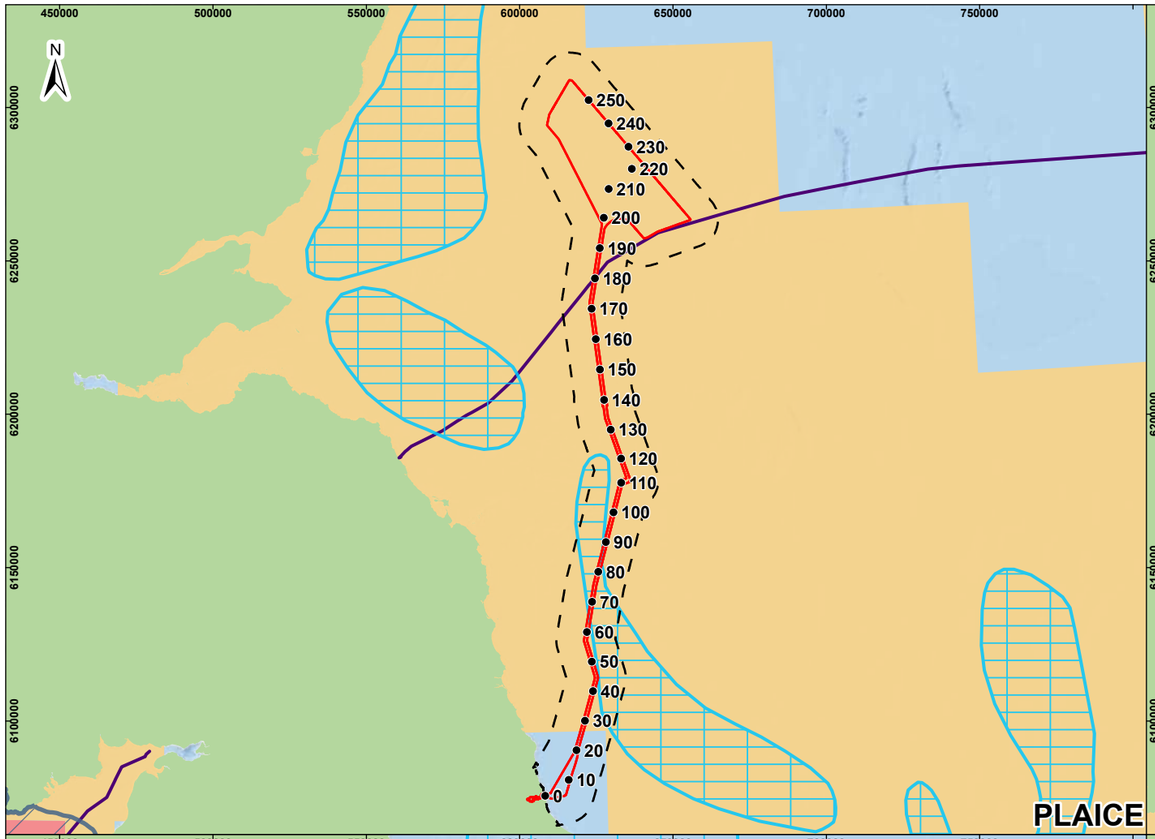
- Lower

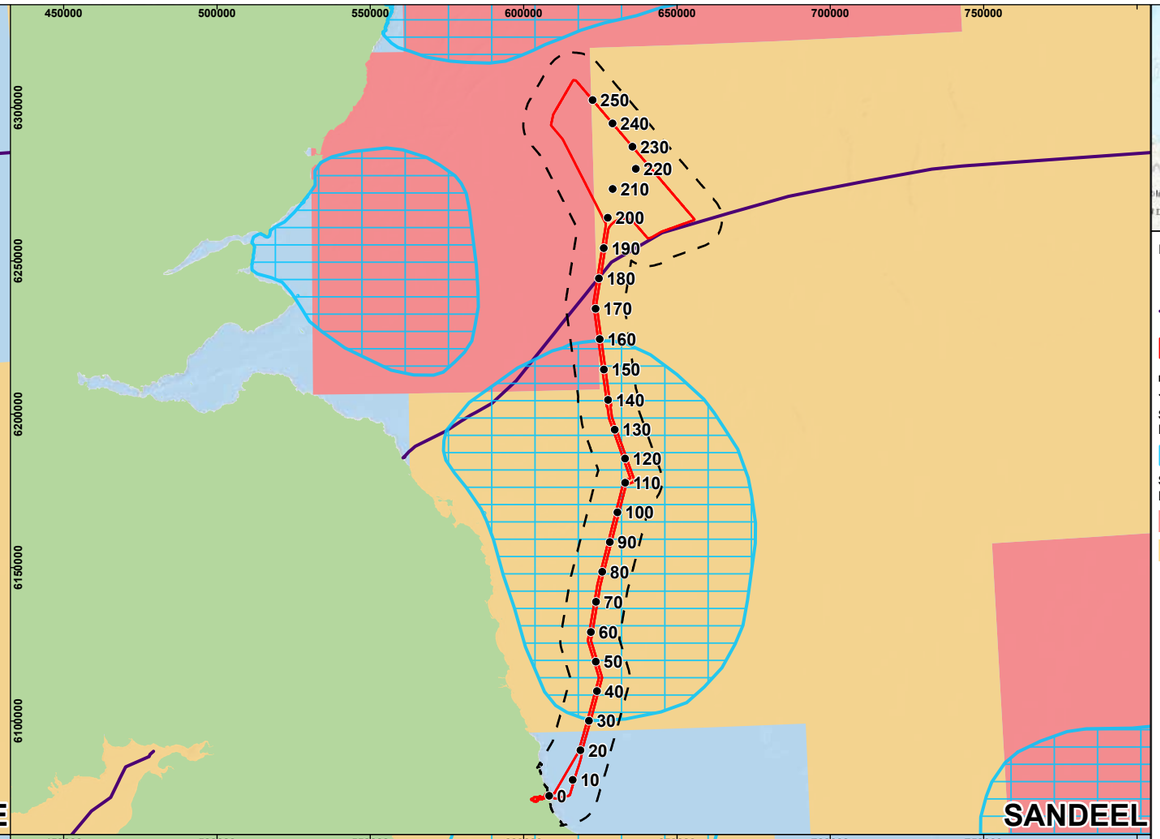
Morven Offshore Wind Farm | GoBe APEMGroup

Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** SPAWNING GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (ATLANTIC COD, HERRING, LEMON SOLE, NORWAY POUT)	0 10 20 30 40 50 km Scale@A31:2,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey **Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number: FIGURE 4-3

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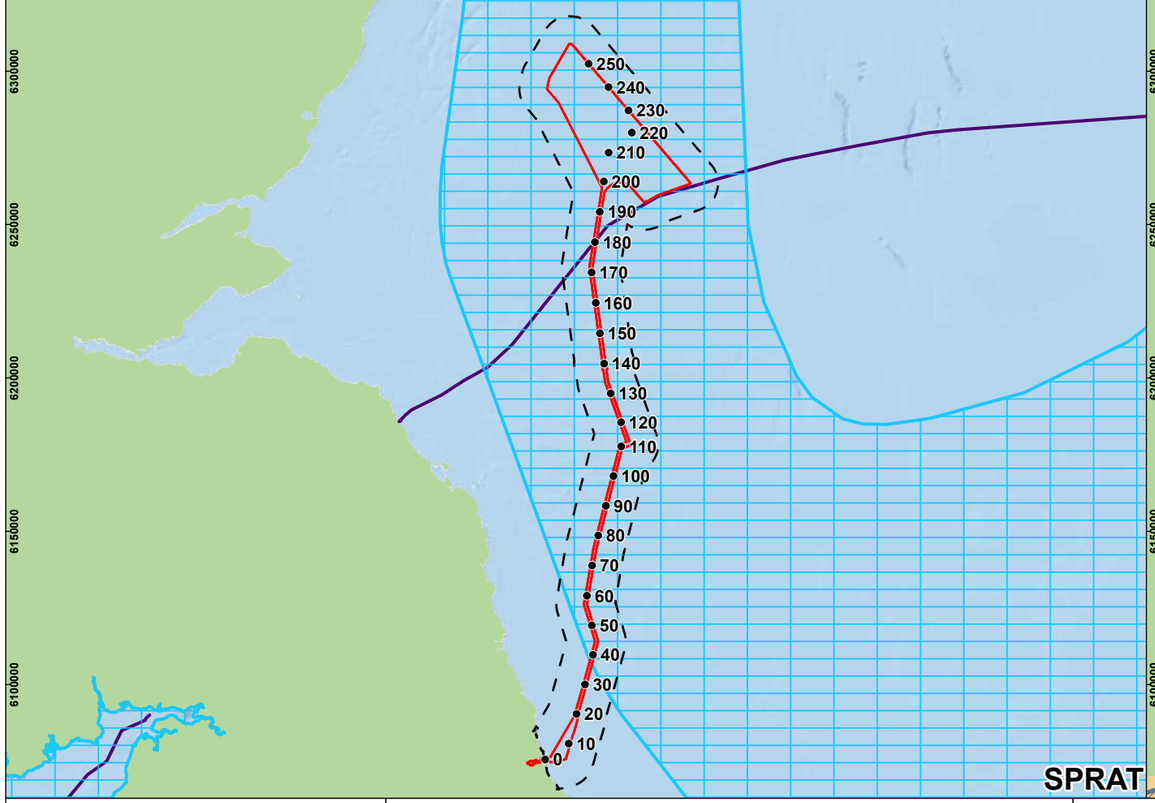
- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area

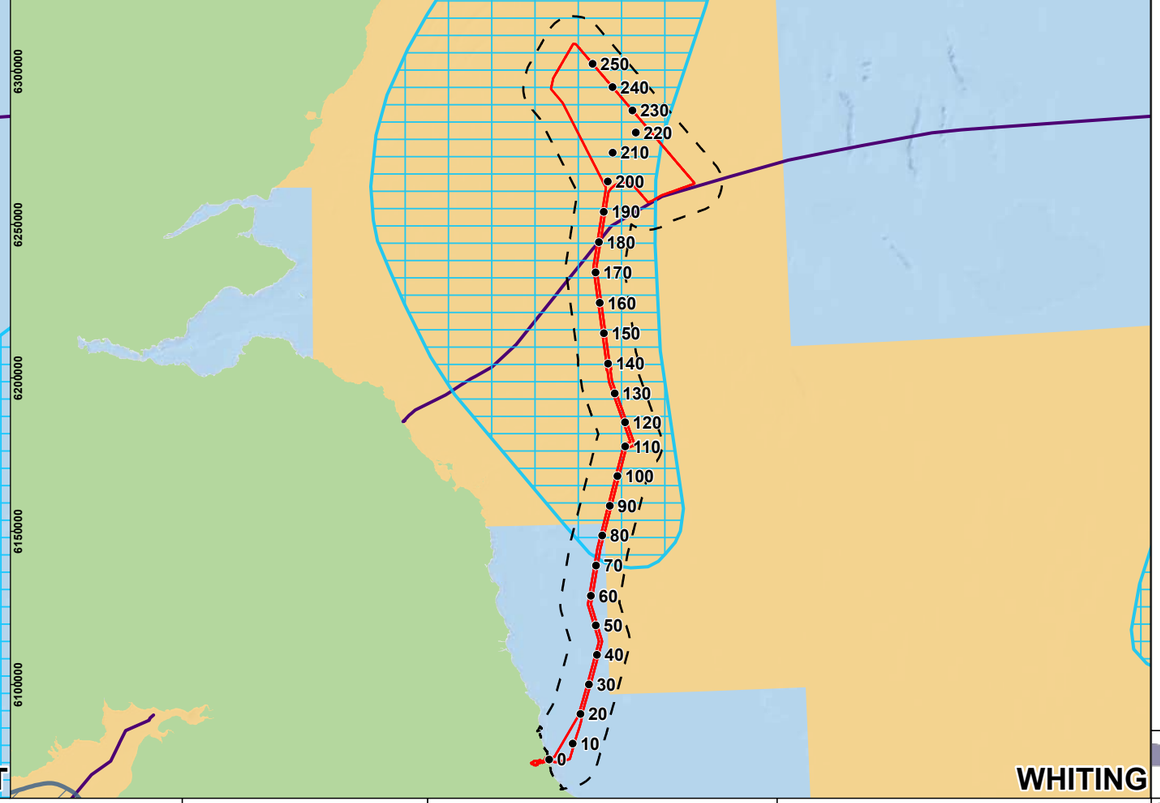
Spawning Grounds (Coull *et al.*, 1998) Intensity

- Undetermined

Spawning Grounds (Ellis *et al.*, 2012) Intensity

- Higher
- Lower



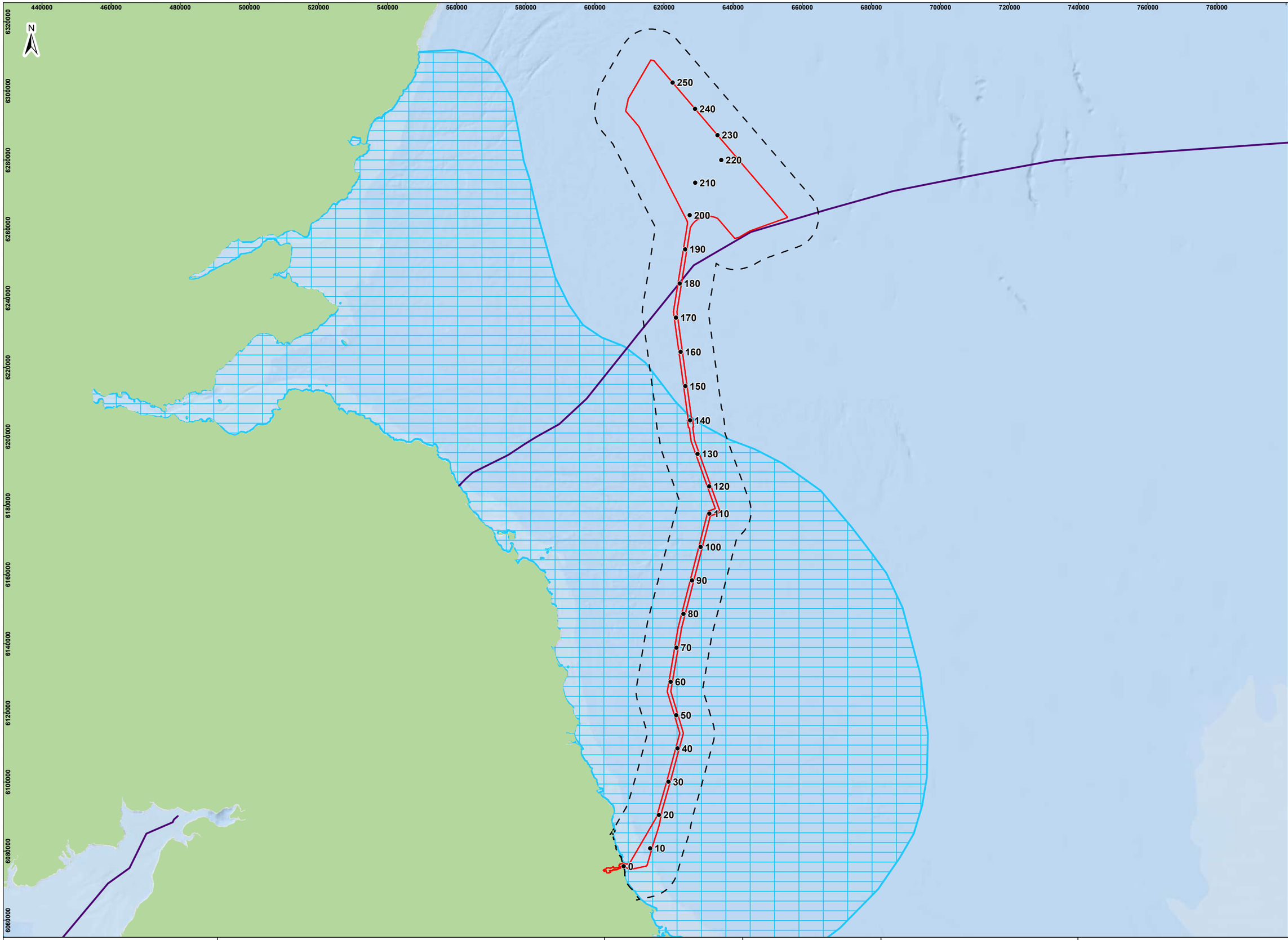


Morven Offshore Wind Farm | GoBe APEM Group

Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** SPAWNING GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (PLAICE, SANDEEL, SPRAT, WHITING)	0 10 20 30 40 50 km Scale@A31:2,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number: FIGURE 4-4

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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area

Spawning Grounds (Coull *et al.*, 1998) Intensity

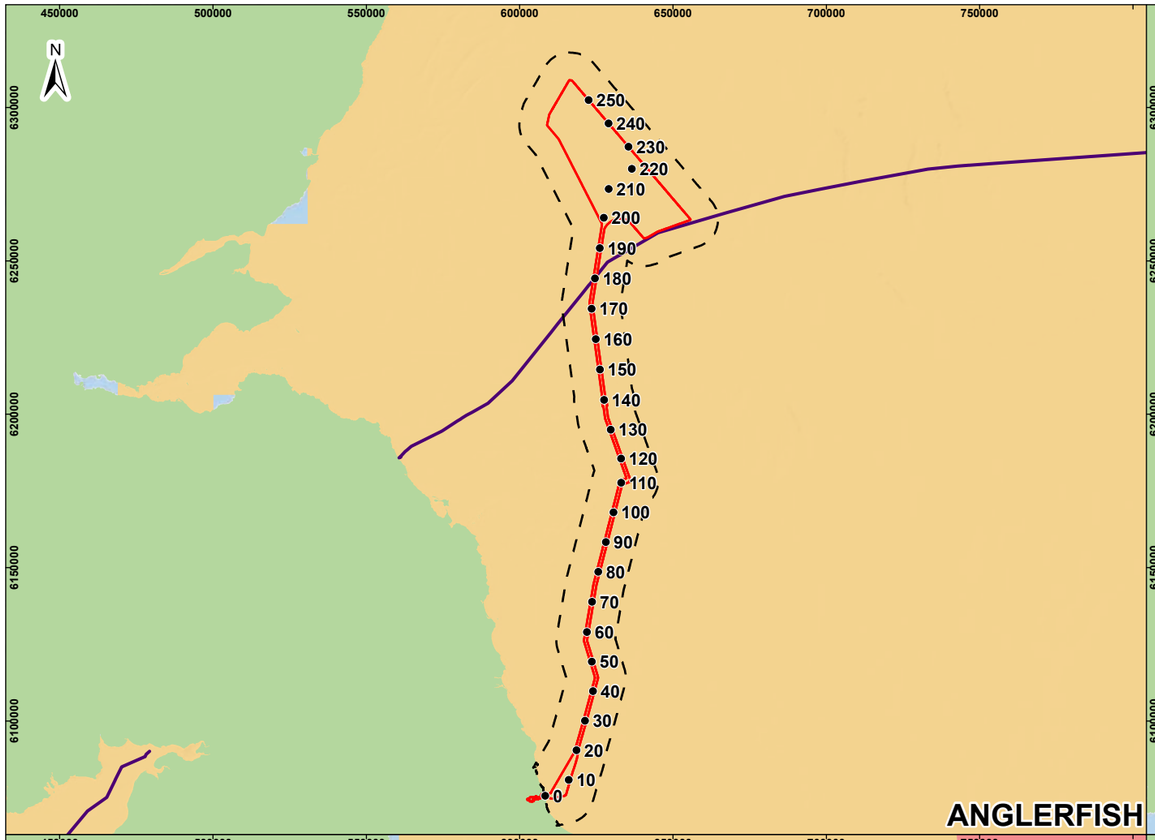
- Undetermined

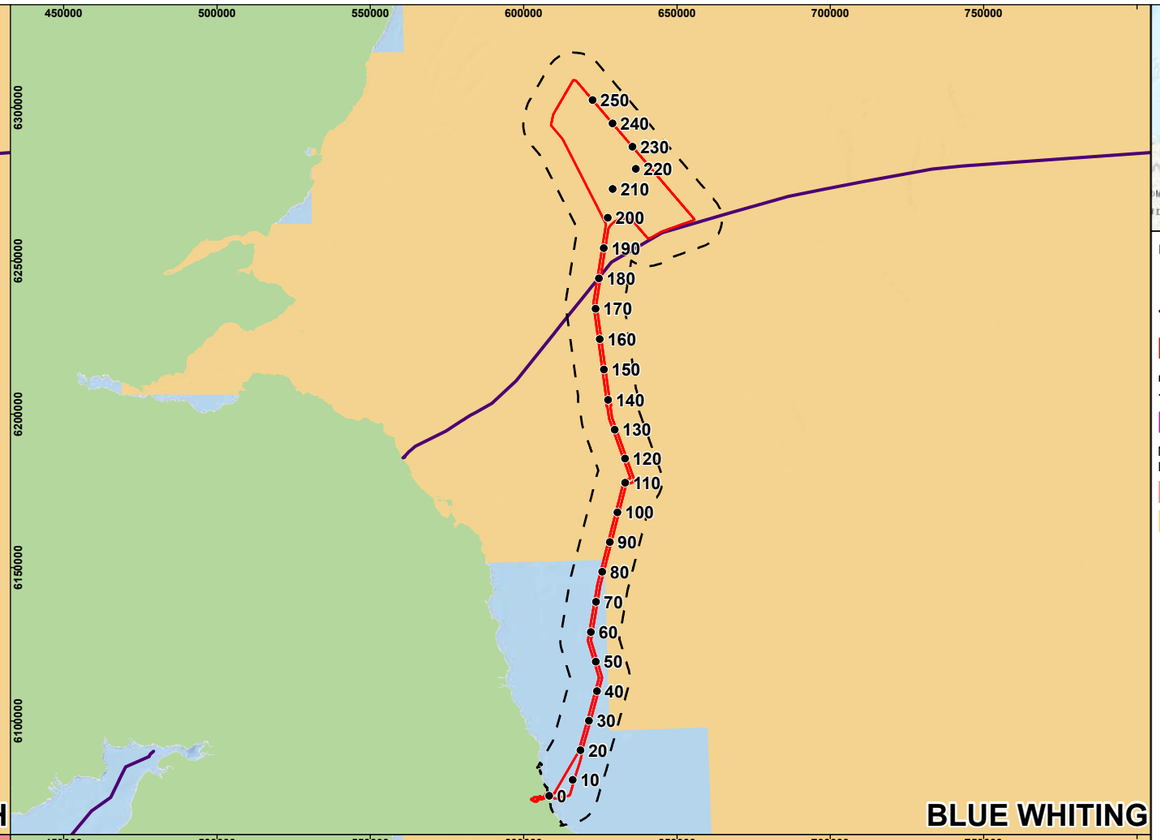
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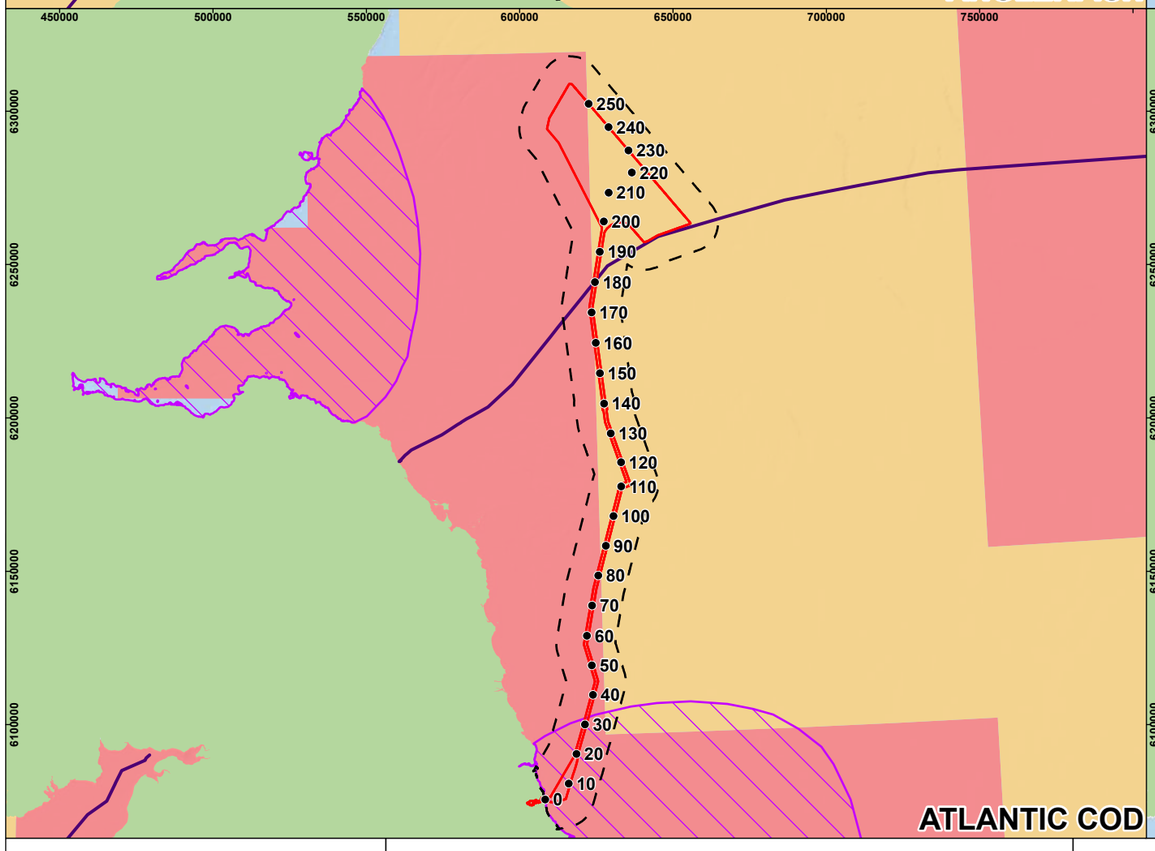
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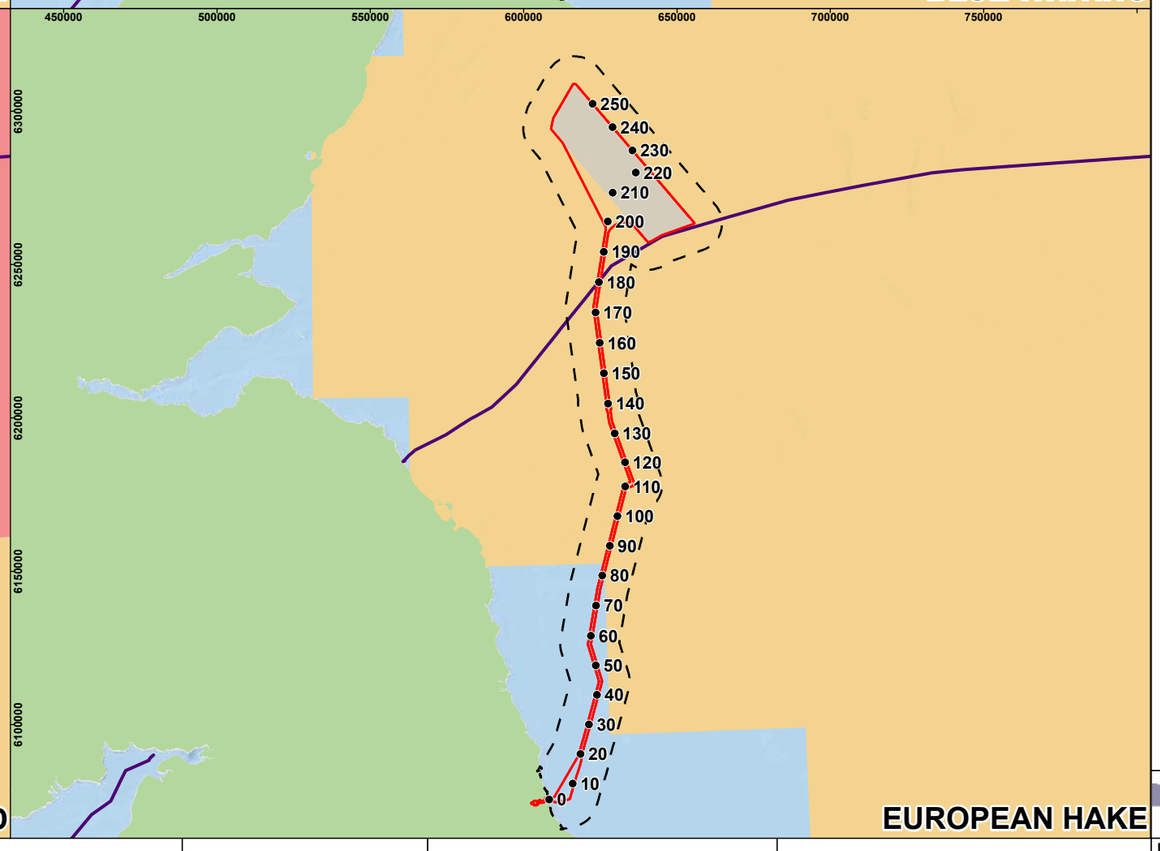
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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area
- Nursery Grounds (Coull *et al.*, 1998)

Nursery Grounds (Ellis *et al.*, 2012) Intensity

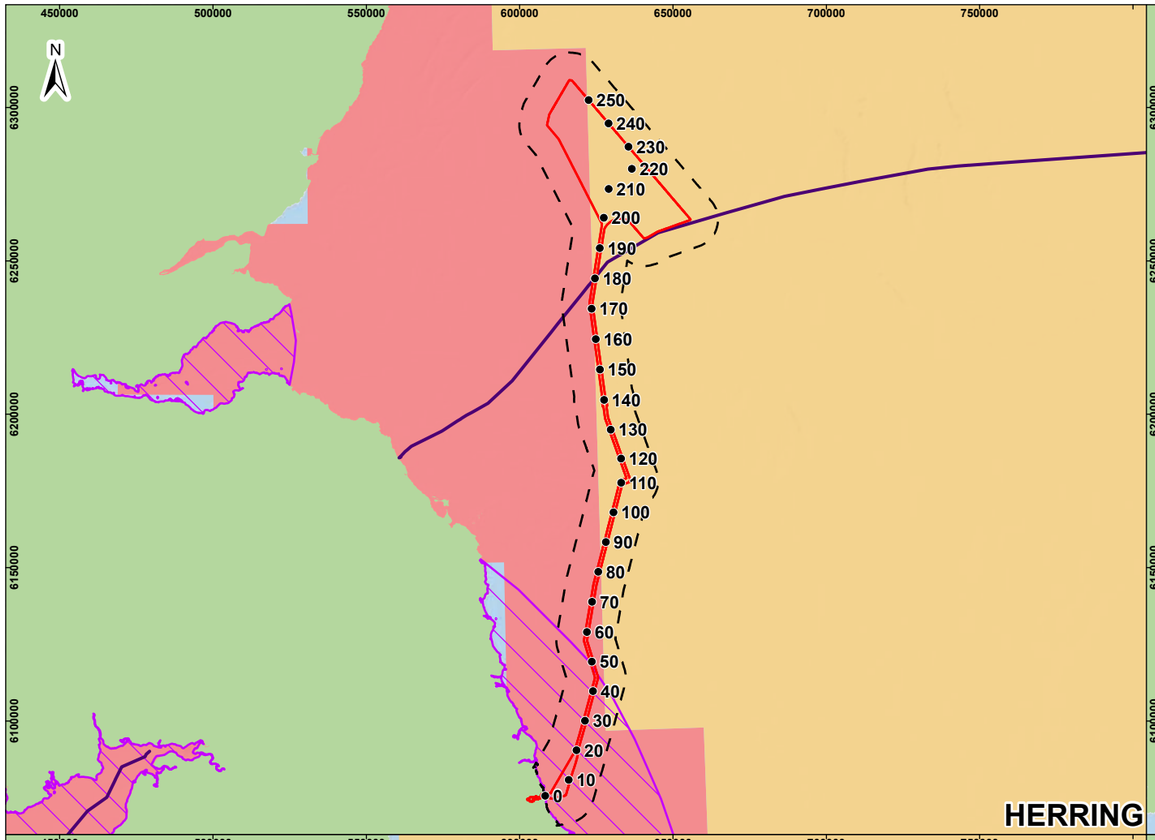
- Higher
- Lower

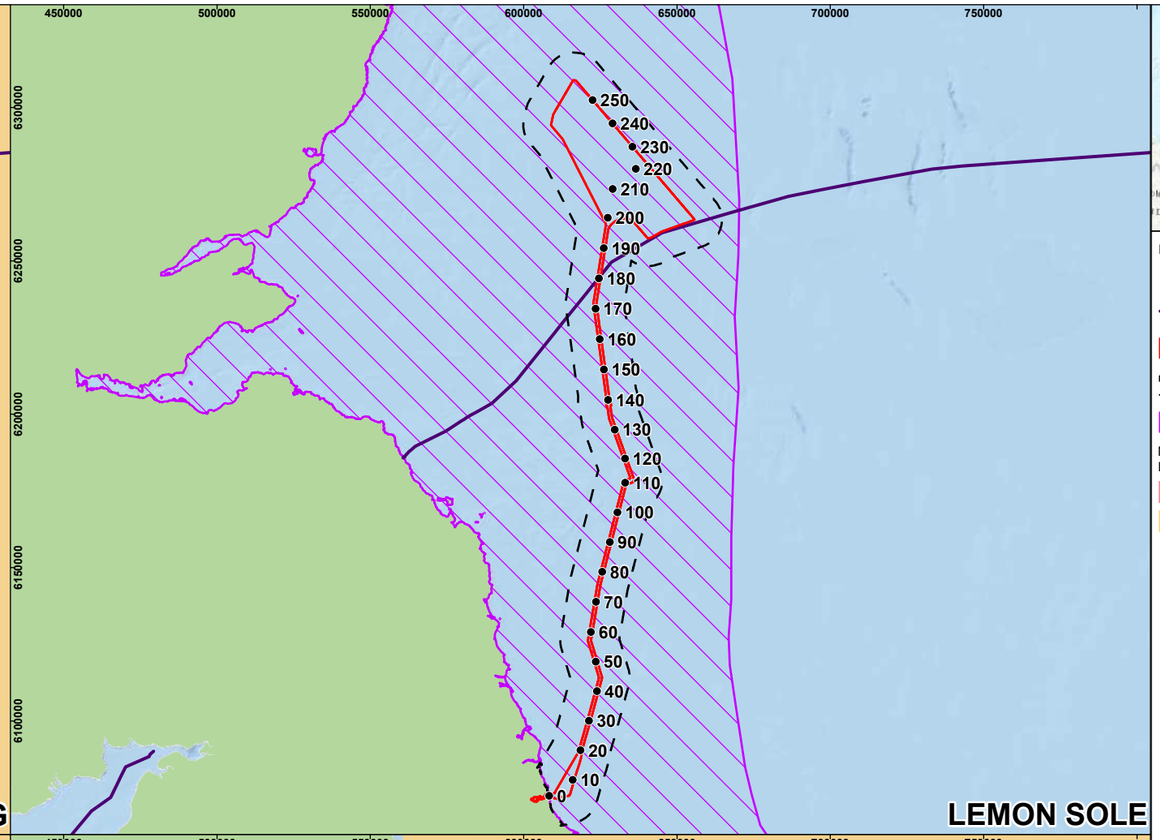
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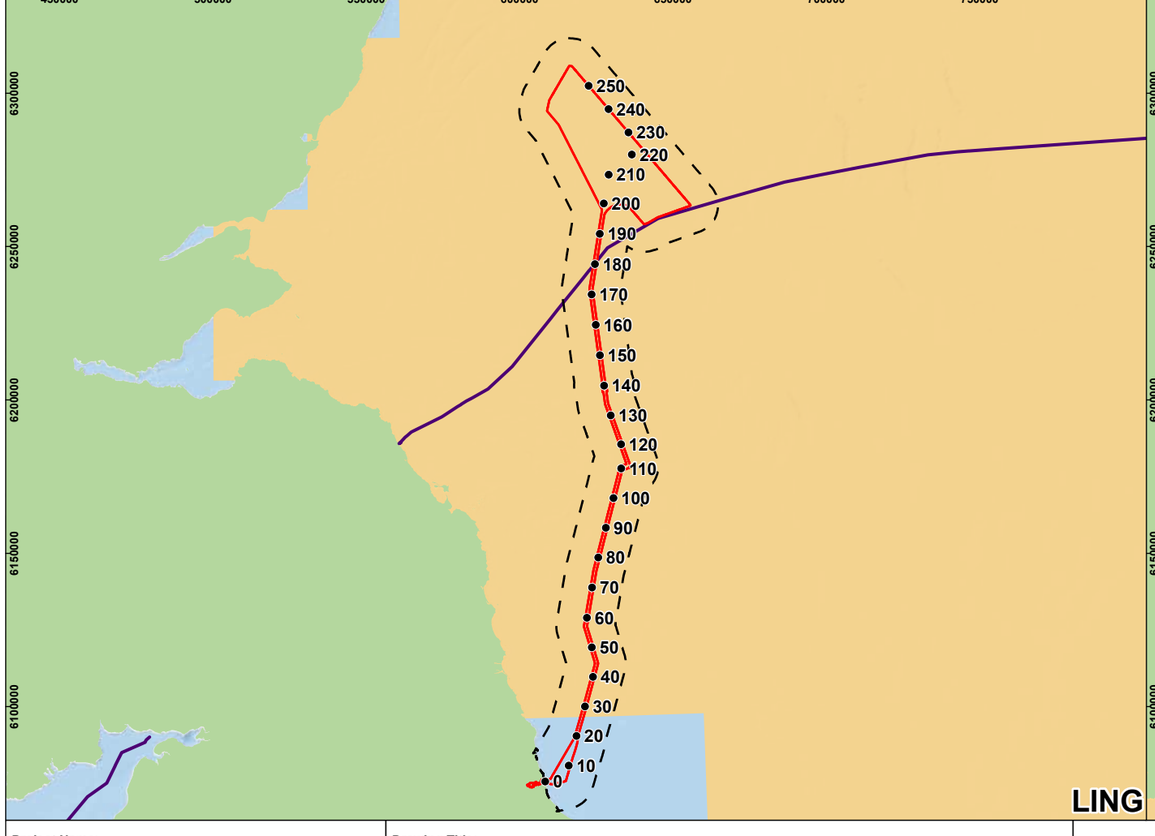
Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** NURSERY GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (ANGLERFISH, BLUE WHITING, ATLANTIC COD, EUROPEAN HAKE)	0 10 20 30 40 50 km Scale@A31:2,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey **Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

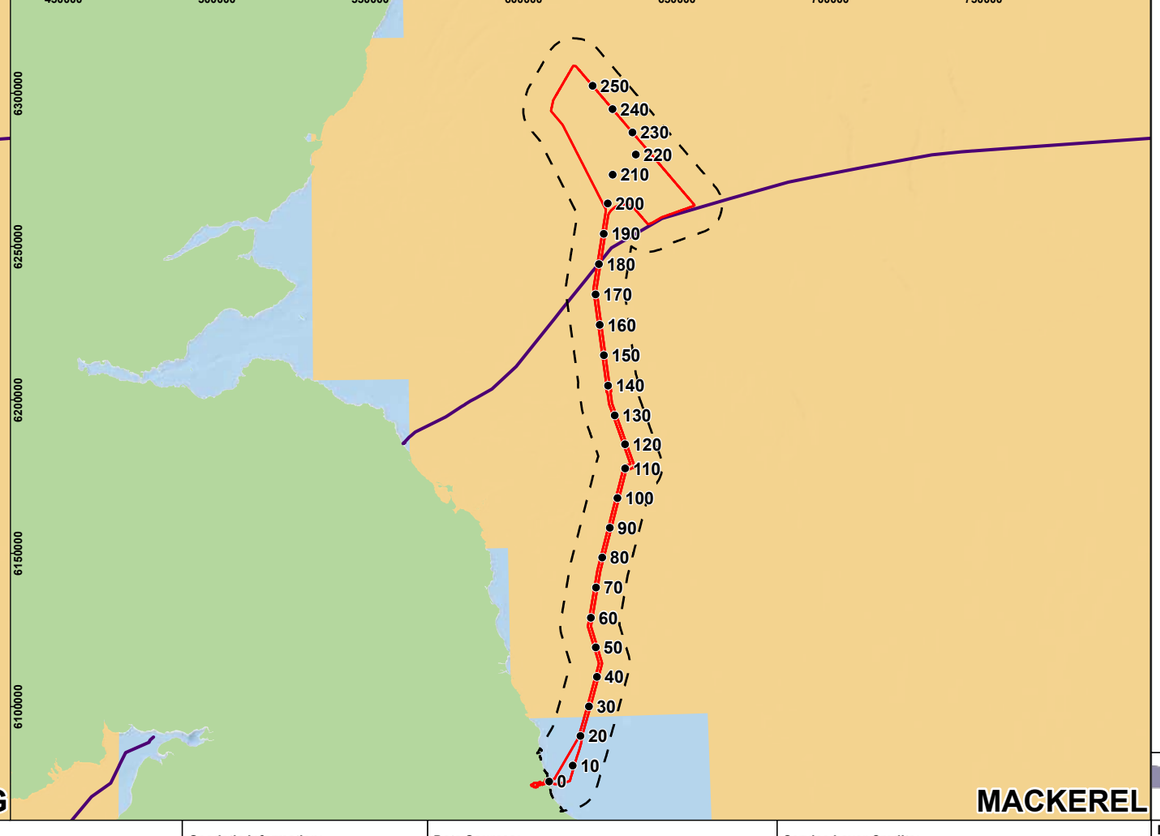
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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area
- Nursery Grounds (Coull *et al.*, 1998)

Nursery Grounds (Ellis *et al.*, 2012) Intensity

- Higher
- Lower

Morven Offshore Wind Farm | GoBe APEM Group

Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
NURSERY GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (HERRING, LEMON SOLE, LING, MACKEREL)

0 10 20 30 40 50 km

Scale@A31:2,000,000

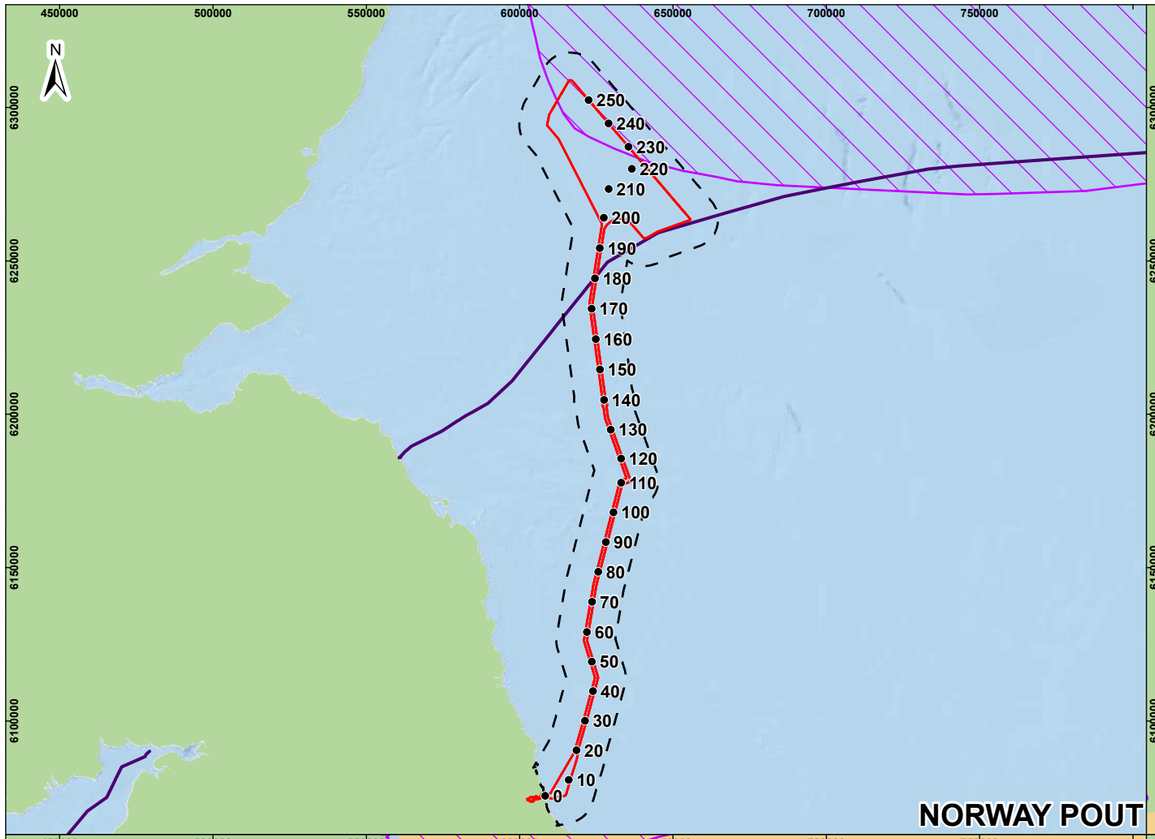
Geodetic Information:
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Projection: ED 1950 UTM Zone 30N

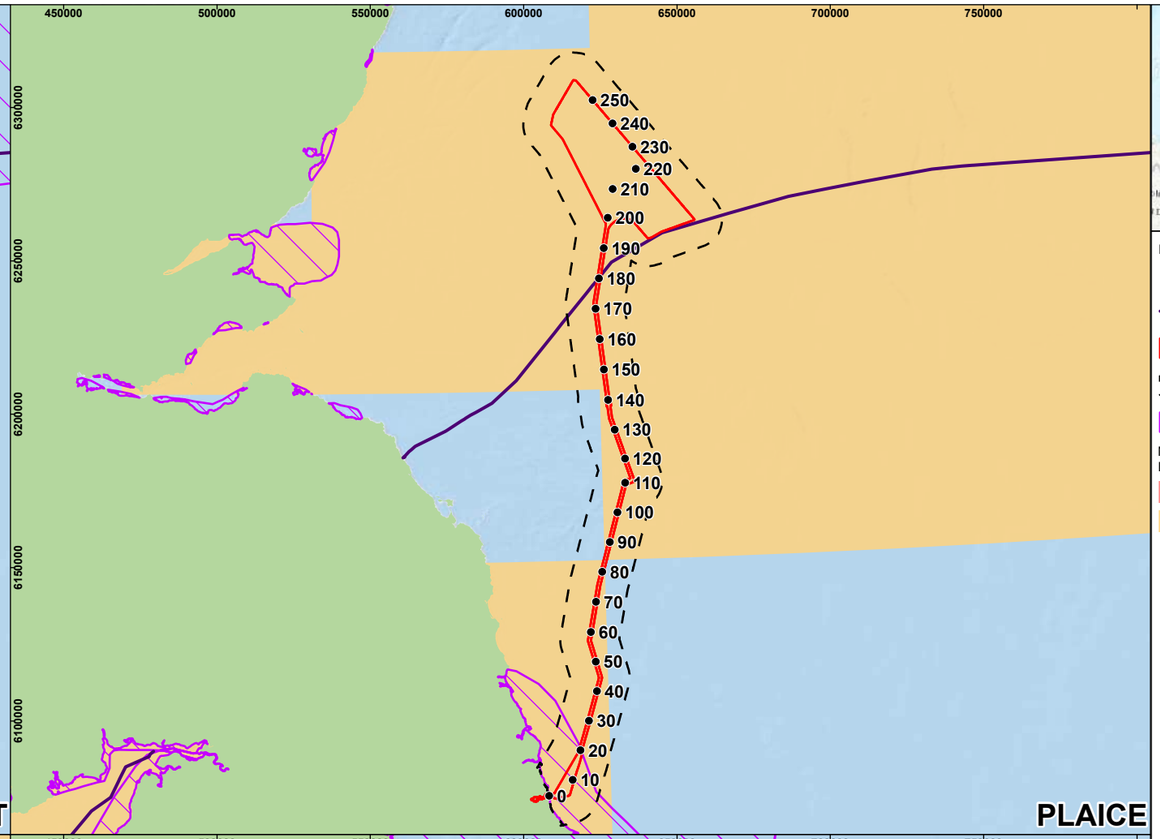
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BP, Ordnance Survey

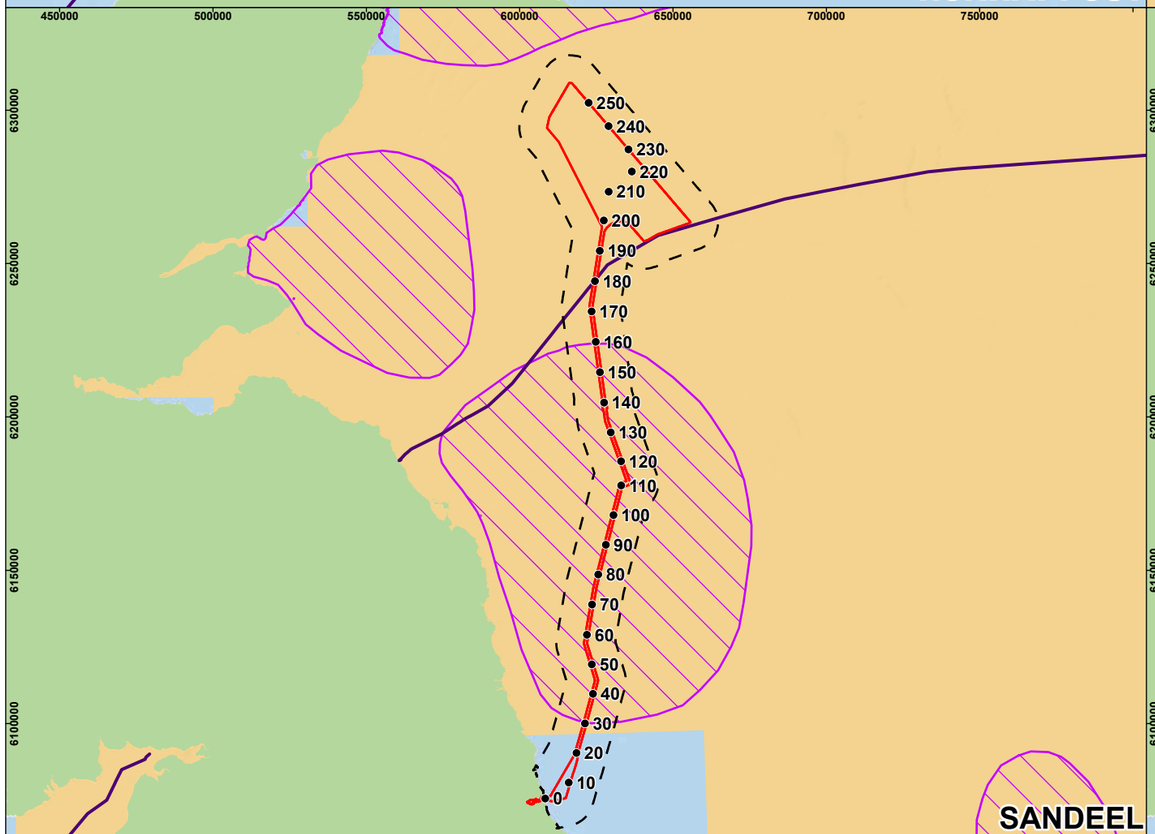
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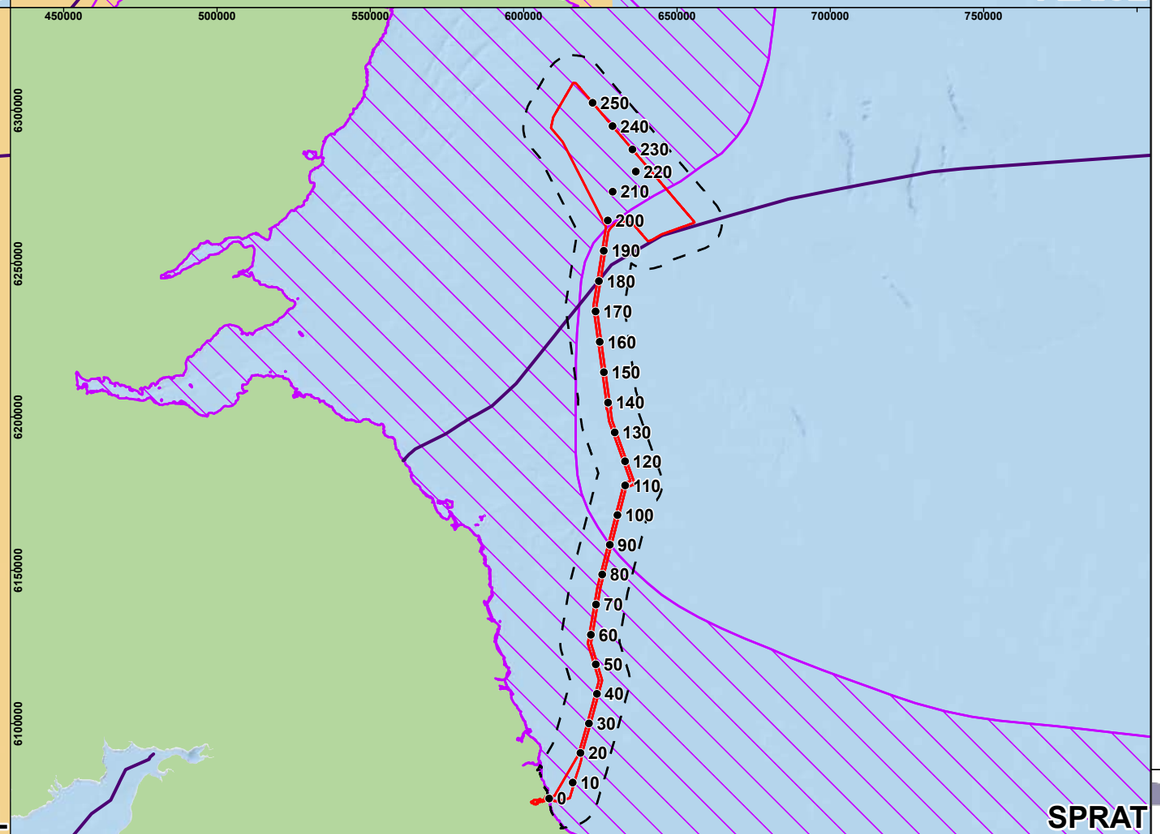
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FIGURE 4-7

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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area
- Nursery Grounds (Coull *et al.*, 1998)

Nursery Grounds (Ellis *et al.*, 2012) Intensity

- Higher
- Lower

Morven Offshore Wind Farm | GoBe APEM Group

Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
NURSERY GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (NORWAY POUT, PLAICE, SANDEEL SPRAT)

0 10 20 30 40 50 km

Scale@A31:2,000,000

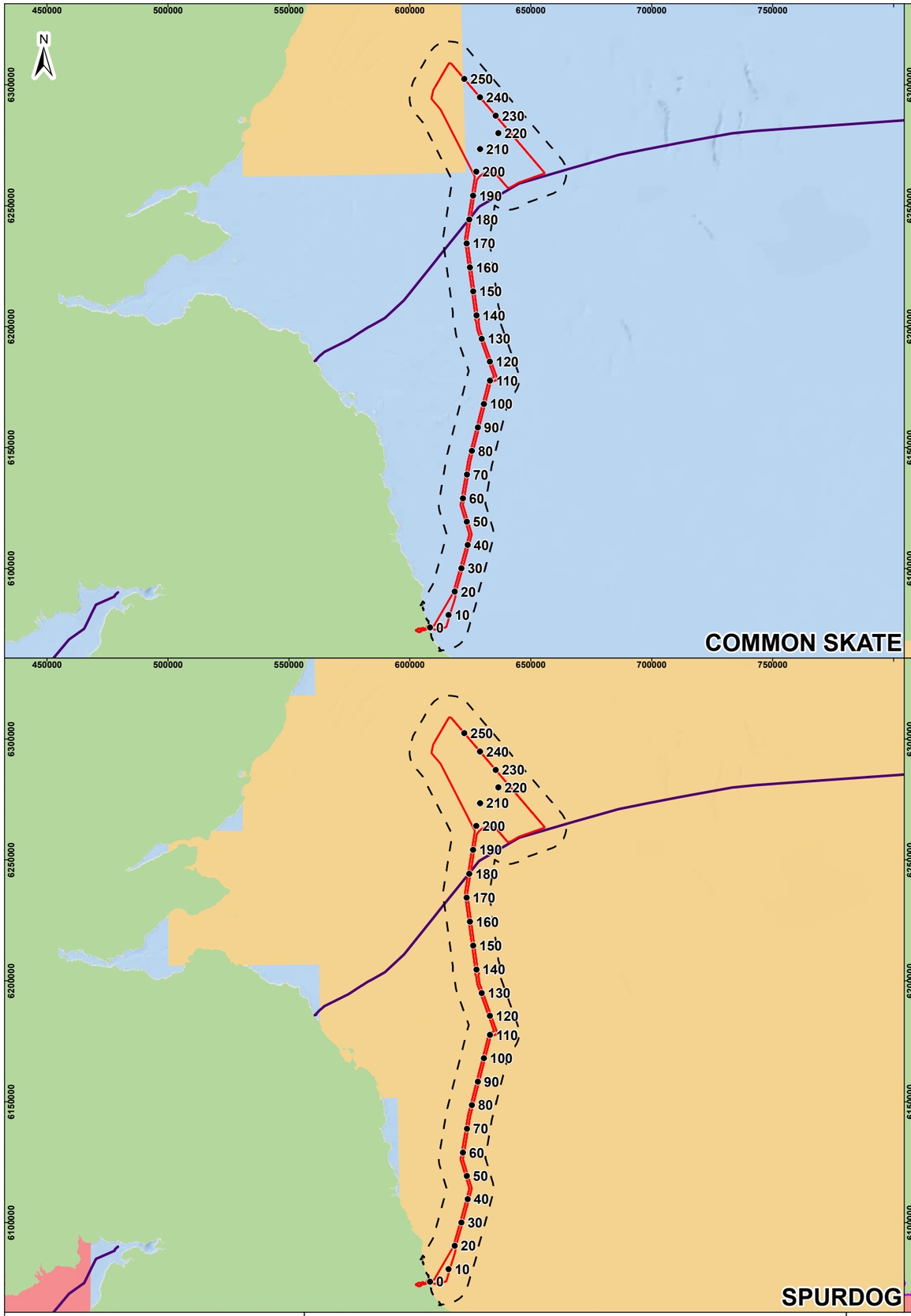
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Projection: ED 1950 UTM Zone 30N

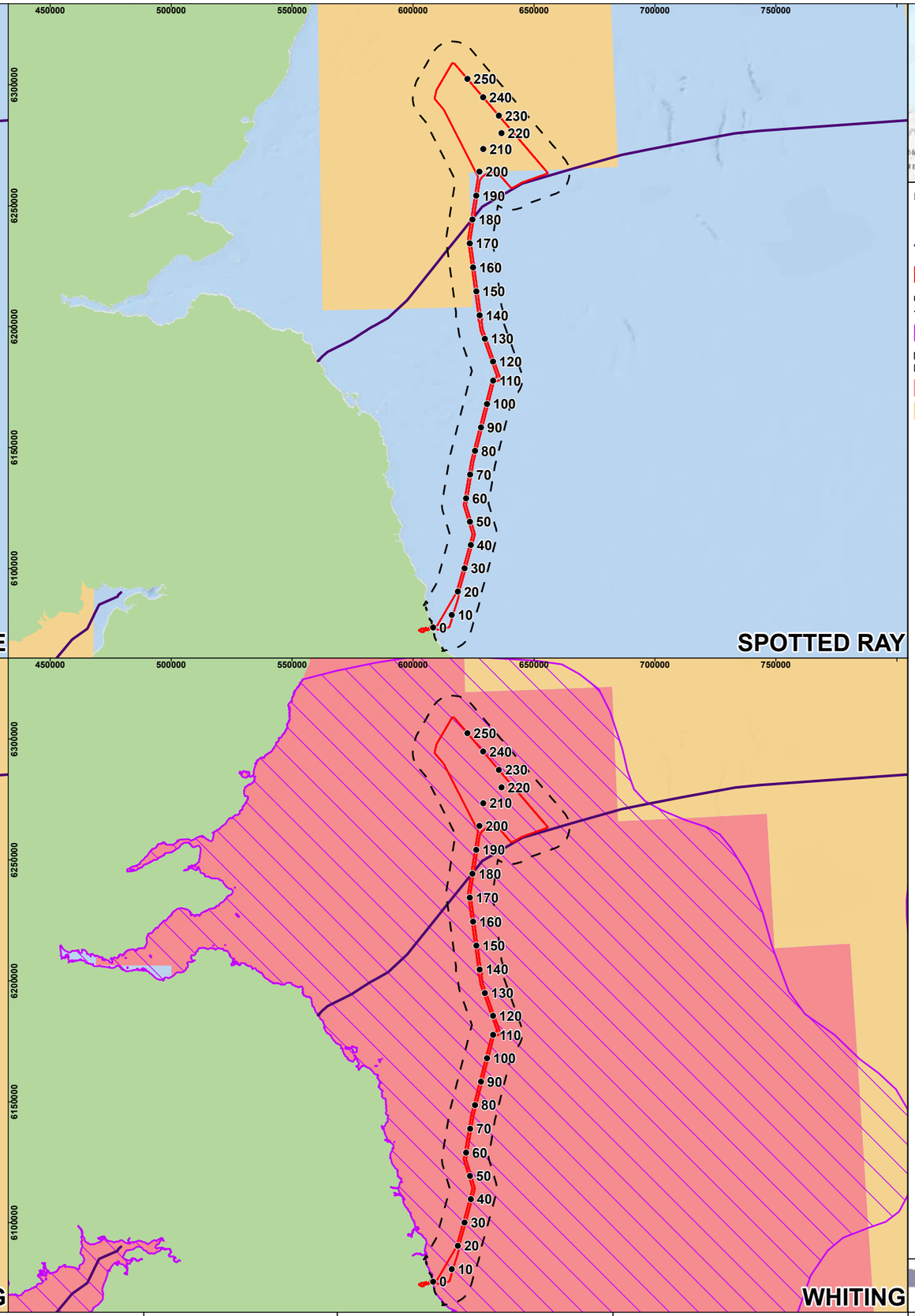
Data Sources:
BP, Ordnance Survey

Service Layer Credits:
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number:
FIGURE 4-8

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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area
- Nursery Grounds (Coull *et al.*, 1998)

Nursery Grounds (Ellis *et al.*, 2012) Intensity

- Higher
- Lower

Morven Offshore Wind Farm | GoBe APEMGroup

Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
NURSERY GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (COMMON SKATE, SPOTTED RAY, SPURDOG, WHITING)

0 10 20 30 40 50 km

Scale@A3:1:2,000,000

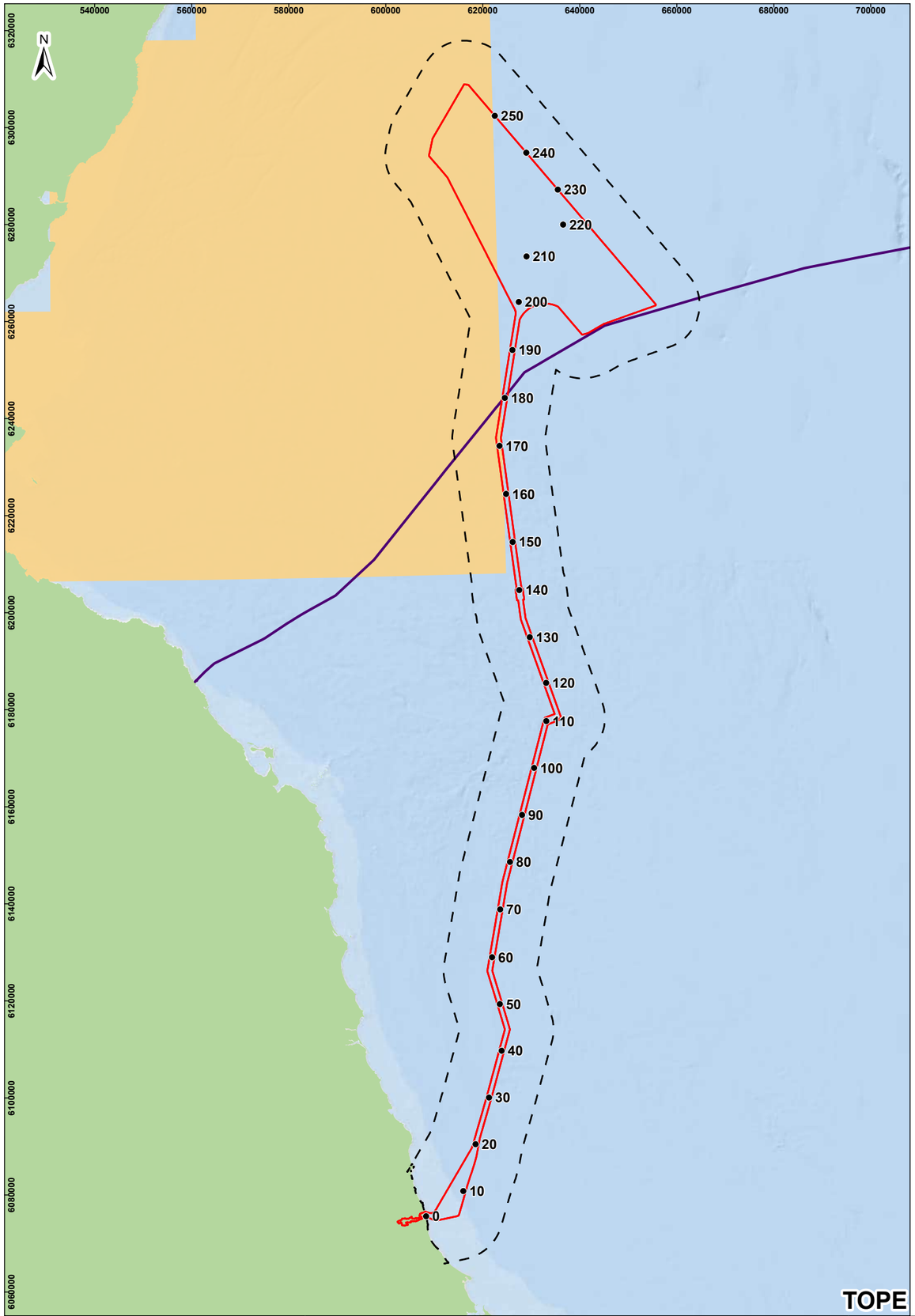
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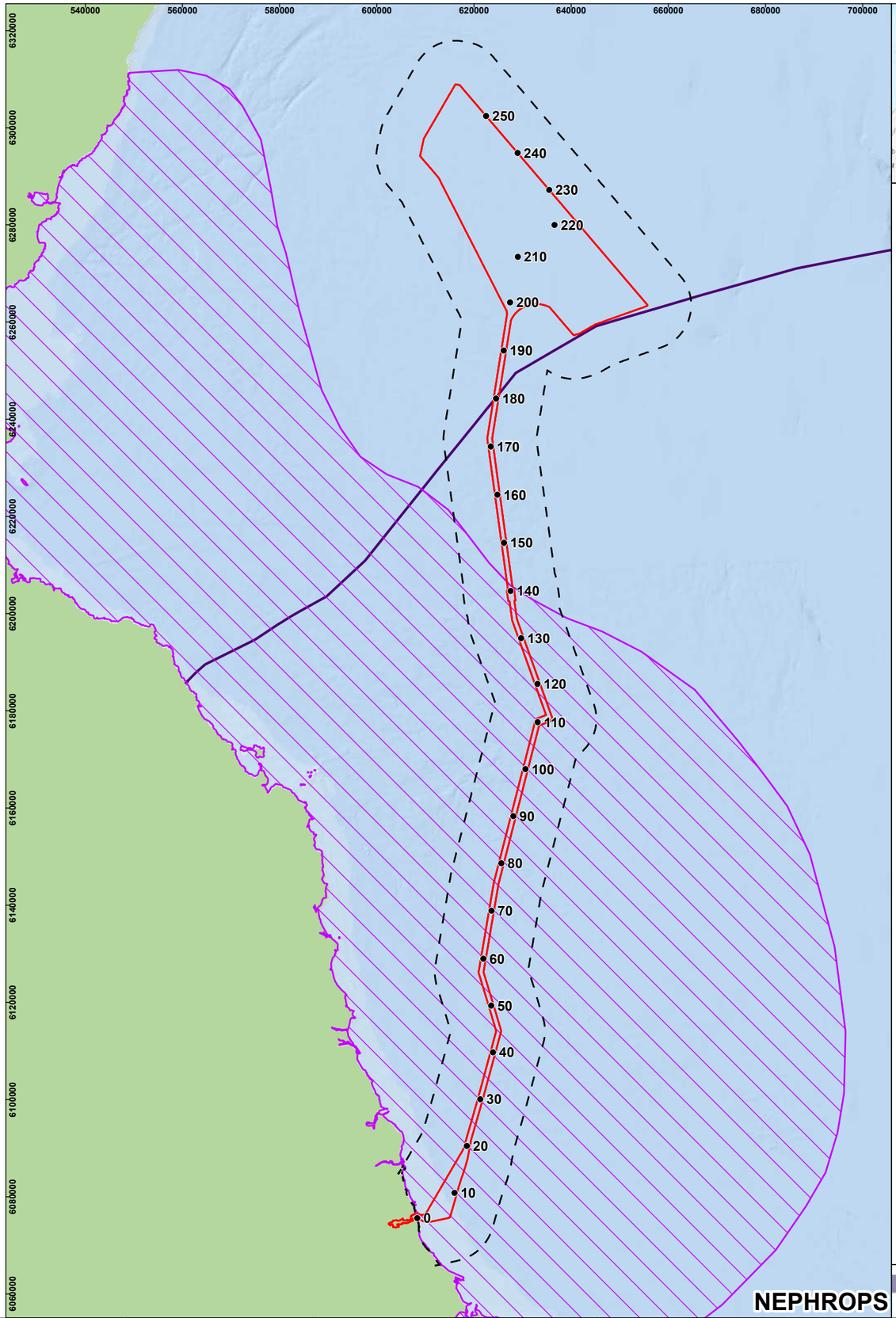
Data Sources:
BP, Ordnance Survey

Service Layer Credits:
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World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number:
FIGURE 4-9

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LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area
- Nursery Grounds (Coull *et al.*, 1998)

Nursery Grounds (Ellis *et al.*, 2012) Intensity

- Lower

Morven Offshore Wind Farm | GoBe APEM Group

Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** NURSERY GROUNDS WITHIN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (TOPE, NEPHROPS)	0 8 16 24 km Scale@A3:1,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Ocean Base: OceanWise, Esri, Garmin, NaturalVue World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS

Drawing Number: FIGURE 4-10

VER	DATE	DETAILS	BY	CHECK
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Atlantic Herring

4.4.5.4 Atlantic herring are demersal spawners that deposit adhesive eggs directly onto the seabed. Spawning is strongly associated with specific substrate types, with a preference for well-oxygenated coarse sediments including gravel, sandy gravel, coarse sand, shell and maerl, whilst habitats containing a high proportion of fine sediments are generally avoided (Ellis *et al.*, 2012). As a result of their reliance on suitable spawning substrates, herring are particularly sensitive to activities that may result in seabed disturbance, sediment deposition or habitat loss.

4.4.5.5 The Fish and Shellfish Ecology Study Area overlaps two North Sea autumn-spawning herring stocks. In Scottish waters, the Fish and Shellfish Ecology Study Area overlaps the Buchan component of the wider Buchan and Shetland stock, with mapped spawning grounds occurring approximately 0.3km from the MHPGC Project PEIR Red Line Boundary (**Figure 4.3**). This stock typically spawns between August and September (Ellis *et al.*, 2012). In English waters, the Fish and Shellfish Ecology Study Area overlaps the Banks stock, with mapped spawning grounds occurring 6.5km from the MHPGC Project PEIR Red Line Boundary. This stock typically spawns between August and October (Ellis *et al.*, 2012). Atlantic herring stocks from both of these spawning grounds form part of the wider NSAS population (Kyle-Henney *et al.*, 2024). The Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, also overlaps with Atlantic herring nursery grounds identified by both Coull *et al.* (1998) and Ellis *et al.* (2012) (**Figure 4.7**). The nursery grounds extend across much of the North Sea, with the section of the MHPGC Project PEIR Red Line Boundary from approximately KP80 to the landfall located within higher-intensity nursery grounds and the remainder located within lower-intensity nursery grounds (Ellis *et al.*, 2012).

4.4.5.6 A detailed assessment to identify and characterise the spawning potential for Atlantic herring within the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, was undertaken and is presented within **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR.** Spawning habitat suitability categorisation within the MHPGC Project PEIR Red Line Boundary was undertaken in accordance with the methodologies and classifications presented by Kyle-Henney *et al.* (2024), using project-specific sediment PSA data collected during site-specific surveys for the MHPGC Project (Gardline, 2024; 2025), together with PSA data from the Morven North and Morven South surveys undertaken within the MHPGC Project PEIR Red Line Boundary (Tetra Tech RPS Energy, 2026). Within this PEIR chapter, MHPGC Project-specific survey data collected outside the MHPGC Project PEIR Red Line Boundary, together with BGS (2015), EMODnet broadscale habitat mapping (EMODnet, 2018) and OneBenthic PSA data (Cefas, 2024a), were also classified to provide broader regional context.

4.4.5.7 Available PSA data collected for the MHPGC Project-specific surveys and BGS PSA data were categorised into “prime”, “sub-prime”, “suitable” and “unsuitable” spawning habitat, whereas all other datasets were categorised as “preferred”, “marginal” and “unsuitable” due to their respective data limitations. The Morven North and Morven South PSA datasets had previously been classified using the broader categorisation scheme in the respective technical reports for those projects, and this classification was retained for consistency. The relationship between these classification schemes is presented in **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR.**

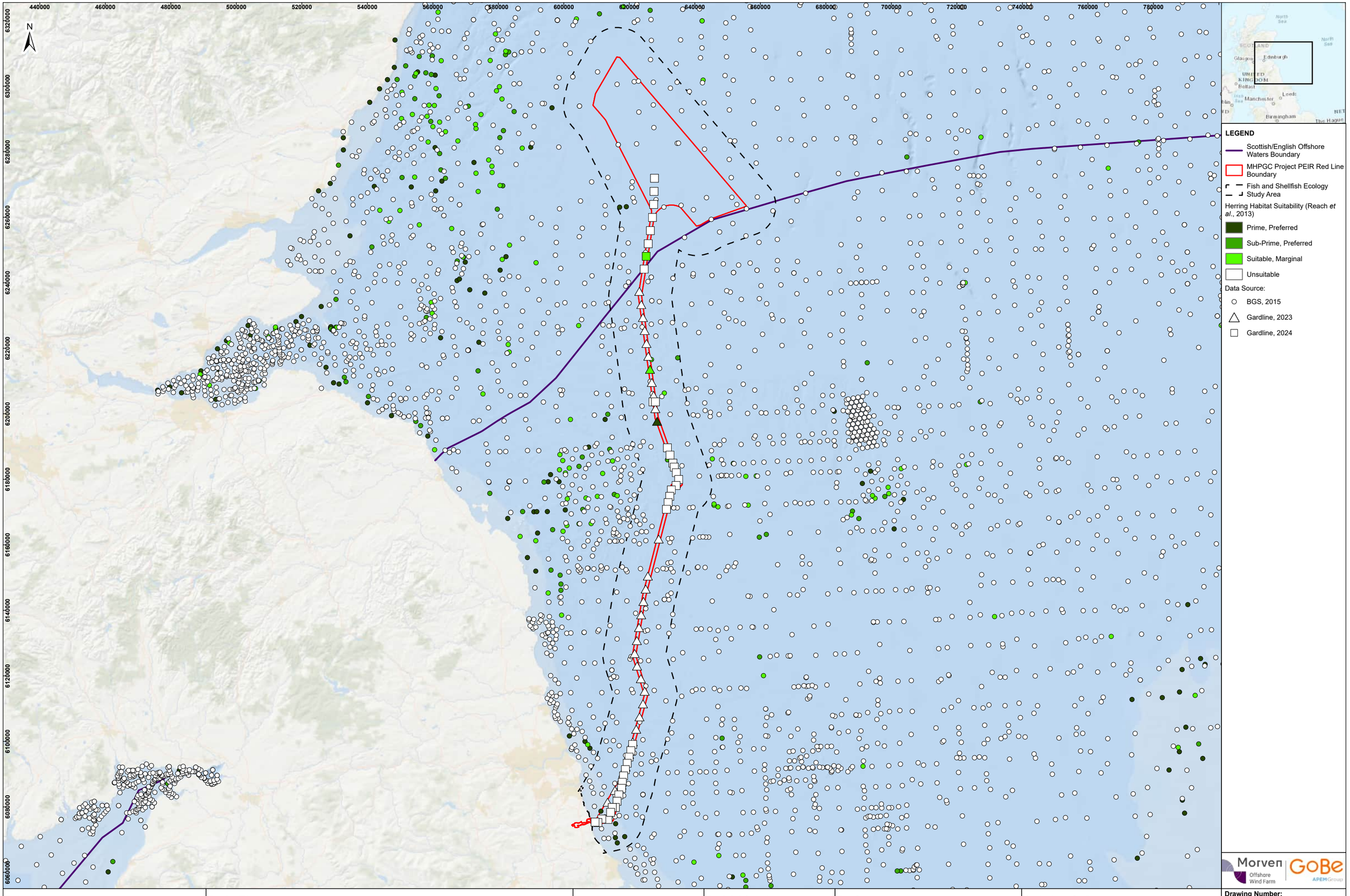
4.4.5.8 In Scottish waters, categorised PSA data from the MHPGC Project-specific surveys and the Morven North and Morven South surveys indicated that the MHPGC Project PEIR Red Line Boundary is dominated by sediments unsuitable for Atlantic herring spawning. No samples within the MHPGC Project PEIR Red Line Boundary were classified as prime or sub-prime spawning habitat. Similarly, in the wider Fish and Shellfish Ecology Study Area, sediments are predominantly unsuitable according to both the site-specific survey datasets and the BGS PSA data (**Figure 4.11**). In English waters, these datasets similarly indicate that the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area is dominated by sediments unsuitable for Atlantic herring spawning, with only isolated occurrences of suitable and prime spawning habitat identified. In accordance with these findings, the categorised EMODnet seabed substrate data and OneBenthic PSA data indicate that the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR

Red Line Boundary, is predominantly characterised by sediments unsuitable for Atlantic herring spawning in both Scottish and English waters.

4.4.5.9 Additionally, areas of spawning potential for herring have been identified using a heatmapping methodology outlined by Kyle-Henney *et al.* (2024) (as adapted from Reach *et al.* (2013)). The heatmap is informed by EMODnet seabed substrate data (EMODnet, 2018), spawning ground data (Coull *et al.*, 1998), fishing activity data / VMS data (2007-2020) (MMO, 2020), and IHLS data (ICES, 2025). The greater the number of overlapping data layers the greater the 'heat' mapped. Areas of higher 'heat' therefore indicate a higher confidence that the seabed may be suitable for herring spawning.

4.4.5.10 IHLS data, which provide a proxy for contemporary Atlantic herring spawning activity based on the distribution and abundance of larvae, indicate generally low cumulative larval abundance (<1,500 per m^2) over a 10-year period, throughout the majority of the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary (**Figure 4.12**). Although larval distributions may extend beyond spawning grounds as a result of hydrodynamic transport, the data suggest relatively low levels of spawning activity within both Scottish and English waters compared with other areas of the North Sea. Slightly elevated larval abundances were recorded in association with the Buchan spawning ground in Scottish waters (1,500 per m² to 5,500 per m²), outside of the MHPGC Project PEIR Red Line Boundary, while low-intensity spawning activity was identified in proximity to the Banks spawning ground in English waters (0 to 1,500 per m²) which overlaps the Fish and Shellfish Ecology Study Area. These findings are broadly consistent with the habitat suitability assessment, which indicates that the Fish and Shellfish Ecology Study Area, including the area within the MHPGC Project PEIR Red Line Boundary, is predominantly characterised by sediments unsuitable for Atlantic herring spawning, with only limited areas of suitable habitat present.

4.4.5.11 The heatmapping assessment indicates that the majority of the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, is characterised by low spawning confidence (0.1-0.2). Localised areas of medium spawning confidence were identified within both Scottish and English waters (0.05–0.1), generally corresponding to areas where discrete areas of habitat of marginal suitability coincide with historical spawning records. Areas of highest spawning confidence were largely associated with the Banks spawning ground identified by Coull *et al.* (1998), which lies predominantly outside the Fish and Shellfish Ecology Study Area. Overall, the confidence assessment is consistent with the habitat suitability and IHLS analyses, indicating a low likelihood of extensive contemporary Atlantic herring spawning activity within the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area.



Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
HERRING SPAWNING HABITAT SUITABILITY BASED ON THE SITE-SPECIFIC BENTHIC SURVEY RESULTS (GARDLINE, 2024A; 2025A) AND BGS DATA (2015)

0 5 10 15 20 25 km

Scale@A31:1,000,000

Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

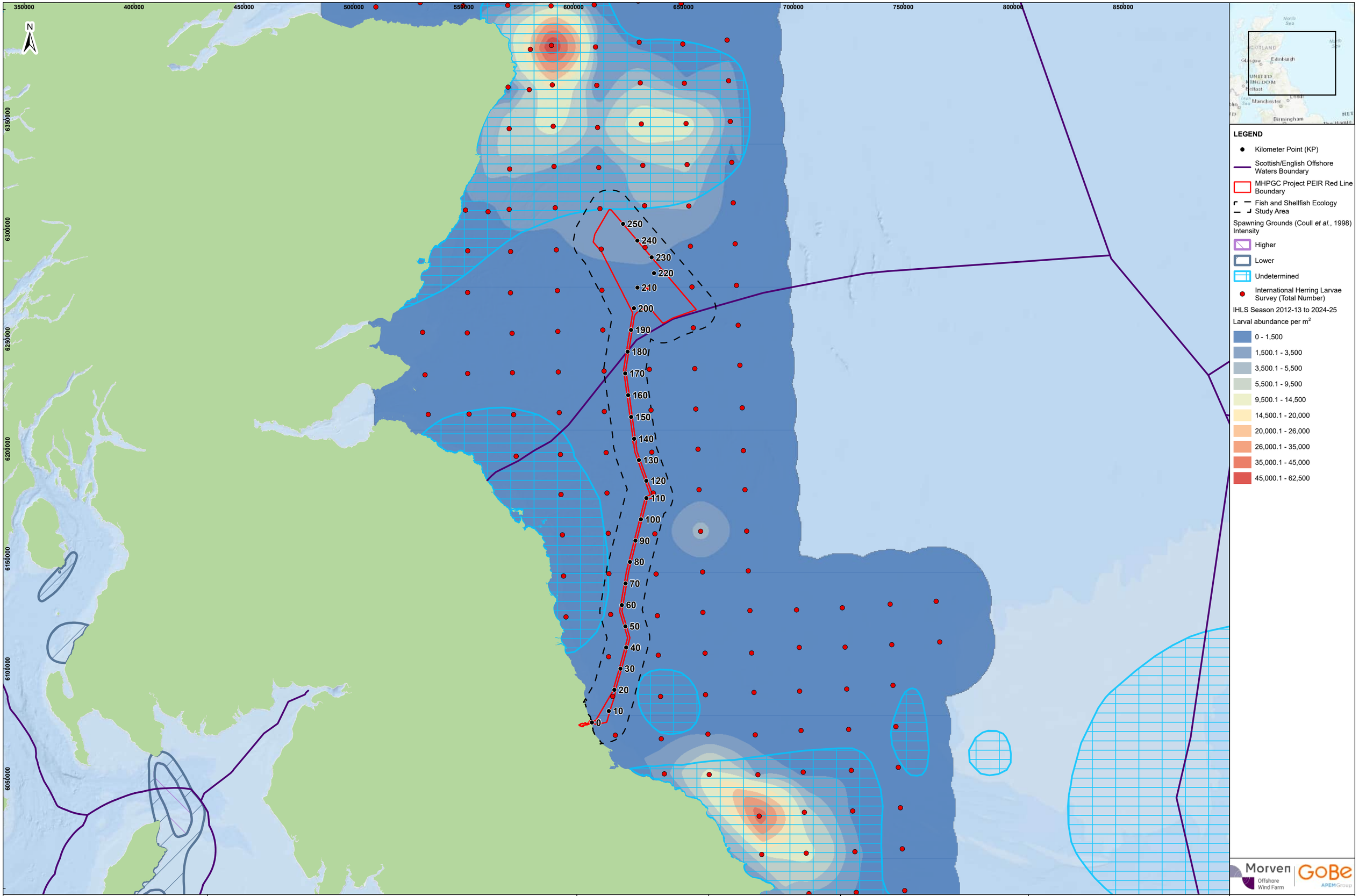
Data Sources:
BP, Ordnance Survey

Service Layer Credits:
World Ocean Base: OceanWise, Esri, Garmin, NaturalVue
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS

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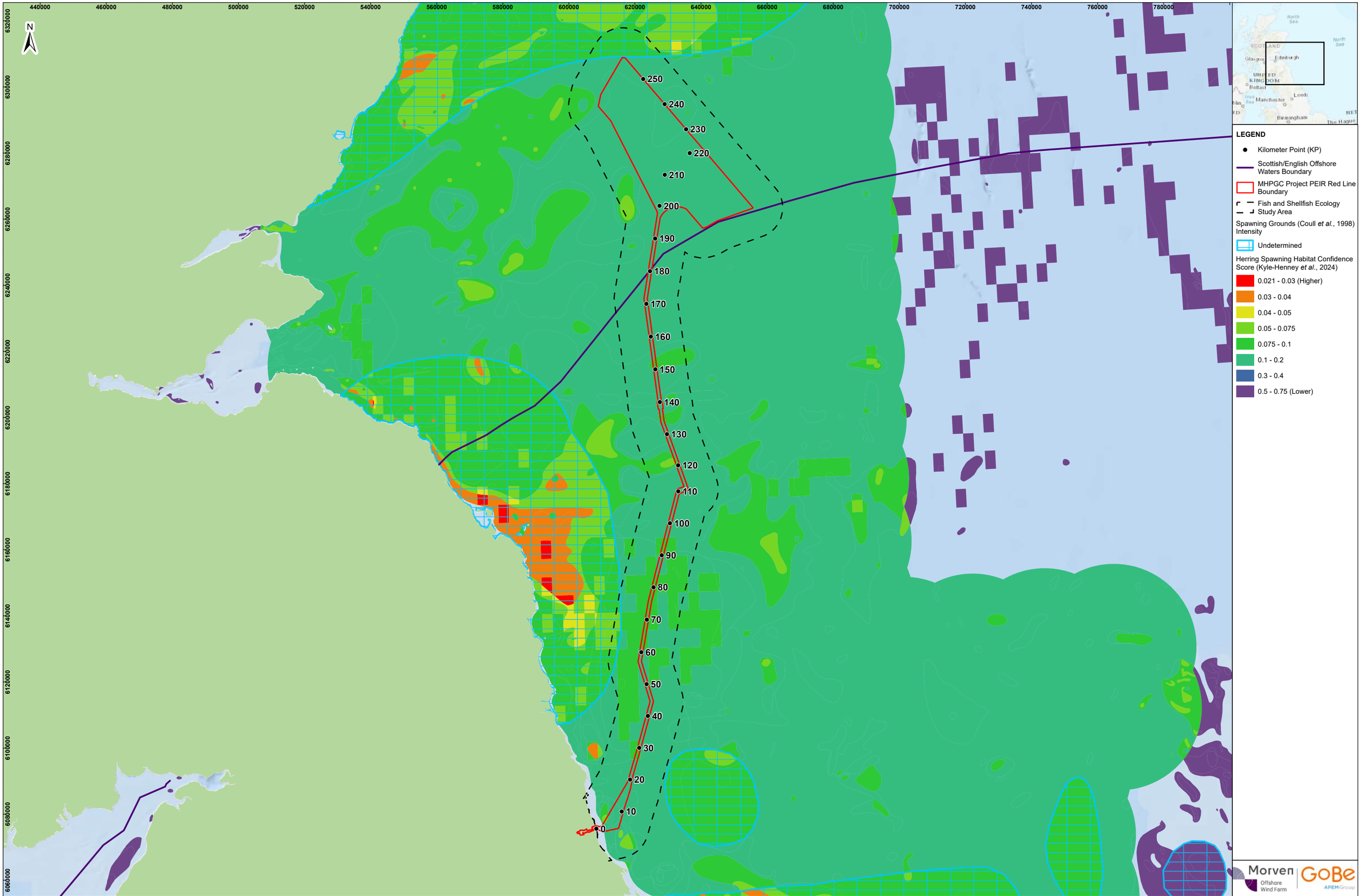
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FIGURE 4-11

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Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** INDICATIVE HERRING SPAWNING GROUND BASED ON IHLS GENERAL MAPPING DATA (ICES 2012/13 - 2024/25 SEASONS) - LARVAL ABUNDANCE PER M^2	0 5 10 15 20 25 30 35 km Scale@A31:1,500,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue	**Drawing Number:** FIGURE 4-12

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Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
HERRING SPAWNING HABITAT CONFIDENCE HEATMAP

0 5 10 15 20 25 km

Scale@A31:1,000,000

Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

Service Layer Credits:
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

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Drawing Number:
FIGURE 4-13

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Sandeel

4.4.5.12 Sandeel comprise a group of small, burrowing fish species, including greater sandeel (*Hyperoplus lanceolatus*), lesser sandeel (*Ammodytes tobianus*) and Raitt's sandeel (*Ammodytes marinus*). Sandeel rely on suitable sandy sediments as supporting habitat throughout their life cycle, including for burrowing, feeding, overwintering and spawning. Sandeel eggs are demersal and remain on the seabed following spawning. As a result of their reliance on specific sediment characteristics to support these life-history functions, sandeel are particularly sensitive to activities that may result in seabed disturbance, sediment deposition or habitat loss.

4.4.5.13 Sandeel exhibit a strong preference for sandy habitats, particularly sediments dominated by medium to coarse sands with low silt content (Wright *et al.*, 2000; Holland *et al.*, 2005; Jensen *et al.*, 2011). Their dependence on suitable sandy substrates for burrowing results in strong habitat association and site fidelity, with distribution often occurring in discrete patches where sediment conditions are favourable.

4.4.5.14 In Scottish waters, whilst no important spawning grounds identified by Coull *et al.* (1998) overlap the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, the north-western section of the Fish and Shellfish Ecology Study Area intersects high-intensity spawning habitat identified by Ellis *et al.* (2012). In English waters, the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, overlaps an important spawning ground identified by Coull *et al.* (1998), together with areas of both high- and low-intensity spawning habitat identified by Ellis *et al.* (2012) (**Figure 4.4**). More broadly, low-intensity spawning grounds are widespread throughout much of the North Sea. The Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, also overlaps low-intensity sandeel nursery grounds identified by both Coull *et al.* (1998) and Ellis *et al.* (2012), in Scottish and English waters (**Figure 4.8**). These nursery grounds are widely distributed across the North Sea, indicating the broad regional importance of the area for juvenile sandeel.

4.4.5.15 The MHPGC Project PEIR Red Line Boundary is located in proximity to several protected sites designated for subtidal sand and gravel habitats that may provide suitable sandeel habitat. In Scottish waters, the MHPGC Project PEIR Red Line Boundary runs adjacent to the Firth of Forth Banks Complex MPA, whilst in English waters it lies between the Farnes East MCZ and the North East of Farnes Deep MCZ/ HPMA, both of which include sandy seabed habitats and overlap mapped sandeel spawning grounds.

4.4.5.16 A detailed assessment to identify and characterise potential supporting sandeel habitat within the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, was undertaken and is presented within **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**. Supporting habitat suitability categorisation was undertaken in accordance with the methodologies and classifications presented by Reach *et al.* (2024), using project-specific sediment PSA data collected during site-specific surveys of the MHPGC Project PEIR Red Line Boundary (Gardline, 2024; 2025), together with PSA data from the Morven North and Morven South surveys (Tetra Tech RPS Energy, 2026) undertaken within the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area. Within this PEIR chapter, MHPGC Project-specific survey data collected outside the MHPGC Project PEIR Red Line Boundary, together with BGS (2015), EMODnet broadscale habitat mapping (EMODnet, 2018) and OneBenthic PSA data (Cefas, 2024a), were classified to provide broader regional context.

4.4.5.17 Available PSA data collected for the MHPGC Project-specific surveys and BGS PSA data were categorised into “prime”, “sub-prime”, “suitable” and “unsuitable” spawning habitat, whereas all other datasets were categorised as “preferred”, “marginal” and “unsuitable” due to their respective data limitations. The Morven North and Morven South PSA datasets had previously been classified using the broader categorisation scheme in the respective technical reports for those projects, and this classification was retained for consistency. The relationship between these classification schemes is presented in **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR.**

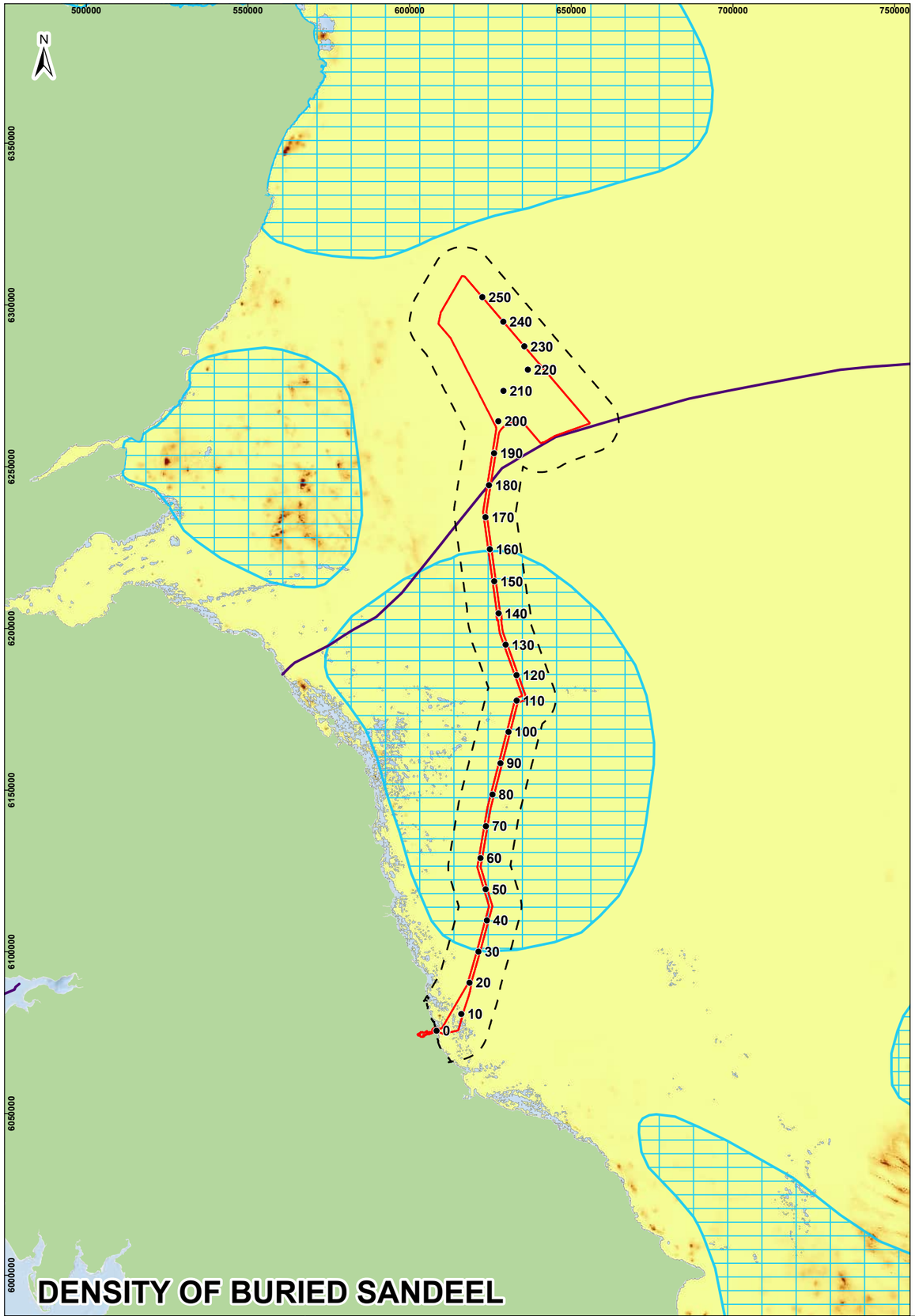
4.4.5.18 In Scottish waters, categorised PSA data from the MHPGC Project-specific surveys identified limited areas of habitat suitable for sandeel. No prime or sub-prime supporting habitat was identified within the MHPGC Project PEIR Red Line Boundary (**Figure 4.15**). Similarly, PSA data from the Morven North and Morven South surveys indicated that the majority of sampled sediments within the respective project boundaries and wider study areas were classified as marginal sandeel supporting habitat, with only isolated occurrences of preferred habitat identified (Tetra Tech RPS Energy, 2026). However, BGS PSA data indicated the presence of prime supporting habitat within the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area. In English waters, the MHPGC Project PEIR Red Line Boundary was similarly dominated by unsuitable supporting habitat, although isolated occurrences of sub-prime and suitable habitat were identified within the northern section of the Fish and Shellfish Ecology Study Area. No prime habitat was recorded. Although BGS (2015) PSA data indicated the presence of prime spawning habitat within the northern section of the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area.

4.4.5.19 The regional EMODnet seabed substrate and OneBenthic PSA datasets broadly supported these findings, identifying areas of preferred supporting habitat within Scottish waters and the northern section of English waters. Compared with the MHPGC Project PEIR Red Line Boundary, Morven North and Morven South datasets, the regional datasets indicated a more extensive distribution of preferred supporting habitat. This difference is likely attributable to the broader spatial scale and modelling approaches underpinning the regional datasets, which may not fully capture local-scale variability in sediment characteristics.

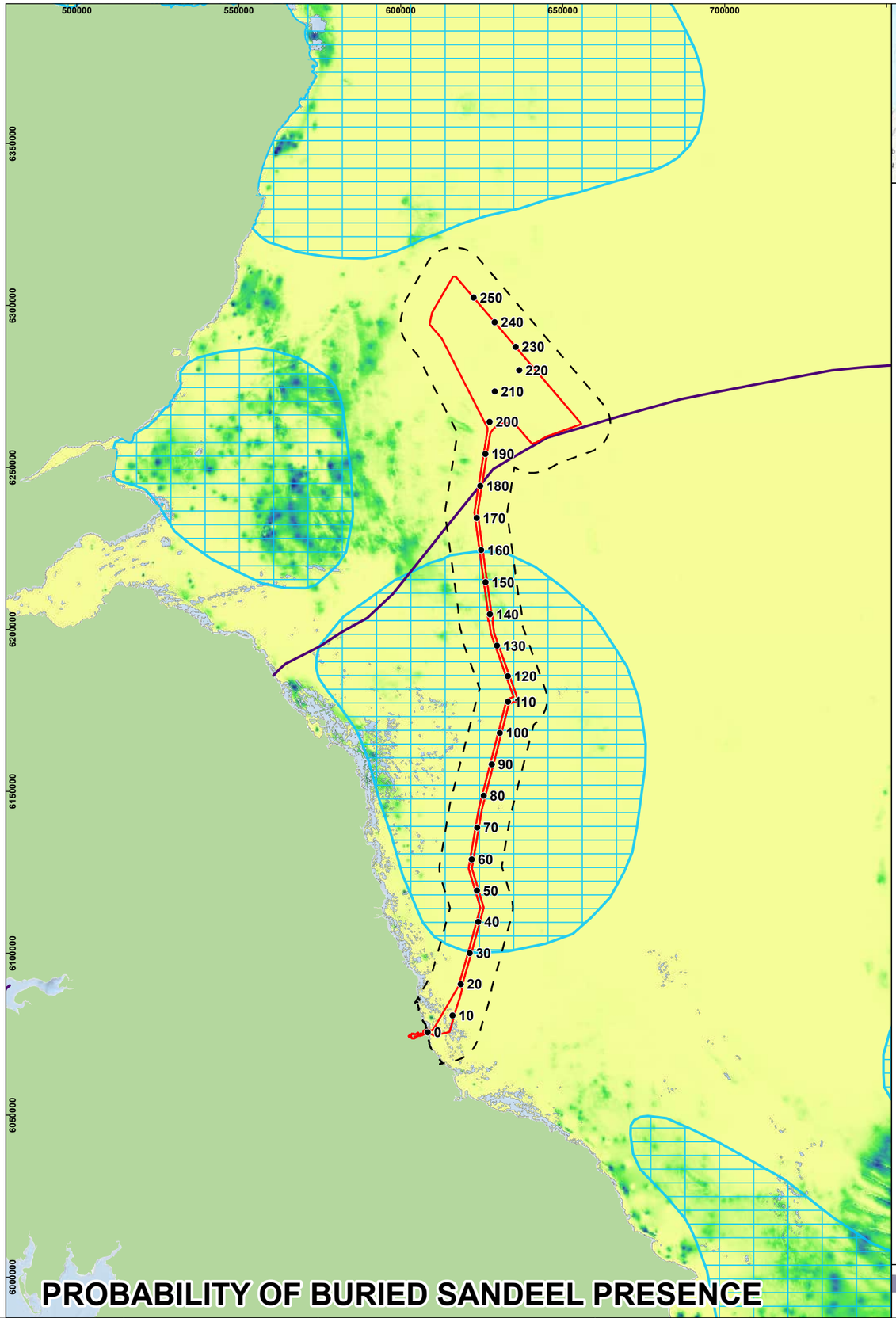
4.4.5.20 To further assess spawning habitat suitability, modelled buried sandeel density and probability of occurrence data were considered (Langton *et al.*, 2021). Similar to the MHPGC Project PEIR Red Line Boundary, Morven North and Morven South datasets, these data indicate that sandeel are largely absent from the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area, with only limited evidence of localised occurrence within these boundaries both Scottish and English waters, particularly in areas where mapped spawning grounds overlap in English waters (**Figure 4.14**). OneBenthic sandeel presence records (Cefas, 2024b) similarly indicate limited evidence of sandeel occurrence within the Fish and Shellfish Ecology Study Area.

4.4.5.21 Additionally, suitable areas for spawning have been identified using a heatmapping methodology outlined by Reach *et al.* (2024) (as adapted from Latto *et al.* (2013)). The heatmap is informed by EMODnet seabed substrate data (EMODnet, 2018), spawning ground data (Coull *et al.*, 1998), fishing activity data / VMS data (2007-2020) (MMO, 2020), sandeel fishing grounds (Wright *et al.*, 2019) and OneBenthic sandeel presence (Cefas, 2024b). The greater the number of overlapping data layers the greater the 'heat' mapped. Areas of higher 'heat' therefore indicate a higher confidence that the seabed may be suitable supporting habitat for sandeel.

4.4.5.22 The heatmapping assessment indicates that confidence in sandeel spawning potential is largely driven by the distribution of suitable sandy sediments and areas identified as supporting sandeel populations. Consistent with the habitat suitability and ground-truthing assessments, the results indicate that suitable sandeel habitat occurs only in localised areas, with the majority of the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, characterised by limited evidence of contemporary sandeel presence and spawning activity.



DENSITY OF BURIED SANDEEL



PROBABILITY OF BURIED SANDEEL PRESENCE



LEGEND

- Kilometer Point (KP)
- Scottish/English Offshore Waters Boundary
- MHPGC Project PEIR Red Line Boundary
- Fish and Shellfish Ecology Study Area

Spawning Grounds (Coull *et al.*, 1998) Intensity

- Undetermined

Density of Buried Sandeel

- 0 per sq m
- 120 per sq m or greater

Probability of Buried Sandeel Presence

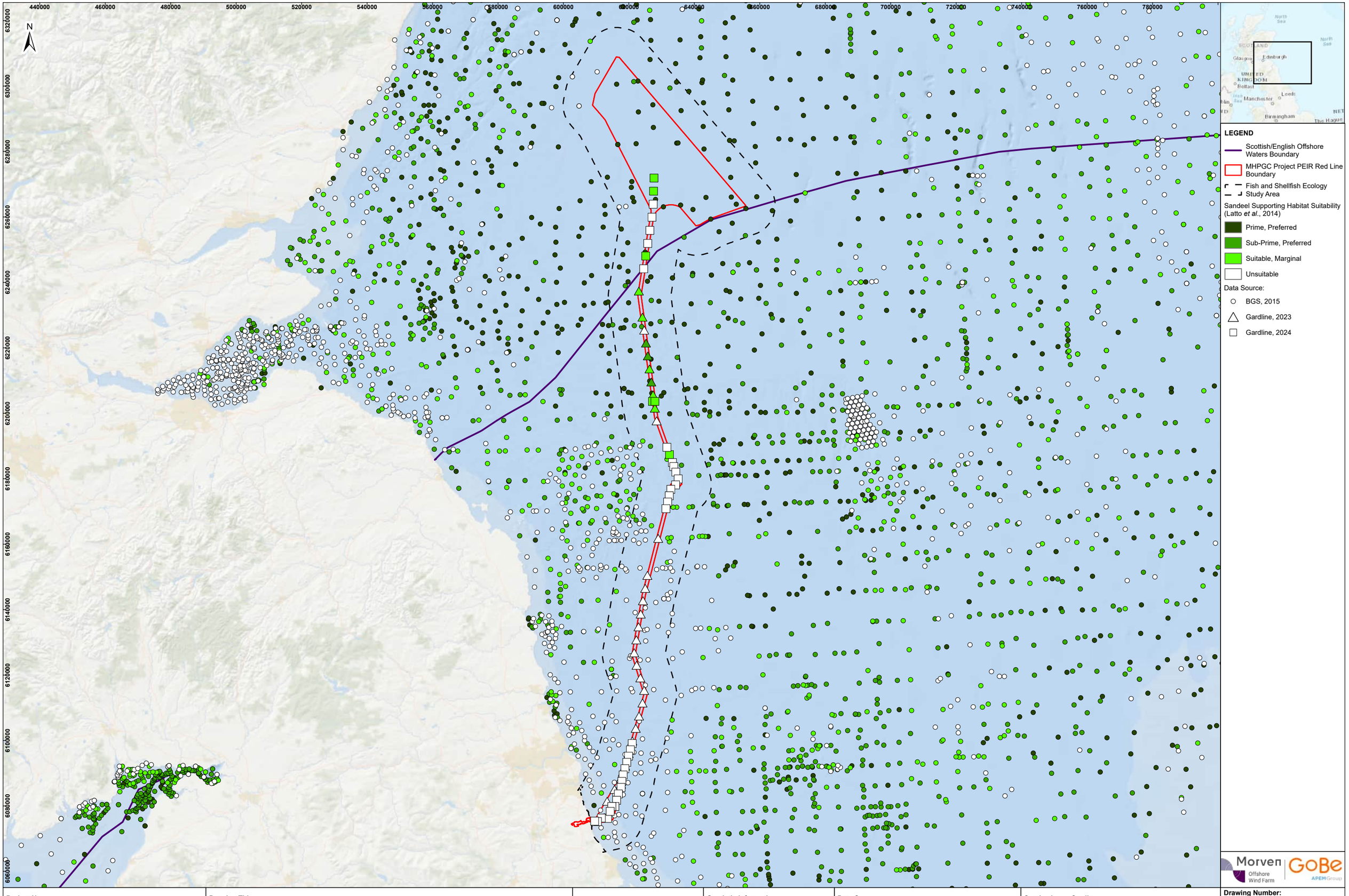
- 0 (Less Probable)
- 1 (More Probable)

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Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** DENSITY AND PROBABILITY OF PRESENCE OF BURIED SANDEEL IN THE FISH AND SHELLFISH ECOLOGY STUDY AREA (LANGTON *ET AL.*, 2021)	0 10 20 30 km Scale@A31:1,500,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

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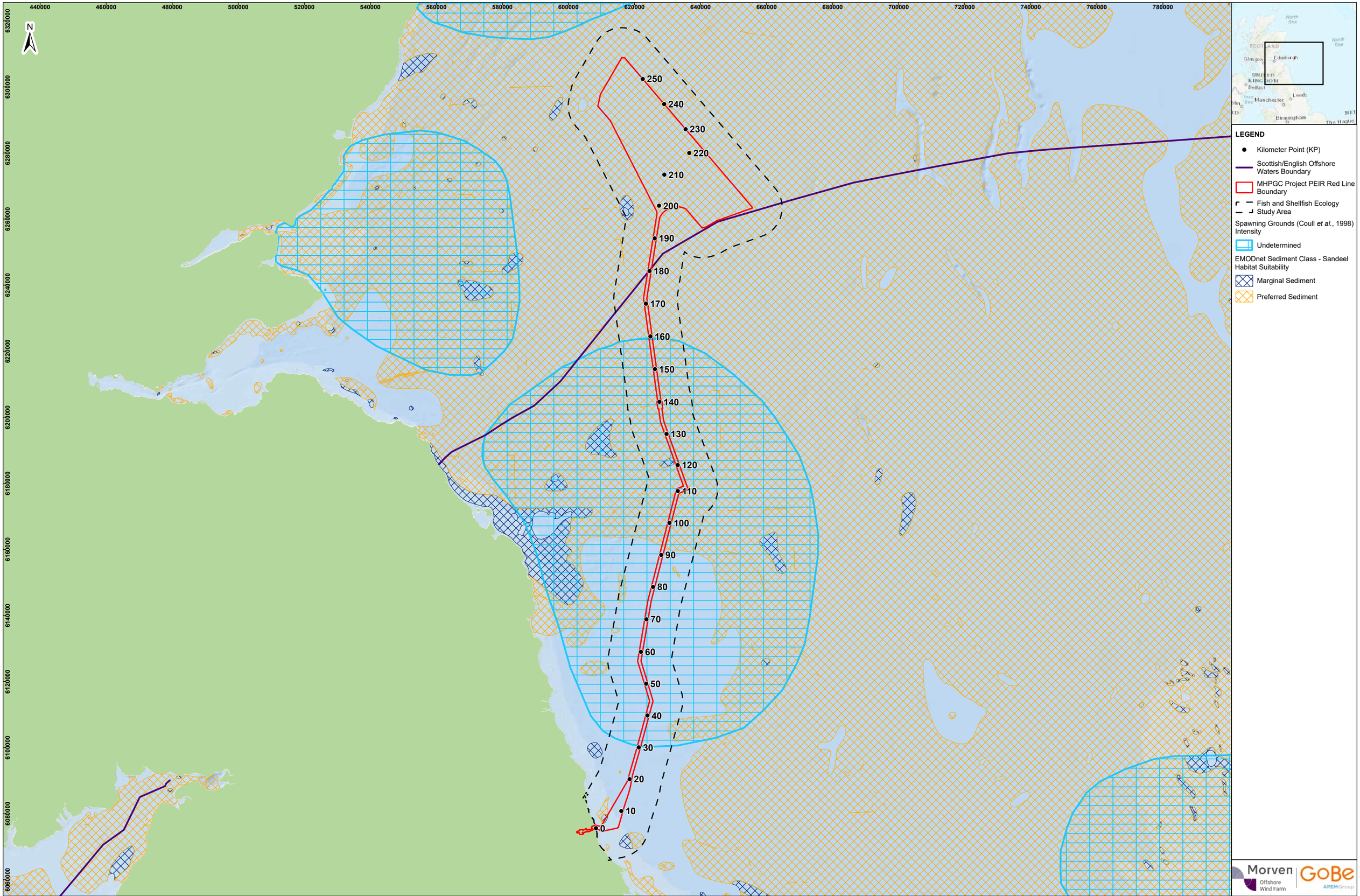


Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** SANDEEL SUPPORTING HABITAT SUITABILITY BASED ON THE SITE-SPECIFIC BENTHIC SURVEY RESULTS (GARDLINE, 2024A; 2025A) AND BGS DATA (2015)	0 5 10 15 20 25 km Scale@A31:1,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Ocean Base: OceanWise, Esri, Garmin, NaturalVue World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS

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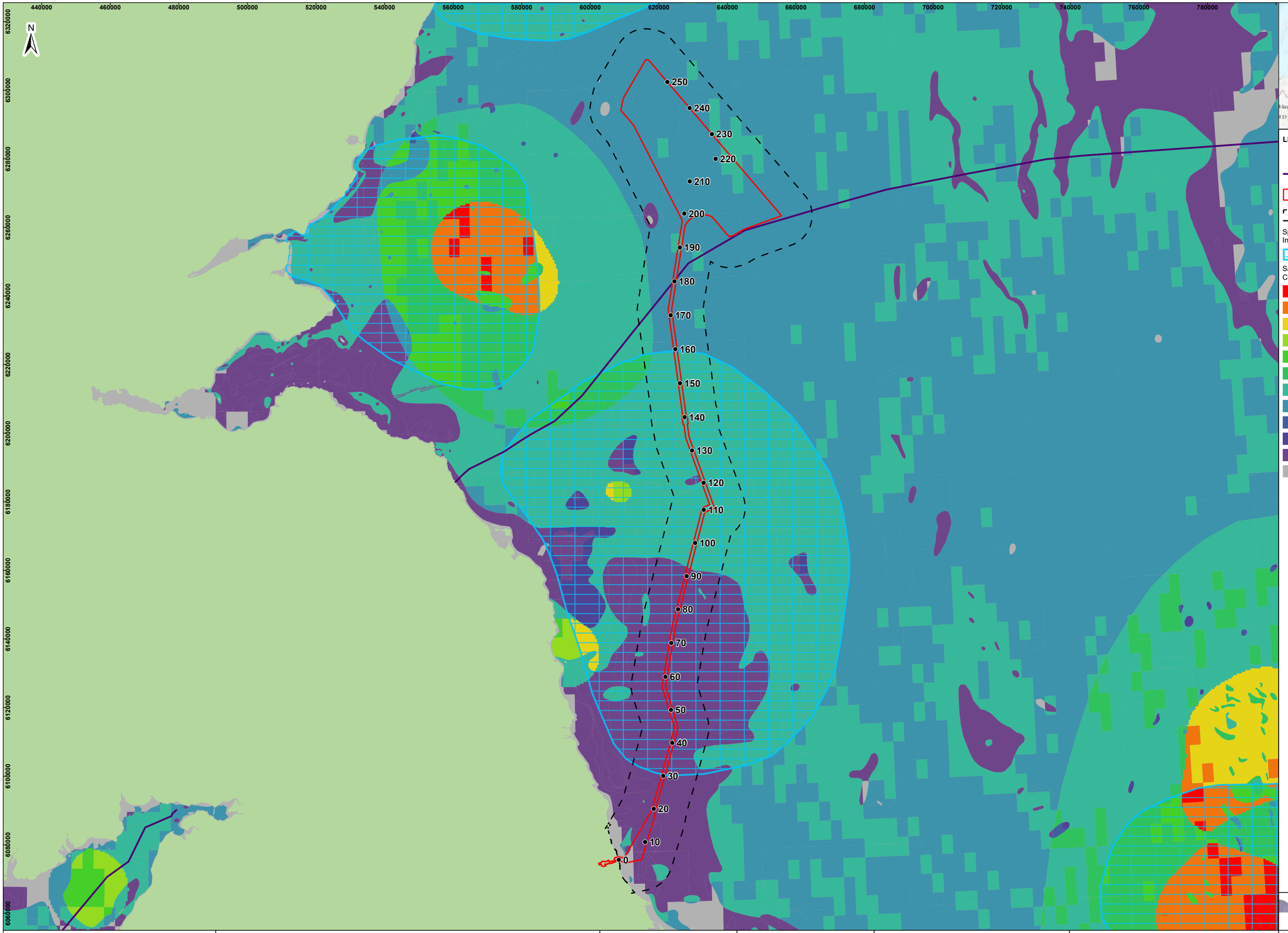
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Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** INDICATIVE SANDEEL SUPPORTING HABITAT (EMODNET, 2018)	0 5 10 15 20 25 km Scale@A3:1,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Ocean Base: OceanWise, Esri, Garmin, NaturalVue World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS	**Drawing Number:** FIGURE 4-16

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Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** SANDEEL SUPPORTING HABITAT CONFIDENCE HEATMAP	0 5 10 15 20 25 km Scale@A31:1,000,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue	**Drawing Number:** FIGURE 4-17

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Species

4.4.6 Species of commercial importance

4.4.6.1 Detailed information on species of commercial importance is provided in **Volume 2, Chapter 7: Commercial Fisheries, of the PEIR**. Commercial fisheries landings within the Local Commercial Fisheries Study Area, (defined as the ICES statistical rectangles (approximately 55 km × 55 km) that overlap the MHPGC Project PEIR Red Line Boundary and surrounding waters, including the Fish and Shellfish Ecology Study Area), indicate that shellfish species dominate the fishery, with *Nephrops*, European lobster, edible crab and king scallop representing the key commercially important shellfish species. Among finfish, herring, haddock and whiting, contribute to commercial landings.

4.4.7 Designated Sites

4.4.7.1 European designated sites (i.e. SACs) and nationally designated sites (i.e. MPAs and MCZs) with relevant qualifying features (i.e. Fish and Shellfish species) which overlap with the Fish and Shellfish Ecology Study Area are listed in **Table 4.10** and illustrated in **Figure 4.18**.

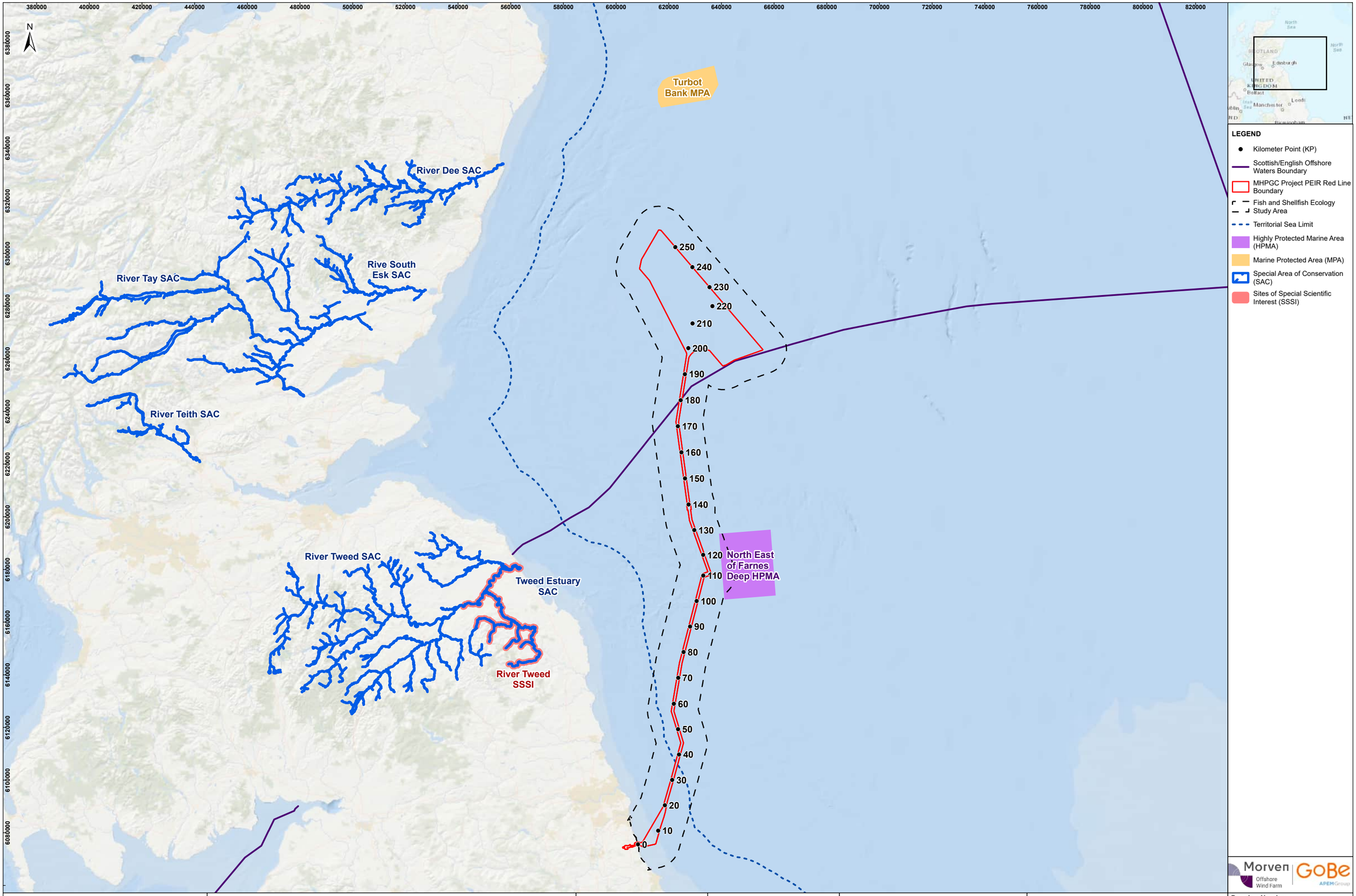
4.4.7.2 There are no sites designated for the protection of named Fish and Shellfish features that overlap with the MHPGC Project PEIR Red Line Boundary (ocean quahog, a shellfish feature of North East of Farnes Deep MCZ and Farnes East MCZ, is addressed in **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology, of the PEIR**). The nearest site is the Turbot Bank Marine MPA, located 38km to the north of the MHPGC Project PEIR Red Line Boundary in Scottish waters, outside of the Fish and Shellfish Ecology Study Area, which is designated for the protection of sandeel. Sites designated for the protection of mobile, migratory fish where connectivity may occur with the Fish and Shellfish Ecology Study Area include the River Dee SAC (57km), Tweed Estuary SAC (61km), River Tweed SAC and SSSI (66km), River South Esk SAC (81km), River Tay SAC (136km), Humber Estuary SAC (164km), and River Teith SAC (198km).

4.4.7.3 A full screening of European sites (i.e. SACs) with qualifying Fish and Shellfish features has been undertaken as part of the HRA process (see **MHPGC Project Habitats Regulations Appraisal/Habitats Regulations Assessment Report to Inform Appropriate Assessment (RIAA), prepared to accompany the PEIR**). The assessment of European sites and the potential for impacts to site(s) conservation objectives will be undertaken in the RIAA. A detailed MPA/MCZ and HPMA assessment will be provided to support the DCO application and Scottish Marine Licence Application(s). A document outlining the approach to the MPA/MCZ and HPMA assessment is provided within **Approach to Marine Protected Area/Marine Conservation Zone and Highly Protected Marine Area Assessments, prepared to accompany the PEIR**.

Table 4.10: Summary of designated sites with relevant Fish and Shellfish features with potential connectivity with the Fish and Shellfish Ecology Study Area and their distances to the MHPGC Project PEIR Red Line Boundary

Designated Site	Distance to the MHPGC Project PEIR Red Line Boundary (km)	Features
Scottish sites		
Turbot Bank MPA	38	Sandeels
River Dee SAC	57	Atlantic salmon, freshwater pearl mussel
River Tweed SAC and SSSI	66	Atlantic salmon, sea lamprey, river lamprey
River South Esk SAC	81	Atlantic salmon, freshwater pearl mussel
River Tay SAC	136	Atlantic salmon, sea lamprey, river lamprey
River Teith SAC	198	Atlantic salmon, sea lamprey, river lamprey
English sites		

Designated Site	Distance to the MHPGC Project PEIR Red Line Boundary (km)	Features
North East of Farnes Deep HPMA (UKEHPMA001)	4.1	The marine ecosystem of the area (includes the seabed, water column and sea surface and everything living within).
Tweed Estuary SAC (extends between English and Scottish waters)	61	Sea lamprey, river lamprey



Project Name: MORVEN HAWTHORN PIT GRID CONNECTION PROJECT	**Drawing Title:** DESIGNATED PROTECTED AREAS IN RELATION TO THE FISH AND SHELLFISH ECOLOGY STUDY AREA	0 10 20 30 km Scale@A31:1,250,000	**Geodetic Information:** Datum: European 1950 Projection: ED 1950 UTM Zone 30N	**Data Sources:** BP, Ordnance Survey	**Service Layer Credits:** World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue	**Drawing Number:** FIGURE 4-18

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4.4.8 Valued Ecological Receptors

4.4.8.1 The value of ecological features is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM, 2018). VERs have been identified based on their conservation status, ecological importance, legal protection, and functional role within the Fish and Shellfish Ecology Study Area. This includes consideration of Fish and Shellfish receptors recognised through relevant international and national legislation, biodiversity strategies, conservation priorities and as qualifying features of Designated Sites (see **Table 4.10**). Fish and Shellfish VERs identified within the Fish and Shellfish Ecology Study Area include species of conservation or commercial importance, together with species whose spawning and/or nursery grounds overlap the Fish and Shellfish Ecology Study Area, or those that have the potential to transit the area during migration. The identified VERs are presented in **Table 4.11** which includes their IUCN Red List (2024) and the OSPAR List of Threatened and/or Declining Species status.

4.4.8.2 In Scottish waters, many of the VERs are also recognised as Scottish Priority Marine Features (PMFs) (JNCC, 2012; Tyler-Walters *et al*., 2016) which identify species (and habitats) considered to be of conservation importance in Scotland's seas because they are threatened or declining, have a significant proportion of their population in Scottish waters, or perform an important ecological function. In English waters, Fish and Shellfish VERs also include Species of Principal Importance identified under Section 41 of the NERC Act 2006.

4.4.8.3 Key commercially important species are also considered VERs. These are species which support commercial fisheries within the Fish and Shellfish Ecology Study Area or the wider North Sea (see **Volume 2, Chapter 7: Commercial Fisheries, of the PEIR** for further information).

Table 4.11: Fish and Shellfish VERs known to occur within the Fish and Shellfish Ecology Study Area and associated conservation and commercial importance

Common Name	Species Name	PMF	UK Post-2010 Biodiversity Framework Priority Species	Section 41 NERC Act 2006: Species of Principal Importance (England)	IUCN Red List*	OSPAR Threatened /Declining List	Commercial Importance	Overlap with Spawning Grounds	Overlap with Nursery Grounds
Demersal spawners									
Herring	*Clupea harengus*	✓	✓	✓	LC		✓	✓	✓
Sandeel	*Ammodytidae*	✓	✓	✓	LC			✓	✓
All other fish receptors									
Mackerel	*Scomber scombrus*	✓	✓	✓	LC				✓
Horse Mackerel	*Trachurus trachurus*	✓	✓	✓	VU				
Sprat	*Sprattus sprattus*	✓			LC			✓	✓
Whiting	*Merlangius merlangus*	✓			LC		✓	✓	✓
Blue whiting	*Micromesistius poutassou*	✓	✓	✓	LC				✓
Atlantic cod	*Gadus morhua*	✓	✓	✓	VU	✓		✓	✓
Lemon sole	*Microstomus kitt*	✓			LC			✓	✓
Ling	*Molva molva*	✓			NT				✓
Saithe	*Pollachius virens*	✓			LC				
European Plaice	*Pleuronectes platessa*	✓			LC			✓	✓
Haddock	*Melanogrammus aeglefinus*	✓			NT		✓		
European hake	*Merluccius merluccius*		✓	✓	LC				✓
Anglerfish	*Lophius piscatorius*		✓	✓	LC				✓

Common Name	Species Name	PMF	UK Post-2010 Biodiversity Framework Priority Species	Section 41 NERC Act 2006: Species of Principal Importance (England)	IUCN Red List*	OSPAR Threatened /Declining List	Commercial Importance	Overlap with Spawning Grounds	Overlap with Nursery Grounds
Norway pout	*Trisopterus esmarkii*	✓	✓		LC			✓	✓
Elasmobranchs									
Thornback ray	*Raja clavata*	✓	✓		NT	✓			
Spotted ray	*Raja montagui*	✓			LC	✓			✓
Cuckoo ray	*Amblyraja radiata*	✓			LC				
Thorny skate	*Amblyraja radiata*	✓			NT	✓			
Lesser spotted dogfish	*Scyliorhinus canicula*	✓			LC				
Spurdog	*Squalus acanthias*	✓	✓	✓	EN				✓
Tope	*Galeorhinus galeus*	✓	✓	✓	CR	✓			✓
Common smooth hound	*Mustelus mustelus*	✓			VU				
Basking shark	*Cetorhinus maximus*	✓	✓		EN	✓			
Common skate	*Dipturus batis*	✓	✓	✓	CR				✓
Flapper skate	*Dipturus intermedius*	✓	✓	✓	CR	✓			✓
Diadromous species									
Atlantic salmon	*Salmo salar*	✓	✓	✓	VU	✓			
European eel	*Anguilla Anguilla*	✓	✓	✓	CR	✓			

Common Name	Species Name	PMF	UK Post-2010 Biodiversity Framework Priority Species	Section 41 NERC Act 2006: Species of Principal Importance (England)	IUCN Red List*	OSPAR Threatened /Declining List	Commercial Importance	Overlap with Spawning Grounds	Overlap with Nursery Grounds
Brown trout (Sea trout)	*Salmo trutta trutta*	✓	✓	✓	LC	✓			
River lamprey	*Lampetra fluviatilis*	✓	✓	✓	LC				
Sea lamprey	*Petromyzon marinus*	✓	✓	✓	LC				
Allis shad	*Alosa alosa*	✓	✓	✓	CR	✓			
Twait shad	*Alosa fallax*	✓	✓	✓	NT	✓			
Shellfish									
Edible crab	*Cancer pagurus*	✓†			NE		✓		
European lobster	*Homarus gammarus*	✓†			LC		✓		
Nephrops	*Nephrops norvegicus*	✓†			LC		✓	✓	✓
King scallop	*Pecten maximus*				LC		✓		
Freshwater Pearl Mussel	*Margaritifera margaritifera*		✓	✓	EN				

**NE: Not Evaluated, NA: Not Applicable, DD: Data Deficient, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, RE: Regionally Extinct, EW: Extinct in the Wild, EX: Extinct*

†PMF component that is strongly associated with a PMF habitat.

4.4.9 Future baseline conditions

4.4.9.1 During the 35-year operational lifetime of the MHPGC Project, the Fish and Shellfish ecology baseline can be expected to evolve both on a natural basis and in response to global trends such as climate change and other anthropogenic activities. The Infrastructure Planning (EIA) Regulations 2017, the Marine Works (Environmental Impact Assessment) Regulations 2007 and the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 require that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included. Therefore, an assessment of future baseline conditions, in the absence of the MHPGC Project, has been undertaken and is described within this section.

4.4.9.2 Fish and Shellfish species in the western North Sea are strongly influenced by both environmental variability and commercial fishing activities. Historically, population sizes and species distributions have fluctuated in response to climatic changes and levels of fisheries exploitation, highlighting their dynamic nature.

4.4.9.3 The North Sea is also experiencing increasing human activity, with the expansion of offshore infrastructure such as wind farms and subsea cables. As these industries continue to grow over the coming decades, the baseline environment for Fish and Shellfish species is likely to evolve, potentially altering habitats, movement patterns, and local population dynamics.

4.4.9.4 Fisheries management strategies and regulations may also shift in response to changing environmental and industrial conditions. Possible changes could include adjustments to catch quotas, the designation of regional fisheries zones, or the identification of new areas of commercial importance, all of which may influence species distribution and abundance. For example, in March 2024, a prohibition was announced for commercial sandeel fishing in Scottish and English waters of the North Sea.

4.4.9.5 Environmental variation from climate change may further drive changes in life history traits, including shifts in spawning and migration timing, or alterations in preferred habitats. For instance, rising sea surface temperatures could lead some species to move further offshore in search of cooler waters during critical stages of their life cycle, resulting in a redistribution of populations across the North Sea.

4.4.9.6 Considering the above factors, the populations and ranges of the species discussed are likely to change within the 35-year operational lifetime of the MHPGC Project.

4.5 Impact assessment methodology

4.5.1 Overview

4.5.1.1 The overarching approach for the impact assessment in the PEIR is set out in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR.** However, consideration has also been given to CIEEM guidelines for ecological assessment in the UK (CIEEM, 2024), which allows for professional judgement in determining the significance of an effect. This section describes the technical methods used to determine the magnitude of impacts and sensitivity of the receptors and sets out the significance criteria that have been used for the Fish and Shellfish ecology assessment.

4.5.1.2 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign the magnitude of potential impacts and values to the sensitivity of receptors.

4.5.2 Magnitude of impact

4.5.2.1 The magnitude of an impact is influenced by several key factors, including the scale of the change, the spatial extent the impact is likely to occur and the duration, frequency and reversibility of the impact.

4.5.2.2 Fish and Shellfish behaviour and response to impact vary widely depending on their life history traits. Many benthic species such as shellfish, are slow-moving or sessile organisms, and thus avoidance of the impact may not be possible, so the effect from a single activity will vary. Similarly, demersal spawning fish species that exhibit substrate-dependent spawning behaviours may have limited ability to avoid impacts.

4.5.2.3 When defining the magnitude of the impact, criteria detailed in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR** has been followed (see **Table 4.12**).

Table 4.12: Definition of terms relating to the magnitude of an impact

Magnitude	Definition
High	Impact would lead to large scale effects on the distribution of habitats and species, with sufficient severity to affect the long-term viability of the population over a generational scale.
Medium	Impact would lead to temporary changes in distribution of habitat and/or species with the potential for reduced population sizes, but not at a scale which would affect the population trajectory over generations. Impact would lead to permanent effects on individuals that may influence individual survival but not at a level that would alter population trajectory over a generational scale.
Low	Impact would result in some measurable change in attributes, quality or vulnerability (e.g. minor population disturbance), minor loss of habitat, or detrimental alteration to species at an individual level but is unlikely to be measurable at a population level.
Negligible	Impact would result in a very minor, temporary loss or detrimental alteration to habitat or individuals which would not affect the population.

4.5.3 Receptor sensitivity

4.5.3.1 Sensitivity is determined in accordance with the criteria set out in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR**. Sensitivity is defined through consideration of the receptor's vulnerability to the relevant impact, including its resistance, resilience and capacity for recovery, together with its importance at an international, national or local scale.

4.5.3.2 To support the assessment of Fish and Shellfish ecology receptors, published sensitivity assessments were reviewed where available, including the FeAST assessments (NatureScot, 2026) and Marine Evidence-based Sensitivity Assessment (MarESA) sensitivity assessments (MarLIN, 2026). These assessments consider receptor tolerance to specific pressures and the ability to recover following disturbance. The evidence base was further supplemented by peer-reviewed literature, relevant supporting studies, and findings from the PrePARED project. This information was used to inform the sensitivity assessments presented herein, together with professional judgement and the broad sensitivity definitions provided in **Table 4.13**.

Table 4.13: Definition of terms relating to the sensitivity of the receptor

Sensitivity	Definition
Very high	Effect is very likely to cause a large-scale permanent change in habitat or species population structure and/or survival, with no ability to adapt behaviours. No ability for the habitat or animal to recover from the effect – permanent damage with no resilience. Where adverse effects to multiple key ecological functions for fish or shellfish species (e.g. feeding, burrowing etc) could occur with no potential for recovery. Species which are a protected feature of an SAC in the Fish and Shellfish Ecology Study Area (i.e. very high value).
High	Limited ability to adapt behaviour and/or limited ability for the habitat or animal to recover; effect may cause a change in both habitat/species population structure and survival of individuals. Habitat or species may not recover or may take several years to return to baseline conditions. Where adverse effects on multiple key ecological functions (e.g. feeding, burrowing etc) could occur with limited potential for recovery. Fish species which are a protected feature of an MPA/MCZ in the Fish and Shellfish Ecology Study Area or represent supporting habitat for a SPA (i.e. high value).
Medium	Ability to adapt behaviour or exhibit some resilience; habitat/species population may be affected but survival rates not likely to be affected. Habitat likely to recover but over a longer period. Where adverse effects on one or more key ecological functions (e.g. feeding, burrowing) could be sustained beyond the duration of the impact, but not at a level that would affect individual survival. Fish species which are of conservation importance (e.g. Annex II) but are not a qualifying feature of a designated site (i.e. medium value) within the Fish and Shellfish Ecology Study Area.
Low	Ability to adapt behaviour and/or tolerate the effect without any impact on habitat/species population and survival rates. Habitat likely to recover rapidly with minimal long-lasting change i.e. highly dynamic environment which is regularly subject to changing environmental conditions. Low sensitivity is such that adverse effects on ecological functions (e.g. feeding, burrowing etc) are likely to be very short-term and would not affect individual survival. Species that are limited in extent/distribution and are not subject to any protected status (i.e. low value).
Negligible	Very little or no effect on existing Fish and Shellfish species. Species that are very common and widespread and not subject to any marine conservation status.

4.5.4 Significance of effect

4.5.4.1 The matrix used for the assessment of significance is shown in **Table 4.14.** The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect. For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse or beneficial. Any effect that has a significance of minor or negligible is not considered to be significant in EIA terms.

Table 4.14: Matrix used for the assessment of the significance of the effect

Sensitivity of receptor	Magnitude of impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible (Not significant)	Negligible or minor (Not significant)	Negligible or minor (Not significant)	Minor (Not significant)
Low	Negligible or minor (Not significant)	Negligible or minor (Not significant)	Minor (Not significant)	Minor or moderate (Not significant or significant)
Medium	Negligible or minor (Not significant)	Minor (Not significant)	Moderate (Significant)	Moderate or major (Significant)
High	Minor (Not significant)	Minor or moderate (Not significant or significant)	Moderate or major (Significant)	Major (Significant)
Very high	Minor (Not significant)	Moderate or major (Significant)	Major (Significant)	Major (Significant)

4.5.5 Assessment limitations and assumptions

4.5.5.1 Data limitations and assumptions relating to the characterisation of the baseline environment are described in **Section 4.4**. The assessment has been undertaken with regards to those limitations and assumptions.

4.5.5.2 The assessment has assumed that the offshore cables could be placed anywhere within the MHPGC Project PEIR Red Line Boundary, seaward of the landfall. Consequently, all habitats and species occurring within the Fish and Shellfish Ecology Study Area, including receptors of conservation importance in both Scottish and English waters, have been considered in the assessment.

4.5.5.3 Further to this, species sensitivity assessments undertake for this assessment are informed by published evidence including MarESA and FeAST sensitivity assessments, and peer reviewed literature. Published sensitivity assessments consider receptor tolerance to specific pressures and the ability to recover following disturbance; however, these assessments are not site-specific, and sensitivity may vary according to species-specific life history traits, behavioural responses, habitat associations, and local environmental conditions. Consequently, published sensitivities have been used as a line of evidence to inform professional judgement when assigning sensitivities to Fish and Shellfish ecology receptors within the MHPGC Project PEIR Red Line Boundary.

4.5.5.4 To account for this uncertainty and to ensure a precautionary assessment, where a range of sensitivities may apply to a receptor, the worst-case sensitivity has been adopted when determining the significance of effects.

4.5.5.5 Notwithstanding the limitations associated with published sensitivity evidence and the inherent uncertainties in ecological assessments, the available baseline data, habitat characterisation and evidence base are considered sufficiently robust to support the assessment findings and conclusions presented within this chapter.

4.6 Key parameters for assessment

4.6.1 Scope of the assessment

4.6.1.1 The approach to assessment was presented in the MHPGC Project Scoping Report and has been refined in consultation with relevant statutory and non-statutory consultees as detailed in **Section 4.3** and through the MHPGC Project Scoping Opinions received from the PINS and MD-LOT.

4.6.1.2 **Table 4.15** summarises the impacts considered as part of the assessment, while a summary of the effects scoped out of the assessment is presented in **Table 4.16**.

Table 4.15: Impacts scoped into the assessment

Impact	Phase			Potential effects scoped into the assessment
	Construction	O&M	Decommissioning	
Long term habitat loss	✗	✓	✓	Long term habitat loss effects occur during O&M phases once infrastructure has been placed on the seabed during construction and will remain in place for the lifetime of the MHPGC Project, and potentially following decommissioning. Construction activities are only considered to result in temporary habitat loss effects through sandwave levelling and cable trenching for example. Therefore, long term habitat loss is instead considered during O&M and decommissioning only. During decommissioning, it is possible that hard structures will be removed and therefore established species will be lost. However, previous habitat would be reinstated.
Temporary habitat loss and disturbance	✓	✓	✓	Temporary habitat loss and/or disturbance could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning.
Increased SSCs and associated deposition	✓	✓	✓	Increased SSCs and associated deposition could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning.
Disturbance/remobilisation of sediment bound contaminants	✓	✓	✓	Disturbance and/or remobilisation of sediment bound contaminants could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning.
Underwater sound (excluding UXO)	✓	✓	✓	Underwater sound (excluding UXO) could occur during all phases where noise-generating activities are present, including pre-installation surveys, vessel noise, construction noise, maintenance activities and removal of infrastructure during decommissioning.
Underwater sound from UXO clearance	✓	✗	✗	If UXO clearance is required, it will only occur during the construction phase of the MHPGC Project. Therefore, this is not considered for O&M or decommissioning phases.
Increased introduction and spread of INNS	✓	✓	✓	Increased risk of introduction and spread of INNS could occur throughout the MHPGC Project phases where vessels are used (i.e. transfer through ballast water and on hulls) and where hard structures are placed in otherwise soft sediment.
EMF from subsea electrical cabling	✗	✓	✗	Effects from EMF will only occur in the marine environment when the MHPGC Project is operational. Therefore, this is not considered for construction or decommissioning phases.

Impact	Phase			Potential effects scoped into the assessment
	Construction	O&M	Decommissioning	
Thermal emissions from operational cables	✗	✓	✗	Thermal emissions from the subsea electrical cables will only occur when the MHPGC Project is operational. Therefore, this is not considered for construction or decommissioning phases.
Colonisation of hard structures	✗	✓	✗	Hard structures may be colonised in the O&M phase following placement on the seabed during the construction phase. During decommissioning, the current MDS is to remove hard structures which would prevent further colonisation. If they are left in situ during decommissioning, any change would be considered negligible compared to the O&M phase.
Removal of hard substrates	✗	✗	✓	During decommissioning, the current MDS is to remove hard structures, the potential for effects to Fish and Shellfish from the loss of colonised hard substrates is therefore assessed during the decommissioning phase.

C = construction; O&M = operations and maintenance; D = decommissioning

Table 4.16: Impacts scoped out of the assessment

Impact	Phase			Justification for scoping out of the assessment
	C	O&M	D	
Accidental release of pollutants during construction, O&M, and decommissioning phases	✗	✗	✗	There is a risk of pollution being accidentally released during the construction, O&M and decommissioning phases of the MHPGC Project from sources including vessels/vehicles and equipment/machinery. However, the risk of such events is managed by the implementation of measures to be set out in the Outline OEMP (CoT06/MM-006) which will be submitted as part of the application for development consent and Marine Licence application(s) to the Scottish Ministers. The Outline OEMP will include an Outline MPCP (CoT37). These plans include measures for pollution prevention, emergency response and spill management, and address all potential contaminant releases, including the provision of emergency contact details. A detailed OEMP, including a detailed MPCP, will be developed post-consent in accordance with the Outline OEMP. These plans will also set out industry good practice and OSPAR, International Maritime Organisation and International Convention for the Prevention of Pollution from Ships (MARPOL) guidelines for preventing pollution at sea. Therefore, the likelihood of an accidental spill occurring is very low following the implementation of these plans and in the unlikely event that such an event did occur, the magnitude of any resulting effect will be reduced through measures outlined in the MPCP. No concerns regarding the proposed management approach and subsequent scoping out of this impact have been raised during consultation. As such, this impact is scoped out of further assessment. The Applicant has committed to undertaking a trenchless drilling installation method at landfall, between the offshore and onshore environment (CoT13). Landfall feasibility assessments have been undertaken for the proposed landfall options and concluded that both HDD and Direct Pipe installation methods are technically feasible at the preferred landfall locations (ARUP, 2025). Geological and geotechnical desk studies have also been completed for the nearshore landfall area (Fugro, 2024). No major feasibility constraints to the use of trenchless installation methods have been identified at the proposed landfall location. During HDD, there is the risk for frac-out of drilling fluid (inert) during the construction phase which could result in a decline in water quality in the intertidal and shallow water areas of the MHPGC Project PEIR Red Line Boundary. However, as detailed in **Volume 2, Chapter 1: Physical Processes, of the PEIR**, net transport at the landfall is southwards and any frac-out drilling muds, which are non-toxic, that cannot be captured, will be dispersed in subtidal waters. A review of the Fish and Shellfish baseline also indicates there are no protected habitats or Fish and Shellfish species present which could be affected by frac-out prior to dispersal. The risk of frac-out will be managed through the implementation of an Outline MPCP (CoT37) and a Bentonite Breakout Plan (CoT47). As such, this impact is scoped out of further assessment.

C = construction; O&M = operations and maintenance; D = decommissioning

4.6.2 Maximum design scenario

4.6.2.1 The MDS for each impact identified in **Section 4.6.1** has been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The MDS presented in **Table 4.17**. have been selected from the parameters provided in **Volume 1, Chapter 2: Project Description, of the PEIR** and methodology outlined in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR**.

Table 4.17: MDS relevant for the assessment of potential impacts on Fish and Shellfish ecology

Impact	Maximum Design Scenario	Explanation
Note: The cable length measurements are for the maximum distance between the OSP and trenchless drill exit pit unless otherwise stated. For clarity one trench length is as follows: • OSP to exit pit – up to 324.67km; • OSP to MHWS – up to 326.00km; • Scottish waters (OSP – Scottish-English offshore waters boundary) – up to 98km; • English waters (English offshore waters boundary – exit pit) – up to 226.67km; and • English waters (English offshore waters boundary – MHWS) – up to 228.00km.		
Construction		
Temporary habitat loss and disturbance	**Construction duration:** up to four years. **UXO Clearance:** • Up to 22 UXO require low order clearance; • Scottish waters: 8 (for funnel area out with overlap with Morven North and Morven South); • English waters: 14 **Pre-Lay Grapnel Run (PLGR):** Per trench = 3,246,700m² • Scottish waters: 98km length × 10m width = 980,000m² • English waters: 226.67km length × 10m width = 2,266,700m² Total (up to two trenches) = 6,493,400m² • Scottish waters: 1,960,000m² • English waters: 4,533,000m² **Boulder clearance:** Per trench = 1,380,000 m² • Scottish waters: 31km length × 20m width = 620,000m² • English waters: 38km length × 20m width = 760,000m² Total (up to two trenches) = 2,760,000m²	The MDS assumes the maximum footprint of construction phase activities that have the potential to cause temporary habitat loss or disturbance. **UXO clearance:** • Avoidance by micro-routing or relocation will be prioritised over clearance. Where clearance is required, low order detonation is the preferred clearance option. High order clearance detonation is included in the EIA on a precautionary basis only and is not proposed as part of the application for consent. Should low order clearance not be feasible, alternative clearance methods would be considered in consultation with regulators and clearance activities secured under a separate Marine Licence application as required. **Boulder clearance and PLGR:** • Route preparation activities include boulder and debris clearance and PLGR. • The width of temporary habitat loss or disturbance from route preparation activities, such as PLGR, ploughing/pre-lay trenching and rock carpet, is assumed to be encompassed within the seabed disturbance associated with cable installation.

Impact	Maximum Design Scenario	Explanation
	• Scottish waters: 1,240,000m² • English waters: 1,520,000m² **Sandwave clearance:** • Sandwave clearance activities undertaken using mass flow excavation (MFE) over an approximate four month duration; • Sediment disturbance rate is 1000kg/s • Surface width of up to 28m per trench and base width of up to 20m per trench; Per trench = 1,484,000m² • Scottish waters: 31km length × 28m width = 868,000m² • English waters: 22km length × 28m width = 616,000m² Total (up to two trenches) = 2,968,000m² • Scottish waters: 1,736,000m² • English waters: 1,232,000m² **Cable installation (trenching):** • Installation via trenching of up to 324.67km of cable, with a trench width of up to 2.1m and a depth of up to 3m; • Trenching rate is 400m/hr. Per trench = 2,045,421m³ • Scottish waters: 98km length × 2.1m width x 3m depth = 617,400m³ • English waters: 226.67km length × 2.1m width x 3m depth = 1,428,021m³ Total (up to two trenches) = 4,090,842m³ • Scottish waters: 1,234,800m³ • English waters: 2,856,042m³ **Trenchless techniques (landfall) (English waters):** • Up to four boreholes. Trenchless installation via Horizontal Directional Drilling (HDD), (conduit diameter	• Boulder and debris clearance is estimated to be required within the offshore export cable corridor and is therefore considered to be the MDS. **Sandwave:** • Sandwave clearance activities may be undertaken using a range of techniques (plough and MFE), over an approximate four-month duration in both Scottish and English waters. Releases via both are modelled; • A conservative MFE near-bed sediment release rate of 1000 kg/s conservatively estimated based on the MDS trench cross section dimensions, the speed of progress of the tool and the bulk density of the local sediment type; • Dredge spoil release is simulated as an instantaneous release at the water surface. 10% of 11,000m³ is assumed to form the passive phase of the plume; • Other seabed preparation such as sandwave clearance plough, boulder clearance and PLGR may be used but do not represent the MDS in terms of potential increases in SSC and associated deposition. **Cable installation:** • Trenching may be carried out by mechanical cutting, jet trenching, ploughing or Controlled Flow Excavation (CFE). Jet trenching is anticipated to generate the highest SSC and has therefore been assumed as the MDS; • Suspension of 100% of material from the trench cross section will give the MDS for sediment disturbance; • Conservatively assumes 100% fluidisation of material expelled from a U-shaped trench. In reality trenching will move a proportion of material rather than bringing it fully into suspension; • Offshore export cable corridor trenching modelling assumes sediment release along the whole offshore export cable corridor;

Impact	Maximum Design Scenario	Explanation
	of 1.6m, conduit length of 2,000m). Drilling fluid discharge up to 180m^3 each and up to 1,083m^3 total. • Trenchless drill punchout will be up to approximately 1660m offshore of MHWS in water depths up to 20m lowest astronomical tide (LAT). • Up to four exit pits (140m long × 50m wide x 5m deep). Area up to 7,000m² each; 28,000m² total. Volume up to 18,667m^3 each; 74,668m^3 total. • Up to two floatation pits (240m long × 55m wide x 5m deep). Area up to 13,200m² each; 26,400m² total. Volume up to 39,167m^3 each; 78,334m^3 total. **Vessel seabed interactions (English waters):** Total = 5,098,259m^2 • Up to 127,456m^2 anchor seabed disturbance per vessel movement x 40 full anchor spread movements = 5,098,240m^2 • Up to six jack-up events (2m diameter spud legs x 4), 3.14m^2 per events, total disturbance =18.85m².	• Cable routes cross a variety of seabed materials, and burial depth may be up to 3m in some areas. The assessment therefore considers this upper bound to define the MDS in terms of sediment disturbance; • Trenching rate will be up to 400m/hr. **Trenchless techniques (landfall):** • Trenchless installation methods include HDD and Direct Pipe; • HDD represents the maximum MDS for sediment disturbance due to the potential for drilling fluid release (frac-out); • The MDS for sediment disturbance by trenchless installation is given by applying a conservative Bentonite concentration of 100kg/m^3 in drilling mud, the volume of spoil released is equal to the maximum volume of the bore; • Other stages of drilling (pilot hole drilling and stages of reaming) may result in smaller release events separated in time. But the MDS is considered as a release of drilling mud from a single conduit; • Two drills could be operational at one time; however, the timing of drilling will be staggered meaning there will not be an occasion where punch-out occurs simultaneously (or within 6 hours of each other). • Trenchless drill punchout will be up to approximately 1,660m offshore of MHWS in water depths up to -20m LAT. **Vessel seabed interactions:** • Vessel activities associated with cable installation in English waters (e.g. anchoring and jack-up operations) may result in temporary, localised seabed disturbance at discrete locations. These impacts are short-term and restricted to the immediate footprint of vessel interactions with the seabed.

Impact	Maximum Design Scenario	Explanation
Increased SSCs and associated sediment deposition	**Construction duration:** up to four years. **Sandwave clearance:** • Sandwave clearance activities undertaken using MFE over an approximate four month duration; • Sediment disturbance rate is 1000kg/s • Surface width of up to 28m per trench and base width of up to 20m per trench; Per trench = 1,484,000m² • Scottish waters: 31km length × 28m width = 868,000m² • English waters: 22km length × 28m width = 616,000m² Total (up to two trenches) = 2,968,000m² • Scottish waters: 1,736,000m² • English waters: 1,232,000m² **Cable installation (trenching):** • Installation via trenching of up to 324.67km of cable, with a trench width of up to 2.1m and a depth of up to 3m; • Trenching rate is 400m/hr. Per trench = 2,045,421m³ • Scottish waters: 98km length × 2.1m width x 3m depth = 617,400m² • English waters: 226.67km length × 2.1m width x 3m depth = 1,428,021m² Total (up to two trenches) = 4,090,842m³ • Scottish waters: 1,234,800m³ • English waters: 2,856,042m³ **Trenchless techniques (landfall) (English waters):** • Up to four boreholes. Trenchless installation via HDD, (conduit diameter of 1.6m, conduit length of 2,000m). Drilling fluid discharge up to 180m³ each and up to 1,083m³ total.	The MDS is defined by the maximum spatial extent of seabed disturbance from cable installation, route preparation, sandwave clearance and landfall works. As SSC increases and sediment deposition are directly linked to the volume of seabed sediment disturbed, the maximum disturbance footprint also represents the worst-case scenario for increased SSC and sediment deposition. Similarly, landfall works and vessel interactions are defined by the maximum footprint of exit pits, floatation pits, anchor spreads and jack-up activities. The MDS is inherently precautionary, assuming all maximum parameters occur concurrently with no reduction for overlapping disturbance footprints. **Site preparation:** • Sandwave clearance activities may be undertaken using a range of techniques (plough and MFE), over an approximate four-month duration in both Scottish and English waters. Releases via both are modelled; • A conservative MFE near-bed sediment release rate of 1000kg/s conservatively estimated based on the MDS trench cross section dimensions, the speed of progress of the tool and the bulk density of the local sediment type; • Dredge spoil release is simulated as an instantaneous release at the water surface. 10% of 11,000m³ is assumed to form the passive phase of the plume; • Other seabed preparation such as sandwave clearance plough, boulder clearance and PLGR may be used but do not represent the MDS in terms of potential increases in SSC and associated deposition. **Cable installation:** • Trenching may be carried out by mechanical cutting, jet trenching, ploughing or CFE. Jet trenching is anticipated to generate the highest SSC because the trenching process relies on high-pressure water jets to mobilise and fluidise seabed sediments, increasing the

Impact	Maximum Design Scenario	Explanation
	• Trenchless drill punchout will be up to approximately 1660m offshore of MHWS in water depths up to 20m LAT. • Up to four exit pits (140m long × 50m wide x 5m deep). Area up to 7,000m² each; 28,000m² total. Volume up to 18,667m³ each; 74,668m³ total. • Up to two floatation pits (240m long × 55m wide x 5m deep). Area up to 13,200m² each; 26,400m² total. Volume up to 39,167m³ each; 78,334m³ total. • Trenchless drill exit pit protection: backfill, rock placement and mattress protection will be implemented. Maximum height above seabed of 0.35m with intention to restore to original seabed level.	proportion of sediment entrained into the water column and the potential extent of sediment plumes compared with alternative trenching techniques. Jet trenching has therefore been assumed as the MDS; • Suspension of 100% of material from the trench cross section will give the MDS for sediment disturbance; • Conservatively assumes 100% fluidisation of material expelled from a U-shaped trench. In reality trenching will move a proportion of material rather than bringing it fully into suspension; • Offshore export cable corridor trenching modelling assumes sediment release along the whole offshore export cable corridor; • Cable routes cross a variety of seabed materials, and burial depth may be up to 3m in some areas. The assessment therefore considers this upper bound to define the MDS in terms of sediment disturbance; • Trenching rate will be up to 400m/hr. **Trenchless techniques (landfall):** • Trenchless installation methods include HDD and Direct Pipe; • HDD represents the maximum MDS for sediment disturbance due to the potential for drilling fluid release (frac-out); • The MDS for sediment disturbance by trenchless installation is given by applying a conservative Bentonite concentration of 10 kg/m³ in drilling mud, the volume of spoil released is equal to the maximum volume of the bore; • Other stages of drilling (pilot hole drilling and stages of reaming) may result in smaller release events separated in time. But the MDS is considered as a release of drilling mud from a single conduit; • Two drills could be operational at one time; however, the timing of drilling will be staggered meaning there will not be an occasion where

Impact	Maximum Design Scenario	Explanation
		punch-out occurs simultaneously (or within 6 hours of each other). • Trenchless drill punchout will be up to approximately 1,660m offshore of MHWS in water depths up to -20m LAT.
Disturbance/remobilisation of sediment bound contaminants	The MDS is as described above for Increased SSCs and associated sediment deposition for the construction phase.	The justification, as described above, for increases to SSCs and associated sediment deposition during the construction phases.
Underwater sound from UXO clearance: mortality, injury, behavioural impacts and auditory masking	**Construction duration:** up to four years. **UXO Low Order Clearance:** • Low order clearance of up to 22 UXOs, • Scottish waters: 8 UXOs (for funnel area outwith overlap with Morven North and Morven South); • English waters: 14 UXOs. • Low order UXO clearance – Maximum size of donor charge: 0.08kg – Maximum charge configuration for low yield technique: 4 x 0.75kg	• The MDS assumes the maximum number of UXO requiring low order clearance. Due to uncertainties in UXO presence and characteristics prior to details survey, a precautionary approach has been adopted. • Low order clearance techniques are assumed as the worst-case scenario for the assessment, including the use of small clearance charges and low-yield configurations. The Applicant is seeking consent for low order clearance of UXO only. High order clearance has been included within this assessment for information and completeness only and does not form part of the consent application; should high order clearance subsequently be determined necessary, this will be secured under a separate Marine Licence application.
Underwater sound (excluding UXO): mortality, injury, behavioural impacts and auditory masking	Construction duration: up to four years. Pre-construction geophysical surveys: Operating frequency of equipment: • Multibeam echosounder: 200 to 400kHz; • Side scan sonar: 300 to 600kHz; • Single beam echosounder: 20 to 40kHz; • Sub bottom profilers: 0.2 to 14kHz (chirp), and 85 to 115kHz (high frequency);	• The MDS for underwater sound (excluding UXO) assumes all relevant sound-generating activities across the construction phase, including geophysical surveys, geotechnical surveys, cable installation activities and associated vessel movements. • Cable installation may be undertaken by mechanical cutting, jet trenching, ploughing or CFE (at localised points along the route where required). Route preparation and seabed preparation activities, including sandwave clearance (which may include MFE), boulder clearance and PLGR), are also assumed to occur. The

Impact	Maximum Design Scenario	Explanation
	• Ultra high resolution seismic (such as sparker): 0.05 to 4kHz; • USBL transponder: 21 to 31kHz; • Up to two survey vessels may be present on site at any one time. Pre-construction geotechnical surveys: • Seismic cone penetration tests (CPT) with a low frequency and low intensity sound source; and • Vibrocoring (VC) with operating frequency of 0.02 to 20kHz. Offshore vessel activity: • Up to 550 return trips by installation vessels (including Cable Lay Vessels (CLV), trenching support vessels (TSV), installation support vessel (ISV), guard vessels (GV), survey vessels, PLGR vessel, out of service cable removal vessel, boulder clearance vessel, dredging vessel, crew transport vessel (CTV), rock dumping vessel, construction support vessel, tug/anchor handler and cable barge); • A maximum of 33 vessels may be operational at any one time during the construction phase. Landfall vessel activity: • Up to 250 return trips by installation and support vessels (including CLV, ISV, GV, dredging vessels, tug/anchor handlers, cable barge, CTV and dive support vessels (DSV)); • A maximum of 14 vessels may be operational at any one time during the construction phase.	sound associated with the CLV vessel represents the MDS for these construction phase activities associated with the installation of the export cables. • A range of geophysical activities using equipment assumed to be typical for the types of surveys anticipated. Parameters have been selected to represent the highest source characteristics (e.g. operating frequencies, pulse rates and durations), thereby defining a precautionary worst-case scenario for sound generation. • The MDS assumes the maximum number of vessels on site at one time and the greatest number of vessel movements during these activities. This represents the broadest range of vessel types and therefore sound signatures which may impact fish or shellfish receptors.
Increased risk of introduction and spread of INNS	**Construction duration:** up to four years. **Offshore vessel activity:** • There will be up to 550 return trips by installation vessels (including CLV, TSV, ISV, GV, Survey Vessels, PLGR vessel, out of service cable removal vessel, boulder clearance vessel, dredging vessel, CTV, rock dumping vessel, construction support vessel, tug/anchor handler and cable barge);	The MDS assumes the maximum number of vessels and return journeys during the construction phase. An increase in vessel numbers and activity within a defined area may elevate the risk of INNS introduction and spread, due to the potential for transfer via hull fouling and/or ballast water (where relevant). • The greatest number of vessels present during the construction phase and their associated vessel

Impact	Maximum Design Scenario	Explanation
	• A maximum of 33 vessels may be operational at any one time during the construction phase. **Landfall vessel activity:** • There will be up to 250 return trips by installation and support vessels (including CLV, ISV, GV, dredging vessels, tug/anchor handlers, cable barge, CTV and DSV); ○ A maximum of 14 vessels may be operational at any one time during the construction phase.	trips represents the MDS for the risk of the introduction and spread of INNS.
Operation and Maintenance		
Temporary habitat loss and disturbance	**O&M duration:** up to 35 years • Up to 41 export cable repairs, each with a length of up to 2km and a 20m width. Up to 40,000m^2 of temporary disturbance each; 1,640,000m^2 total; • Up to 4% of the cable route length, up to 13km, may require remediation per year. Remediation may occur in different locations and for varying lengths but it is anticipated that up to 13km of export cable length per year per trench will require remediation with a maximum width of 20m. Up to 522,240m^2 of temporary disturbance per year; total 18,278,400m^2	The MDS assumes the maximum habitat disturbance associated with cable repair and remediation activities that have the potential to cause temporary habitat loss or disturbance. • During such activities, works would be undertaken using methods similar to installation where required (e.g., excavation and reburial) with the intention of reinstating the seabed to its post-construction condition, such that disturbance is largely confined to areas previously affected by installation.
Increased SSCs and associated sediment deposition	• Operational life of 35 years; • Cable repairs (English and Scottish waters): • Up to 41 export cable repairs, each with a length of up to 2km and a 20m width. Up to 40,000m^2 of temporary disturbance each; 1,640,000m^2 total; • Up to 4% of the cable route length, up to 13km, may require remediation per year. Remediation may occur in different locations and for varying lengths but it is anticipated that up to 13km of export cable length per year per trench will require remediation with a maximum width of 20m. Up to 522,240m^2 of temporary disturbance per year; total 18,278,400m^2.	**Cable repairs (English and Scottish waters):** • The greatest foreseeable number of cable reburial and repair events is considered to be the MDS for sediment dispersion; • The majority of cable repairs are anticipated to be c.500-1000m. The MDS utilises the area of disturbance by repair which provides a highly conservative area; • The repair of cables may be undertaken using similar techniques to those employed during installation, therefore the potential increases in SSC and deposition would be in-line with the construction phase.

Impact	Maximum Design Scenario	Explanation
Disturbance/remobilisation of sediment bound contaminants	The MDS, as described above, for changes to SSC and associated deposition.	The justification, as described above, for changes to SSC and associated deposition.
Long-term habitat loss	**O&M duration:** up to 35 years **Cable protection (area of habitat loss / footprint):** Rock installation Per trench = 378, 980m^2 • 14m width x 27,070m length = 378,980m^2 Total (up to two trenches) = 757,960m^2 Cable Protection Systems (CPS): Per trench = 6,400m^2 • 0.8m width x 8,000m length = 6,400m^2 Total (up to two trenches) = 12,800m^2 Total Cable Protection (rock, rock bags and CPS) Per trench = 385,380m^2 Total (up to two trenches) = 770,760m^2 **Export cable crossings:** Total = 57,600m^2 • Up to 16 crossings • 200m length x 18m width = 3,600m^2 **Exit pit protection:** Rock installation Total = 28,000m^2 • Up to four exit pits 140m length x 50m width = 7,000m^2	• The MDS assumes the maximum footprint of O&M phase activities that have the potential to cause long-term habitat loss. Cable protection: • Cable protection will comprise rock installation, rock bag or concrete mattress. The cable protection type with the largest footprint (rock installation) represents the MDS for long-term habitat loss. • In addition, CPS will be installed. Export cable crossings: • Cable crossing footprint area values are based on the seabed coverage for rock berm design. Exit pit protection: • Exit pits will have external protection using a combination of rock installation, concrete mattresses or backfill of excavated material; • The value presented is therefore considered to be conservative of the disturbed footprint. • Up to 20 concrete mattresses will be used per exit pit resulting in a long-term habitat loss of up to 360m^2 per exit pit (1,440m^2 in total), however the area covered by concrete mattresses is within the footprint of rock installation so does not represent additional habitat loss.
Underwater sound (excluding unexploded ordnance): mortality, injury, behavioural impacts and auditory masking	**O&M duration:** up to 35 years • Up to 5 geophysical surveys proposed per year.	The MDS for underwater sound assumes all relevant sound-generating activities across the O&M phase, including geophysical surveys, and vessel movements for O&M purposes.

Impact	Maximum Design Scenario	Explanation
	• Geophysical equipment as detailed in the construction phase MDS. **Vessel presence:** Routine inspection (no remediation/repair) constitutes survey activity (survey vessel) up to 2 surveys per year per trench; duration 2 weeks per survey; 3 return trips per survey; 2 vessel max at 1 time per survey. **Per year for 2 trenches:** • Surveys – 4 • Return trip – 4x3 = 12 • Total vessels at time – 2 Routine inspection (no remediation/repair) constitutes survey activity (unmanned service vessel (USV) up to 2 surveys per year per trench; duration 6 weeks per survey; 110 return trips (up to 4 USV + 1 guard vessel with port call every 4 days) (55 per survey = 110); up to 4 USV + 1 guard vessel = 5 max at 1 time per survey. **Per year for 2 trenches:** • Surveys – 4 • Return trips – 4x55 = 220 • Total vessels at time – 5 • Remediation (up to 13.056km per year per trench, in different locations along route) **Vessels on site for remediation activities, for up to two trenches:** • Up to four operation and maintenance vessels on site at any one time, comprising a combination of construction support vessel (CSV) and/or Service Operation Vessels (SOV) and/or guard vessel and/or rock dump vessels and/or CTVs/workboats. **Vessel movements (remediation), for up to two trenches:** • Up to 62 operation and maintenance vessel movements (return trips) each year, consisting of CSV or SOV and/or guard vessel and/or rock dump vessels and/or CTVs/workboats.	

Impact	Maximum Design Scenario	Explanation
	• Repair (41 lifetime repairs, for up to two trenches) **Vessels on site for repair activities, for up to two trenches:** • Up to four operation and maintenance vessels on site at any one time, comprising a combination of CLV and/or barge and/or Barge Handlers/Tugs and/or Jack-Up and/or CSV and/or CTV and/or Rockdump. **Vessel movements (repair), for up to two trenches:** Up to 245 operation and maintenance vessel movements (return trips) over the operational lifetime (35yrs) consisting of CLV and/or barge and/or Jack-Up and/or Barge Handlers/Tugs and/or CSV and/or CTV and/or Rockdump.	
Electromagnetic Fields (EMF) from subsea electrical cabling	**O&M duration:** up to 35 years Export cables: • Up to two conductors of 320kV High Voltage Direct Current (HVDC), each of 326,670m in length; • Minimum burial depth of 0.5m; • Distance between trenches is up to 50m; • Maximum magnetic field strength of cable of 825.99µT **Cable protection:** • Total (rock installation + CPS) = 770,760m^2 (see MDS for long term habitat loss). **Cable crossings:** • Up to 16 crossings • 2m height Total footprint: 57,600m^2 (see MDS for long term habitat loss)	The MDS assumes the maximum length of cables across and the minimum burial depth, representing a conservative worst-case scenario for EMF exposure during the O&M phase. • **Volume 2, Annex 4.2: Marine EMF Assessment, of the PEIR** concludes that for a cable size of 2,000mm^2 and a burial depth of 0.5m, the measured magnetic flux density at the seabed is 192.42 microteslas (µT) for fully bundled cables, 414.06µT for cables separated by 25m and 825.99µT for a separated (single-cable) scenario with no magnetic field cancellation. At 1m above the seabed, these values reduce to 25.68µT, 149.89µT and 299.04µT, respectively. Although these values present the worst-case operational/installation scenarios, it is highly unlikely that these values will be present during operation. Cable protection and crossings may locally increase separation between the cable and the seabed, which would reduce exposure to EMF (and thermal emissions). As such, the highest field strengths are associated with minimum burial depth and absence of magnetic field cancellation, representing a conservative worst-case scenario that is unlikely to occur along the majority of the cable during operation.
Thermal emissions from operational cables	**O&M duration:** up to 35 years • Export cables:	The MDS assumes the maximum length of cables across and the minimum burial depth, resulting in impacts to demersal Fish and Shellfish receptors due to heating during the O&M phase.

Impact	Maximum Design Scenario	Explanation
	• Up to two conductors of 320kV HVDC, each of 326,670m in length; • Minimum burial depth of 0.5m; • Distance between trenches is up to 50m; • • Cable protection: • Total (rock installation + CPS) = 770,760m^2 (see MDS for long term habitat loss). • • Cable crossings: • Up to 16 crossings • 2m height • Total footprint: 57,600m^2 (see MDS for long term habitat loss)	
Colonisation of hard structures	**O&M duration:** • up to 35 years **Cable protection (surface area exposed to seawater):** • Rock installation ○ <u>Per trench = 487,316m^2</u> • Top surface: ○ 14m width x 27,070m length = 378,980m² • Side surfaces: ○ 2 × (27,070m length × 2m height) = 108,280m² ○ 2 × (14m width × 2m height) = 56m² • Total surface area (top + sides): ○ 378,980m^2 + 108,280m^2 + 56m^2 = 487,316m² • <u>Total (up to two trenches) = 974,632m²</u> • CPS: ○ <u>Per trench = 19,201m²</u>	**<u>O&M phase</u>** The MDS assumes the maximum surface area of structures exposed to the water column during O&M phase activities that have the potential to result in the colonisation of hard substrate. • For the purposes of this assessment, all structures are assumed to be regular rectangular forms, and surface areas are calculated based on simplified geometry to provide a consistent and precautionary estimate of exposed surface area.

Impact	Maximum Design Scenario	Explanation
	• Top surface: ○ 0.8m width × 8,000m length = 6,400m² • Side surfaces: ○ 2 × (8,000m length × 0.8m height) = 12,800m² ○ 2 × (0.8m width × 0.8m height) = 1.28m² • Total surface area (top + sides): ○ 6,400 + 12,800 + 1.28 = 19,201m² • Total (up to two trenches) = 38,402m² **Export cable crossings:** • Total = 71,552m² • Up to 16 crossings • Top surface (per crossing): ○ 200m length × 18m width = 3,600m² • Side surfaces (per crossing): ○ 2 × (200m length × 2m height) = 800m² ○ 2 × (18m width × 2m height) = 72m² • Total surface area (per crossing): ○ 3,600m² + 800m² + 72m² = 4,472m² **Exit pit protection:** • Total = 35,600m² • Rock installation • Up to four exit pits • Top surface (per pit): ○ 140m length × 50m width = 7,000m² ○ 2 × (140m length × 5m height) = 1,400m² ○ 2 × (50m width × 5m height) = 500m² • Total surface area (per pit): ○ 7,000m² + 1,400m² + 500m² = 8,900m²	

Impact	Maximum Design Scenario	Explanation
Increased risk of introduction and spread of INNS	**O&M:** Operational lifespan of 35 years. **Vessel presence:** • Routine inspection (no remediation/repair) constitutes survey activity (survey vessel) up to 2 surveys per year per trench; duration 2 weeks per survey; 3 return trips per survey; 2 vessel max at 1 time per survey. **Per year for 2 trenches:** • Surveys – 4 • Return trip – 4x3 = 12 • Total vessels at time – 2 • Routine inspection (no remediation/repair) constitutes survey activity (Unmanned Surface Vessel (USV)) up to 2 surveys per year per trench; duration 6 weeks per survey; 110 return trips (up to 4 USV + 1 guard vessel with port call every 4 days) (55 per survey = 110); up to 4 USV + 1 guard vessel = 5 max at 1 time per survey. **Per year for 2 trenches:** • Surveys – 4 • Return trips – 4x55 = 220 • Total vessels at time – 5 • Remediation (up to 13.056km per year per trench, in different locations along route) **Vessels on site for remediation activities, for up to two trenches:** • Up to four O&M vessels on site at any one time, comprising a combination of CSV and/or SOV and/or guard vessel and/or rock dump vessels and/or CTVs/workboats. **Vessel movements (remediation), for up to two trenches:** • Up to 62 O&M vessel movements (return trips) each year, consisting of CSV or SOV and/or guard vessel and/or rock dump vessels and/or CTVs/workboats. • Repair (41 lifetime repairs, for up to two trenches)	The greatest number of vessels present during the O&M phase and their associated vessel trips represents the MDS for the risk of the introduction and spread of INNS. For the O&M phase, the MDS also assumes the maximum surface area of structures exposed to the water column during O&M activities, which may facilitate colonisation of hard substrate. The addition of hard substrate can increase habitat availability for INNS, thereby increasing the likelihood of establishment and subsequent population growth.

Impact	Maximum Design Scenario	Explanation
	Vessels on site for repair activities, for up to two trenches: • Up to four O&M vessels on site at any one time, comprising a combination of CLV and/or barge and/or Barge Handlers/Tugs and/or Jack-Up and/or CSV and/or CTV and/or Rockdump. **Vessel movements (repair), for up to two trenches:** • Up to 245 O&M vessel movements (return trips) over the operational lifetime (35 yrs) consisting of CLV and/or barge and/or Jack-Up and/or Barge Handlers/Tugs and/or CSV and/or CTV and/or Rockdump.	
Decommissioning		
Temporary habitat loss and disturbance	• All offshore export cables and cable protection will be removed.	• The removal of cables may be undertaken using similar techniques to those employed during installation, therefore the parameters would be in-line with the construction phase. • Whilst the MDS is for all materials to be removed for decommissioning, in many cases it may be less environmentally impactful to leave assets in place. The decommissioning approach will be reviewed at the time of decommissioning following the most up to date and best available guidance.
Increased SSCs and associated sediment deposition	Cables and cable protection (English and Scottish waters): • All export cables and cable protection will be removed.	**Cables and cable protection (English and Scottish waters):** • The removal of cables may be undertaken using similar techniques to those employed during installation, therefore the potential increases in SSC and deposition would be in-line with the construction phase. • Whilst the MDS is for all export cable materials to be removed for decommissioning, in many cases it may be less environmentally impactful to leave assets in place. The decommissioning approach will be reviewed at the time of decommissioning following the most up to date and best available guidance.

Impact	Maximum Design Scenario	Explanation
Disturbance/remobilisation of sediment bound contaminants	The MDS, as described above, for changes to SSC and associated deposition.	The justification, as described above, for changes to SSC and associated deposition.
Increased risk of introduction and spread of INNS	All export cables and cable protection will be removed.	Decommissioning is likely to operate within the parameters identified for construction. Whilst the MDS is for all materials to be removed for decommissioning, in many cases it may be less environmentally impactful to leave assets in place. The decommissioning approach will be reviewed at the time of decommissioning following the most up to date and best available guidance.
Removal of hard substrates	All offshore export cables and cable protection will be removed.	The removal of cables may be undertaken using similar techniques to those employed during installation, therefore the parameters would be in-line with the construction phase. Whilst the MDS is for all materials to be removed for decommissioning, in many cases it may be less environmentally impactful to leave assets in place. The decommissioning approach will be reviewed at the time of decommissioning following the most up to date and best available guidance.
Underwater sound (excluding unexploded ordnance): mortality, injury, behavioural impacts and auditory masking	The MDS for sound from vessels for the decommissioning phase is assumed to be as that described for the construction phase.	• A range of geophysical activities using equipment assumed to be typical for the types of surveys anticipated. Parameters have been selected to represent the highest source characteristics (e.g. operating frequencies, pulse rates and durations), thereby defining a precautionary worst-case scenario for sound generation. • The MDS assumes the maximum number of vessels on site at one time and the greatest number of vessel movements during these phases. This represents the broadest range of vessel types and therefore sound signatures which may impact fish or shellfish receptors. • Whilst the MDS is for all materials to be removed for decommissioning, in many cases it may be less environmentally impactful to leave assets in place. The

Impact	Maximum Design Scenario	Explanation
		decommissioning approach will be reviewed at the time of decommissioning following the most up to date and best available guidance.

C = construction; O&M = operations and maintenance; D = decommissioning

4.7 Commitments adopted as part of the MHPGC Project

4.7.1.1 As set out in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment** and **Volume 1, Annex 4.1: Draft Commitments Register, of the PEIR**, several measures have been adopted as part of the MHPGC Project to reduce the potential for impacts on Fish and Shellfish ecology.

4.7.1.2 Embedded mitigation includes the following measures as identified in the Institute of Sustainability and Environmental Professionals (ISEP), formerly Institute of Environmental Management and Assessment (IEMA), Implementing the Mitigation Hierarchy from Concept to Construction (ISEP, 2024):

- Primary mitigation - measures included as part of the project design. ISEP describes these as "modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project and do not require additional action to be taken". This includes modifications arising through the iterative design process. These measures will be secured through the consent itself through the description of the project and the parameters secured in the DCO and marine licence, or both;
- Tertiary mitigation - ISEP describes these as "actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects".

4.7.1.3 Embedded mitigation measures that will form part of the final design (and are established legislative requirements/good practice, or both) have been taken into account as part of the initial assessment presented in **Section 4.8** (i.e., the initial determination of impact magnitude and significance of effects assumes implementation of these measures). This ensures that the measures that the Applicant is committed to are considered in the assessment of effects.

4.7.1.4 Where an assessment identifies likely significant adverse effects, secondary mitigation measures may be applied. These are measures that could further prevent, reduce and, where possible, offset these effects. They are defined by ISEP as "actions that will require further activity to achieve the anticipated outcome" and may be imposed as part of the planning consent, or through inclusion in the ES. These include measures required to reduce the significance of environmental effects and may be secured through an OEMP. Where secondary mitigation measures are required, both pre-mitigation and residual effects are presented.

4.7.1.5 The measures relevant to Fish and Shellfish ecology are outlined in **Table 4.18.** As there is a secured commitment to implementing these measures, they are considered inherently part of the design of the MHPGC Project and have therefore been considered in the assessment presented in **Section 4.8**.

Table 4.18: Embedded commitments relevant to Fish and Shellfish ecology implemented as part of the MHPGC Project

Commitment number	Measure adopted	How the measure will be secured
CoT06/MM-006	An Offshore OEMP will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. A Detailed OEMP will be developed in accordance with the Outline OEMP. The Outline OEMP will include: - an Outline MBP; - an Outline Marine Pollution Contingency Plan; - an Outline Marine Mammal Mitigation Protocol; - an Outline Vessel Traffic Management Plan; - an Outline Navigational Safety Plan; - a chemical risk assessment that includes information such as how chemicals will be used, stored, and transported, in line with recognised best-practice guidance; - a dropped-object protocol will be established to cover the reporting and recovery of any items lost overboard that could endanger other sea users; - a Marine Emergency Action Card outlining the steps to be followed in the case of a marine emergency; - provisions for the handling and disposal of waste.	The Outline OEMP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT07/MM-007	An Outline Offshore Operations and Maintenance Plan will be prepared and submitted as part of the application for development consent and Marine Licence application(s) to the Scottish Ministers. A Detailed Offshore Operations and Maintenance Plan will be produced prior to entering the operations and maintenance phase.	The Outline Offshore Operation & Maintenance Plan will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT08/MM-010	An Outline Offshore CSIP will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. It will include cable burial to be the preferred option for cable protection, where practicable. A Detailed CSIP will be developed prior to construction in accordance with the Outline CSIP. The Outline CSIP will include (but is not limited to): - a Cable Burial Risk Assessment (CBRA), which will define burial depths and safeguards, based on seabed conditions and external aggression and climate change hazards, to keep the offshore export cables protected and compliant through all project phases while upholding navigational and environmental safety; - the implementation, management and monitoring of cable protection.	The Outline Offshore CSIP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.

Commitment number	Measure adopted	How the measure will be secured
CoT13	The Project Description (**Volume 1, Chapter 2 of the PEIR**) sets out that the installation of the offshore export cables under Durham Coast SSSI and SAC will be undertaken by trenchless technologies. The exit pits associated with the trenchless technologies installation will be at least 100m seaward of the eastern boundary of the Durham Coast SSSI and SAC.	The Project Description will be secured via DCO and deemed Marine Licence.
CoT14/MM-022	An Offshore CMS will be produced and implemented prior to construction.	The Outline Offshore CMS will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT37	An Outline MPCP will form part of the Outline OEMP, which will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. The Outline MPCP will describe the hazards, response strategies, and step-by-step actions for handling spills, contaminant releases (including details of non-toxic, biodegradable drilling fluids), and vessel collisions during construction or operations below MHWS, and will include all essential emergency contacts and information. A Detailed MPCP will be developed in accordance with the Outline MPCP.	The Outline Offshore MPCP forming part of the Outline OEMP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT38	An Outline MBP will form part of the Outline OEMP, which will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. The Outline MBP will include (but is not limited to): - follow the latest INNS guidance issued by the Great Britain Non-Native Species Secretariat; - ensure full compliance with the International Marine Organisation (IMO) Ballast Water Management Guidelines; - address biosecurity risks associated with cable installation and any accompanying cable protection measures, acknowledging that materials placed on the seabed could act as new substrates for colonising organisms. A Detailed MBP will be developed in accordance with the Outline MBP.	The Outline MBP forming part of the Outline OEMP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.

Commitment number	Measure adopted	How the measure will be secured
CoT30/MM-078	An Outline Vessel Traffic Management Plan (VTMP) will form part of the Outline OEMP, which will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. A Detailed VTMP will be developed pre-construction in line with the Outline VTMP, and in accordance with the relevant legislation, guidance and industry best-practice. The Detailed VTMP will: - detail vessel routing to and from construction areas and ports to avoid areas of high risk, including liaison with the Port of Seaham and the Port of Sunderland; - include vessel standards and a code of conduct for vessel operators in compliance with international marine regulations as adopted by the Flag State, including the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO, 1972/77) and the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974); - detail measures to reduce disturbance to marine mammal receptors from transiting vessels, such as slow transit through the MHPGC Project and other measures as detailed in the Outline Marine Mammal Mitigation Protocol; - detail measures to reduce disturbance to red throated diver from transiting vessels, such as slow transit through the MHPGC Project and other measures as detailed in the Red Throated Diver Protocol.	The Outline VTMP forming aprt of the Outline OMEP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT36	An Outline Marine Mammal Mitigation Protocol (MMMP) will form part of the Outline OEMP, which will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. A Detailed MMMP will be developed in accordance with the Outline MMMP, which will include measures such as: • adherence to JNCC guidelines, where appropriate, regarding the minimisation of injury from underwater sound generated from known project activities of, geophysical surveys (JNCC, 2017) and UXO clearance (JNCC, 2025a); • adherence to the Scottish Marine Wildlife Watching Code (NatureScot, 2023) and Defra Marine and Coastal Wildlife Code (Defra, 2023); • reporting requirements for the Marine Noise Registry and marine mammal observer sightings.	The Outline MMMP, forming part of the Outline OEMP will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.
CoT47	An Outline Bentonite Breakout Plan will form part of the Outline Code of Construction Practice (CoCP), which will submitted as part of the application for the development consent. A Detailed Bentonite Breakout Plan will be developed substantially in accordance with the outline plan.	The Outline Bentonite Breakout Plan, forming aprt of the Outline CoCP will be secured as a condition within the DCO and deemed Marine Licence.

Commitment number	Measure adopted	How the measure will be secured
CoT58	UXO hazards will be avoided where practicable and appropriate. Where avoidance is not possible, removal techniques will be considered prior to detonation. Low-order techniques, such as deflagration, will be the preferred method where practicable and appropriate. Should low order not be practicable, relocation will be considered and if no alternatives exist high order clearance may be required. If high order is required for UXO clearance works, licensing will be subject to a standalone Marine Licence application(s). The application(s) will provide details of measures to seek to minimise impacts on marine mammals where appropriate.	The commitment to low order clearance will be secured as a condition within the DCO, deemed Marine Licence and Marine Licence application(s) to the Scottish Ministers.

4.8 Assessment of impacts

4.8.1 Overview

4.8.1.1 This section includes the assessment of the impacts to Fish and Shellfish ecology arising from the construction, O&M and decommissioning phases of the MHPGC Project. A summary of the potential effects is presented in **Table 4.52.**

4.8.1.2 For the purposes of this assessment, Fish and Shellfish receptors in Scottish and English waters are considered together, reflecting the mobile nature of many fish species and the connectivity of shellfish populations across the wider regional seas. These receptors are not constrained by jurisdictional boundaries, with movements, migrations and larval dispersal occurring across both Scottish and English waters. Consequently, potential effects on these receptors are considered together, as their distribution and population dynamics are not constrained by administrative boundaries.

4.8.2 Construction phase

Temporary habitat loss and disturbance

4.8.2.1 Temporary habitat loss and disturbance in the Fish and Shellfish Ecology Study Area from construction activities has the potential to impact on Fish and Shellfish ecology by the disturbance of essential habitats for survival (e.g. spawning, nursery and feeding habitats). Such disturbance has the potential to arise from sandwave clearance, route preparation activities (boulder and debris clearance, PLGR), cable installation, floatation pits and anchor placements and jack-up events during the construction phase of the MHPGC Project.

Magnitude of impact

4.8.2.2 Temporary habitat loss and disturbance is likely to occur along the MHPGC Project PEIR Red Line Boundary in offshore Scottish and English waters, during the construction phase, which has the potential to last up to four years. Across the MHPGC Project PEIR Red Line Boundary in English and Scottish waters, the maximum area of temporary habitat loss and disturbance is 14.29km^2. This value is inherently precautionary, as it considers both the footprint of seabed clearance and cable burial disturbance across the MHPGC Project, therefore there is an element of double counting. This approach has been taken however, as there is some potential for recovery of habitats between the activities due to construction timescales.

4.8.2.3 In Scottish waters, the temporary disturbance of suitable habitats for Fish and Shellfish receptors is expected to occur within the footprint of the construction activities which will be within the MHPGC Project PEIR Red Line Boundary, inclusive of KP250 to KP180, whilst activities in English waters will occur from KP180 to KP0 within the proposed export cable corridor.

4.8.2.4 The greatest area of disturbance in Scottish waters is expected to result from PLGR activities, which have the potential for disturbance of up to 1,960,000m², followed by sandwave clearance, affecting up to 1,736,000m² (swathe of up to 28m per trench). Boulder clearance works and cable installation trenching disturb comparatively smaller areas of up to 1,240,000m² and 1,234,800m^2 respectively.

4.8.2.5 In English waters, the greatest area of temporary habitat disturbance is anticipated to result from PLGR activities, totalling up to 4,533,400m², followed by cable installation works, boulder clearance, and sandwave clearance, affecting areas of up to 2,856,042m^2, 1,520,000m^2, and 1,232,000m^2 respectively. At landfall, up to two floatation pits will be required at the exit pit locations, with a total area of seabed disturbance of 26,400m^2 (13,200m^2 per floatation pit). In addition, up to four trenchless technique exit pits may be required, resulting in a temporary disturbance area of up to 28,000m² (7,000m² per exit pit).

4.8.2.6 Vessel seabed interactions in English waters, associated with the installation of the cable at landfall, anchor spread movements are expected to result in up to 5,098,240m² of temporary seabed disturbance from up to 40 full anchor spread movements. A jack-up barge will also be required, with up to six jack-up events, resulting in a total disturbance of 18.85m^2.

4.8.2.7 Any temporary disturbance from these activities will be short term. The total duration of each activity is expected to be one to six months for boulder clearance (dependent on vessel speed; see **Volume 1, Chapter 2: Project Description, of the PEIR**), up to four months for sandwave clearance and between one and nine months for PLGR (dependent on towing speed; see **Volume 1, Chapter 2: Project Description, of the PEIR**). However, each activity is only expected to happen once in any location and will not be continuous over the construction period.

4.8.2.8 Embedded mitigation has been incorporated into the MHPGC Project design to minimise temporary habitat disturbance during construction (**Table 4.18**). An Offshore CMS (CoT14/MM-022) will be produced and implemented prior to construction and will set out measures to minimise unnecessary seabed disturbance during installation activities. In addition, an Outline Offshore CSIP (CoT08/MM-010) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Minsters, which includes cable burial as the preferred option for cable protection, where practicable, and a CBRA to inform installation methods and minimise the requirement for cable protection.

4.8.2.9 Habitats that support Fish and Shellfish receptors, including spawning, nursery and feeding habitats, within the MHPGC Project PEIR Red Line Boundary are generally widespread across the central and northern North Sea. There are no direct impacts from temporary habitat disturbance associated with a designated site. Habitats dominated by sandy and soft sediments, including subtidal mud habitats, are expected to recover quickly from temporary disturbance following natural backfill as a consequence of the natural movement of sediment by local hydrodynamics, restoring the seabed characteristics. Given the temporary and localised nature of construction activities, and the widespread nature of suitable habitats within the surrounding area, any effects on Fish and Shellfish habitat availability are expected to be temporary and localised, with habitats returning to baseline conditions over time.

4.8.2.10 Impacts associated with habitat disturbance during the construction phase, will affect Fish and Shellfish receptors directly, through temporary, localised disturbance of supporting seabed habitats. Impacts will be of local spatial extent (i.e., within the boundaries of the MHPGC Project), of short-term duration and reversible. Taking this into account, the magnitude of impact on Fish and Shellfish receptors is considered to be **low**.

Receptor sensitivity

4.8.2.11 Fish and Shellfish VERS that are considered likely to be sensitive to impacts from temporary habitat loss and disturbance include those that exhibit demersal spawning behaviours, such as herring, sandeel and elasmobranchs, and those that are less mobile, and therefore unable to avoid disturbance, such as shellfish. Other VERs identified in **Section 4.4.8**, are considered less vulnerable to temporary habitat loss as they can move away from impacted areas and recolonise quickly once construction operations have ceased in the relevant area of seabed.

Demersal spawners

Sandeel

4.8.2.12 Sandeel are dependent on the presence of suitable sandy sediments that support key life-history functions, including spawning, foraging, predator avoidance and burial behaviour. Suitable sandeel habitat is typically characterised by well-sorted sand and sandy gravel sediments, which are widely distributed throughout the northern and central North Sea.

4.8.2.13 A detailed assessment of sandeel supporting habitat suitability was undertaken using project-specific sediment data and regional datasets (see **Volume 2, Annex 4.1: Herring and Sandeel**

Assessment, of the PEIR). Project-specific survey data indicate that the majority of the MHPGC Project PEIR Red Line Boundary is characterised by unsuitable or marginal sandeel supporting habitat, with only limited and isolated areas of suitable habitat identified. Modelled sandeel density and occurrence data, together with heatmapping analyses, similarly indicate limited evidence of contemporary sandeel presence, spawning activity and supporting habitat within the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area. Suitable sandeel habitat is considered to be localised and of limited extent within the Fish and Shellfish Ecology Study Area. Therefore, while a degree of interaction with suitable sandeel habitat may occur, the affected area constitutes only a minor proportion of the wider sandeel spawning grounds within the central North Sea (Coull *et al*., 1998).

4.8.2.14 Evidence from OWF monitoring indicates that sandeel recoverability is high. Results from a post-construction monitoring study at the Beatrice OWF indicated that sandeel abundance either increased or remained the same when comparing data from 2014 to 2020, with the offshore construction of the wind farm beginning in April 2017 (BOWL, 2021). The report found no evidence suggesting that construction had any adverse effects on the local sandeel population. Similarly, both short-term and long-term monitoring studies at the Horns Rev OWF in the Baltic Sea, Denmark, demonstrated that the construction and operation (van Deurs *et al*., 2012) of the wind farm did not result in significant negative impacts on sandeel populations. Additionally, the sandeel populations were observed to recover quickly following construction, suggesting that a similar recovery can be expected in the MHPGC Project PEIR Red Line Boundary after localised construction activities, with the rate of recovery depending on the restoration of sediments to a condition suitable for sandeel recolonisation.

4.8.2.15 However, evidence from tagging and genetic studies indicates that adult sandeel movements after settlement are limited, with mixing between populations generally occurring only over relatively short distances (< 30km) and little to no exchange between aggregations separated by more than ~28km (Jensen *et al.,* 2011; Gauld, 1990; Wright *et al*., 2019). This suggests that adult recolonisation of impacted areas is likely to be minimal, and that recovery following local depletion is primarily dependent on larval dispersal, influenced by oceanographic processes and environmental conditions. Larval supply to suitable sandy sediments within the Fish and Shellfish Ecology Study Area is expected during spring, following winter/spring spawning (Ellis *et al.,* 2012), providing a potential mechanism for recolonisation where habitat conditions have been restored.

4.8.2.16 Taking into account their ecological importance as a prey species, conservation importance (as a PMF and qualifying feature of the Turbot Bank MPA), and dependence on suitable sandy substrates, sandeel have the potential to be vulnerable to habitat loss and disturbance. However, project-specific survey data, modelled occurrence data and habitat confidence mapping indicate that suitable habitat within the MHPGC Project PEIR Red Line Boundary is limited, localised and comprises only a minor proportion of the extensive spawning and supporting habitat available across the wider northern and central North Sea. Furthermore, evidence from OWF monitoring indicates that sandeel populations are capable of recovering following temporary habitat disturbance where suitable sediment conditions are restored.

4.8.2.17 Taking the above into consideration, and considering their national importance, sandeel are assessed to be of **medium** overall sensitivity to temporary habitat loss and disturbance. This is consistent with the FeAST assessment for sandeel, which highlights the importance of sediment characteristics for sandeel habitat preferences and settlement (Wright *et al*., 2000) and identifies sandeel as having medium sensitivity to the pressure 'surface abrasion /disturbance of the surface of the seabed'.

Herring

4.8.2.18 Herring are also demersal spawners, reliant upon the presence of suitable substrates for spawning (i.e., gravelly sediments). Herring spawning habitats are widely distributed across the northern and central North Sea. As detailed in **Section 4.4.5,** analysis of project-specific particle size data, together with regional seabed datasets, indicates that the majority of the Fish and Shellfish Ecology Study Area, including the MHPGC Project PEIR Red Line Boundary, is characterised by sediments

unsuitable for Atlantic herring spawning. No prime or sub-prime spawning habitats were identified within the MHPGC Project PEIR Red Line Boundary, with only isolated areas of suitable habitat present. Supporting evidence from IHLS larval distribution data and spawning confidence heatmapping similarly indicates low levels of contemporary spawning activity within the Fish and Shellfish Ecology Study Area relative to other areas of the North Sea. Although localised areas of higher spawning confidence occur in the vicinity of the Buchan and Banks NSAS spawning grounds, these are largely located outside the MHPGC Project PEIR Red Line Boundary. Overall, the available evidence indicates a low likelihood of extensive Atlantic herring spawning activity within the MHPGC Project PEIR Red Line Boundary and the wider Fish and Shellfish Ecology Study Area.

4.8.2.19 Taking into account their ecological value as a key prey species and their dependency on suitable gravelly substrates for spawning, herring have the potential to be vulnerable to habitat disturbance. However, the habitat suitability assessment indicates that the MHPGC Project PEIR Red Line Boundary contains no prime or sub-prime spawning habitat and only limited areas of suitable habitat, with evidence of contemporary spawning activity within the Fish and Shellfish Ecology Study Area also considered low. In addition, any habitat affected would represent only a small proportion of the spawning habitat available across the wider northern and central North Sea and would be expected to recover naturally following disturbance. Consequently, herring are considered to be of low vulnerability and medium recoverability, and the sensitivity of the receptor is assessed as **low**.

All other demersal and pelagic fish receptors

4.8.2.20 Atlantic cod, lemon sole, Norway pout, European plaice, sprat and whiting all have spawning grounds overlapping the Fish and Shellfish Ecology Study Area, however they do not display substrate dependency for spawning and are therefore not considered vulnerable to temporary habitat disturbance impacts. While pelagic spawning species may show a tendency to spawn in general areas, displacement from an immediate area subject to disturbance would not be expected to affect their overall spawning success. This is because pelagic spawning occurs in the water column, rather than being directly dependent on specific seafloor substrates or habitats. Temporary habitat loss or disturbance in a localised area is unlikely to significantly impact the overall spawning success of these species, as they can continue to spawn in adjacent undisturbed areas. Additionally, pelagic spawning species are typically widely distributed and have high fecundity, meaning they produce a large number of eggs. This reproductive strategy helps to ensure the survival of their offspring, even if some eggs are lost due to temporary habitat disturbance in a small area. Therefore, while pelagic spawning receptors may show a tendency to spawn in general areas, their lack of substrate dependency and ability to continue spawning in adjacent undisturbed areas, combined with their high fecundity and wide distribution, contribute to their **negligible** sensitivity to temporary habitat disturbance.

4.8.2.21 Mobile fish receptors (without spawning grounds within the vicinity of the project) do not display substrate dependency and therefore are not considered vulnerable to temporary habitat disturbance, and as such the sensitivity of these species is considered to be **negligible**.

Elasmobranchs

4.8.2.22 All of the identified elasmobranch receptors (including basking shark) are mobile species, and while several are oviparous and lay egg cases on the seabed (including thornback ray, spotted ray, cuckoo ray, thorny skate, and lesser-spotted dogfish), they do not rely on highly specific substrate types. Skate and catshark egg cases are deposited on a range of soft seabed habitats and suitable substrates for egg attachment are expected to be widespread outside the MHPGC Project PEIR Red Line Boundary. In contrast, spurdog and tope are viviparous species and give birth to live pups rather than using the seabed for egg deposition. Given this life-history flexibility and lack of strict substrate dependence, elasmobranchs are not considered vulnerable to temporary habitat disturbance, and their sensitivity is therefore assessed as **negligible**.

4.8.2.23 Flapper skate, and common skate are both listed as critically endangered on the IUCN red list. They are also oviparous, laying egg cases every other year on sandy, muddy flats (Neal *et al*., 2008). In recognition of this, and consistent with the FeAST assessments for these receptors, common skate

and flapper skate are assigned as having **medium** sensitivity to the pressure 'surface abrasion /disturbance of the surface of the seabed'.

Diadromous fish

4.8.2.24 Diadromous species are mobile, and therefore able to avoid areas subject to temporary habitat loss and disturbance. Furthermore, diadromous species are only likely to be within the MHPGC Project PEIR Red Line Boundary during migrations to and from their natal rivers. Habitats within the MHPGC Project PEIR Red Line Boundary are not likely to be important for diadromous fish species, so any temporary habitat disturbance is not likely to cause any direct impact upon diadromous fish species and is not likely to affect their migrations. The sensitivity of these species to temporary habitat disturbance is therefore **low**.

Shellfish

4.8.2.25 *Nephrops* have a known spawning ground which overlaps with the MHPGC Project PEIR Red Line Boundary in English waters (there is no overlap in Scottish waters). As determined in the MarLIN sensitivity review, *Nephrops* are classified as having a low sensitivity to abrasion and physical disturbance (Hill and Sabatini, 2008), noting that burrows (used for shelter and brooding) are likely to be damaged by physical disturbance but that burrows can be re-established within a few days. Although *Nephrops* are strongly substrate-dependent and are a commercially important species within the northern and central North Sea, their habitat is expected to recover rapidly, meaning any adverse effects on burrowing behaviour are likely to be short-term; therefore, their overall sensitivity is considered **low**.

4.8.2.26 Edible crabs are known to be associated with rocky substrates but also inhabit mixed coarse, sand, and soft sediments (Neal and Wilson, 2008). Berried female edible crab bury themselves into soft mud and sand, while brooding eggs in the overwintering period. It should be noted however that edible crab are substrate dependent rather than being philopatric and can therefore fully utilise adjacent areas which will be unaffected. Therefore, the sensitivity of these receptors is considered to be **low,** as denoted by the MarLIN sensitivity review (Neal and Wilson, 2008).

4.8.2.27 European lobster are broadly distributed across the northern and central North Sea and are found across a range of habitats. European lobster are not known to exhibit substrate dependant behaviours and are therefore considered to be of **low** sensitivity to temporary habitat disturbance.

4.8.2.28 King scallop lives attached to the seabed, typically in sandy or muddy habitats, with its shell and mantle exposed at the surface (Marshall & Wilson, 2008). The MarLIN sensitivity review has assessed king scallop as having a low sensitivity to abrasion/disturbance of the seabed and high recoverability (Marshall & Wilson, 2008). The king scallop is of commercial importance and is considered to be of **low** sensitivity to temporary habitat disturbance.

4.8.2.29 Freshwater pearl mussels are a critically endangered species that play a vital role in aquatic ecosystems. As large, long-lived filter feeders with a complex life cycle dependent on juvenile salmonid fish, they are highly sensitive to environmental changes and disturbances. The nearest SACs designated for freshwater pearl mussel (River Dee SAC, River South Esk SAC) are situated 57km or further from the MHPGC Project PEIR Red Line Boundary. Sediment plumes from the MHPGC Project are not likely to reach these distances, therefore, this receptor is not considered further in the assessment of this impact.

4.8.2.30 Remaining shellfish receptors (common prawn, velvet swimming crab, green crab) are not likely to be significantly impacted by temporary habitat loss and disturbance, due to their high mobility and broad habitat requirements. Additionally, these shellfish species are widely distributed throughout the northern and central North Sea region, meaning the temporary loss of a small area of habitat is unlikely to significantly impact their overall populations or productivity. Their ability to recolonise disturbed areas also facilitates recovery post-construction. As a result of this, all other shellfish receptors are considered to be of **low** sensitivity to impacts from temporary habitat disturbance.

Significance of effect

4.8.2.31 Overall, it is considered that the receptor sensitivity ranges from **negligible to medium** and the magnitude of temporary habitat loss and disturbance is **low**. Therefore, the effect of temporary habitat loss and disturbance during the construction phase is considered to be **negligible to minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.2.32 At this stage, no additional mitigation is proposed for temporary habitat loss and disturbance in Scottish or English waters. Therefore, the residual effect of temporary habitat loss and disturbance, during the construction phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Increased SSC and associated sediment deposition

4.8.2.33 Several construction activities during pre-installation and installation of the MHPGC Project Offshore Export cable corridor, particularly during route preparation, cause disturbance to the seabed, and are likely to result in the suspension of sediment. This can create a sediment plume in the water column which can travel away from the MHPGC Project PEIR Red Line Boundary to later settle out and deposit elsewhere. This also includes dredge spoil disposal which is likely to occur within the MHPGC Project PEIR Red Line Boundary.

4.8.2.34 The level of SSC and deposition will vary along the MHPGC Project PEIR Red Line Boundary, in both Scottish and English waters, depending on local sediment conditions and hydrodynamics. These characteristics are described in **Volume 2, Chapter 1 Physical Processes, of the PEIR**.

4.8.2.35 Sediment dispersion modelling has been undertaken, as detailed **in Volume 2, Annex 1.2 Model Design and Validation, of the PEIR**, which has informed the assessment for this pathway. The maximum tidal ellipse used as the Fish and Shellfish Ecology Study Area, and the area which represents the maximum ZoI for sediment dispersion, has been defined as 9km (see **Section 4.4.2)** which is used as a worst-case scenario for this impact pathway. **Volume 2, Annex 1.2 Model Design and Validation, of the PEIR** has identified that the spring tidal excursion distance varies between offshore and nearshore areas from 5km to 9km respectively in English waters, and 6km to 9km in offshore Scottish waters. Therefore, for the purposes of this assessment, habitats and species located within 9km of the MHPGC Project PEIR Red Line Boundary have been considered as a worst-case scenario.

Magnitude of impact

4.8.2.36 Project-specific modelling has indicated the likely distance over which a sediment plume is likely to travel, based on different sediment types (**Volume 2, Annex 1.2, Physical Processes Technical Report, of the PEIR**). Sandwave clearance, dredge spoil disposal and pre-lay trenching were all included in the modelling in both Scottish and English waters. Based on the modelling, in both Scottish and English waters, the following worst-case SSC levels were estimated:

- 0m to 50m: All gravel and a large proportion of disturbed sand is estimated to deposit back on the seabed within 0 and 50m from the area of disturbance, with suspension lasting for the duration of the disturbance plus an additional 30 minutes following the end of the disturbance (although the majority is likely to redeposit within seconds to a few minutes following the disturbance). The level of SSC during disturbance is expected to be very high (tens to hundreds of thousands of mg/l) within this distance. More than one hour after the disturbance has ended, deposition is expected to be limited and not measurable.
- 50m to 500m: Mostly sand and some remaining gravel is expected to be deposited, with high levels (hundreds to low thousands of mg/l) of SSC for the duration of the disturbance plus an additional 30 minutes. More than one hour after disturbance, fine sediment is unlikely to deposit in measurable thickness.

- 500m to the maximum extent of the 9km tidal excursion buffer around the MHPGC PEIR Red Line Boundary: Mainly fine sediments are expected to be deposited with low to intermediate SSC (tens to low hundreds of mg/l) at the time of disturbance with a narrow plume. Between six and 24 hours following the disturbance, deposition of fines is gradually expected to decrease to background levels, with no measurable change following 24 to 48 hours. Finer sediment will have smaller associated deposition thicknesses due to a wider dispersion area.

4.8.2.37 The area of seabed in both Scottish and English waters which is likely to be disturbed is dominated by coarse sediments with some small contributions of mud. Based on the project-specific modelling, the majority of disturbed sediment is therefore expected to deposit rapidly and within 50m of the footprint of disturbance, with some finer fractions carried beyond this distance but expected to deposit within a maximum of 48 hours following disturbance up to the tidal excursion buffer (up to 9km from the MHPGC Project PEIR Red Line Boundary). The modelling indicates that deposition thicknesses of 5cm may occur up to approximately 100m from the activity location. Deposition thicknesses of 1cm may occur up to approximately 200m from the activity location with anything beyond this considered to be very minor deposition thicknesses. A deposition thickness of 1-5cm is likely to occur in very localised areas each side of the MHPGC Project PEIR Red Line Boundary and will depend on the speed and direction of tidal currents.

4.8.2.38 Embedded mitigation has been incorporated into the MHPGC Project design to minimise the extent of seabed disturbance and associated sediment suspension during construction activities (**Table 4.18**). An Offshore CMS (CoT14/MM-022) will be produced and implemented prior to construction and will set out measures to minimise unnecessary seabed disturbance during route preparation and cable installation activities. In addition, an Outline Offshore CSIP (CoT08/MM-010) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. This includes cable burial as the preferred option for cable protection, where practicable, and a CBRA to inform cable installation methodologies and burial requirements.

4.8.2.39 Any increase in SSC significantly above baseline is expected to be highly temporary and localised to the area of disturbance. The implementation of the Offshore CMS (CoT14/MM-022) and Offshore CSIP (CoT08/MM-010) will further minimise the extent of seabed disturbance and resulting sediment mobilisation where practicable. Furthermore, as construction and seabed disturbance moves along the length of the MHPGC Project PEIR Red Line Boundary in offshore Scottish and English waters, any measurable change will be short-term in any one location.

4.8.2.40 Due to the short-term and temporary nature of the impact and natural movement of sediments through local hydrodynamics, any affected species and supporting habitats are expected to recover to baseline conditions within a few days of the disturbance.

4.8.2.41 Therefore, it is considered that the magnitude of increased SSCs and associated deposition, during the construction phase in both Scottish and English waters is considered to be **low**.

Receptor sensitivity

4.8.2.42 Fish and Shellfish VERs that are considered likely to be sensitive to impacts from increased SSC and sediment deposition are those that exhibit demersal spawning behaviours (such as herring, sandeel and elasmobranchs), eggs and larvae, filter feeding species, and those that are less mobile, and therefore unable to avoid disturbance, such as shellfish. Other VERs identified, are considered less vulnerable to increased SSC and deposition as they can move away from impacted areas and recolonise quickly, following the dissipation of elevated SSC and sediment deposition effects.

Demersal spawners

Sandeel

4.8.2.43 Sandeel are highly substrate specific (Wright *et al.,* 2000); after an initial larval dispersal period, sandeel display a degree of site fidelity (Jensen *et al.,* 2011) so their settled distribution reflects the

distribution of preferred habitat. Sandeel rarely occur in sediments where the silt content (particle size <0.63 µm) is greater than 4%, and they are absent in substrates with a silt content greater than 10% (Holland *et al*., 2005; Wright *et al*., 2000). It has been found that they tend to occupy the top 4cm of the seabed and regulate their burial depth based on oxygen availability (Behrens *et al*., 2007). Consequently, changes in sediment composition have the potential to influence habitat suitability for sandeel. This is reflected in FeAST, which identifies sandeel as having medium sensitivity to the pressure 'siltation changes (light)' (Wright *et al*., 2000), as an increase in the fine sediment fraction may temporarily reduce habitat suitability and result in avoidance behaviour until suitable sediment conditions are restored. This is further supported by ICES (2026), which advises that any activity leading to the degradation of sandeel habitat should be avoided, reflecting the recognised importance of maintaining suitable sediments for sandeel.

4.8.2.44 As detailed in **Section 4.4.5**, the Fish and Shellfish Ecology Study Area overlaps mapped sandeel spawning and nursery grounds in both Scottish and English waters. A detailed assessment of supporting habitat suitability was undertaken using project-specific sediment data and regional datasets (see **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**). Project-specific survey data indicate that the majority of the MHPGC Project PEIR Red Line Boundary is characterised by unsuitable or marginal sandeel supporting habitat, with only limited and isolated areas of suitable habitat identified. Modelled sandeel density and occurrence data, together with heatmapping analyses, similarly indicate limited evidence of contemporary sandeel presence, spawning activity and supporting habitat within the MHPGC Project PEIR Red Line Boundary and wider Fish and Shellfish Ecology Study Area. Suitable sandeel habitat is considered to be localised and of limited extent within the Fish and Shellfish Ecology Study Area. Therefore, while a degree of interaction with suitable sandeel habitat may occur, suitable habitat within the MHPGC Project PEIR Red Line Boundary is localised and constitutes only a minor proportion of the wider sandeel spawning and supporting habitat available within the central North Sea (Coull *et al*., 1998).

4.8.2.45 Furthermore, the secondary impacts of increased concentrations of SSC in the water column and smothering (from deposition of particles as a result of comparable activities such as dredging and screening of cargo), have been shown to be inconsequential to sandeel species (MarineSpace Ltd, 2010). Sandeel eggs are also likely tolerant to increases in SSC and smothering from sediment deposition reflecting the naturally dynamic and high-energy environments in which spawning and early life stages occur.

4.8.2.46 Accordingly, while suitable sandeel habitat within the MHPGC Project PEIR Red Line Boundary is limited and localised, the Fish and Shellfish Ecology Study Area overlaps recognised sandeel spawning and nursery grounds and the species is highly dependent on suitable sediment characteristics throughout much of its life cycle. Project-specific survey data, modelled occurrence data and habitat confidence mapping indicate that suitable habitat and evidence of contemporary spawning activity are generally limited within the MHPGC Project PEIR Red Line Boundary, with areas of suitable habitat representing only a small proportion of the wider sandeel habitat resource available across the northern and central North Sea. However, whilst any changes in habitat suitability resulting from increased SSC and sediment deposition are expected to be temporary and reversible, changes in the fine sediment fraction have the potential to influence habitat suitability and spawning success. Taking into account the ecological importance of sandeel, their dependence on suitable sandy substrates, the overlap with recognised spawning grounds, and the medium sensitivity assigned by FeAST to the pressure 'siltation changes (light)', sandeel are considered to be of medium vulnerability and medium recoverability, and the sensitivity of the receptor is therefore assessed as **medium**.

Herring

4.8.2.47 Herring are demersal spawners, depositing adhesive eggs directly onto the seabed or other submerged surfaces. Herring eggs and larvae are considered vulnerable to increased SSC and sediment deposition, which can smother the eggs and disrupt the development of the larvae. This disruption can occur through two main mechanisms. First, the sediment grains can physically retard the growth and development of the larvae. Second, increased sediment can reduce the availability of oxygen around the eggs, negatively impacting the larvae. However, it's important to note that the

impact of SSC on herring egg development is limited to the first couple of hours after the eggs are laid. Griffin *et al.* (2009) indicates that SSC only affects the eggs when it binds with them during this critical initial period. This suggests the timing of potential sediment impacts is focused on the immediate aftermath of the eggs being deposited on the seafloor.

4.8.2.48 Notwithstanding this, the Fish and Shellfish Ecology Study Area is not considered to support important herring spawning activity or extensive areas of suitable spawning substrate. Analysis of 10 years IHLS data indicates that the area is characterised predominantly by low larval densities (**Figure 4.12**), while spawning potential mapping identifies only low to medium confidence herring spawning habitat (**Figure 4.13**). Collectively, these data indicate a low level of confidence that active spawning is occurring within the areas likely to be affected by increased SSC and deposition. This is an important consideration given that ICES (2026) advises that activities on herring spawning habitats should only be undertaken where the effects of those activities have been assessed and demonstrated not to be detrimental. While temporary increases in SSC and sediment deposition may affect small areas of potentially suitable spawning habitat, the available evidence indicates that any overlap with important spawning habitats is likely to be limited.

4.8.2.49 In summary, herring eggs and larvae may be sensitive to increases in SSC and sediment deposition, particularly during the short period immediately following egg deposition when sediment may bind to and smother newly laid eggs. However, the Fish and Shellfish Ecology Study Area is not considered to support important herring spawning activity, with habitat suitability assessments, spawning confidence mapping and IHLS larval data indicating limited overlap with active spawning grounds. Taking into account the ecological and commercial importance of herring, the limited evidence for important spawning activity within the area potentially affected by the impact, and the localised and temporary nature of any increases in SSC and sediment deposition, herring are considered to be of low vulnerability and medium recoverability. The sensitivity of the receptor is therefore assessed as **low**.

All other demersal and pelagic fish receptors

4.8.2.50 Cod, lemon sole, Norway pout, plaice, sprat and whiting all have spawning grounds overlapping the Fish and Shellfish Ecology Study Area. These receptors are pelagic spawners and do not exhibit substrate dependency. Therefore, sediment deposition within these spawning grounds will not result in any potential loss of available spawning habitats. These pelagic spawning receptors, and all other mobile fish receptors are mobile, widely spread across the northern and central North Sea, and will experience exposure to naturally high variability to SSC within their natural range. The receptors are therefore considered to be broadly insensitive to increased SSC and sediment deposition; therefore, the sensitivity of these receptors is considered to be **low**.

Elasmobranchs

4.8.2.51 All of the identified elasmobranch receptors are mobile (including basking shark) and widespread throughout the wider Moray Firth and North Sea. They will experience exposure to naturally high variability in SSC within their natural range, with no substrate dependence for spawning. Therefore, the sensitivity of elasmobranch species is considered to be **low**. This conclusion aligns with the FeAST sensitivity assessments for flapper and common skate, which concludes these receptors to be 'not sensitive' to impacts from siltation rate changes.

Diadromous fish

4.8.2.52 Diadromous species migrate through estuarine environments which typically have higher levels of SSC and are therefore anticipated to have some tolerance to increased SSC. Any adverse effects from increased SSC on diadromous species will likely be temporary behavioural effects but will not create a barrier to migration to and from natal rivers. For example, a study of migrating salmon (*Oncorhynchus* spp.) during dredging operations indicated that individuals successfully moved away from the dredging operations, resuming their prior distribution trends within a short time after encountering the dredging plume (Carlson *et al.*, 2001). The sensitivity of these receptors is therefore considered to be **low**.

Shellfish

4.8.2.53 Edible crab have a high tolerance to SSC and are reported to be insensitive to short-term increases in turbidity; however, they may avoid areas of increased SSC as they rely on visual acuity during predation (Neal and Wilson, 2008). Berried female edible crab exhibit a largely sedentary lifestyle during the overwintering period whilst brooding eggs. During this time, they are considered a static receptor, burying themselves into soft mud and sand, and are therefore unlikely to move away from disturbances. Berried females are considered more vulnerable to smothering from sediment deposition. This heightened vulnerability arises from their sedentary behaviour during this period, as they remain relatively static to ensure proper aeration for their carried eggs. The eggs require regular exposure to well-oxygenated water to facilitate their development, making the immobile females particularly vulnerable to the potential smothering impacts of excessive sediment accumulation. Taking this into account, edible crab are considered to be of medium vulnerability during the overwintering period, but high recoverability given their widespread distribution. Given their commercial importance, the overall sensitivity of this receptor to temporary increases in SSC and sediment deposition is considered **low**.

4.8.2.54 European lobsters do not exhibit a sedentary overwintering habit (unlike edible crab), being and are generally mobile, allowing them to move away from sources of disturbance. However, berried (egg carrying) females may be more vulnerable to increased SSC and smothering impacts as the eggs carried require regular aeration. Overall, European lobster is considered to be of medium vulnerability to increased SSC and deposition, high recoverability due to their mobility and widespread distribution. Give their commercial importance, the sensitivity of the receptor is considered to be **low**.

4.8.2.55 *Nephrops* rely on burrowing in soft sediments for shelter and reproduction and increases in suspended sediment can interfere with these behaviours. Joyce at al., (2010) examined the impact of sediment deposition on *Nephrops* burrowing behaviour. This research found that sediment deposition can inhibit burrowing activity and disrupt the structure of burrows, potentially leading to increased vulnerability to predation and reduced reproductive success. Another study published by Johnson *et al.* (2013) found that exposure to elevated levels of suspended sediment led to changes in the behaviour and physiology of *Nephrops*, including reduced feeding activity and altered respiratory responses. These changes can negatively impact their overall health and fitness. These studies indicate that *Nephrops* show a degree of sensitivity to elevated suspended sediment and localised deposition. Taking this into account, *Nephrops* are assessed as having medium vulnerability to temporary increases in SSC and sediment deposition, but high recoverability due to their widespread distribution and ability to re-establish burrows once conditions stabilise. Given their commercial importance, the overall sensitivity of this receptor is considered **low**.

4.8.2.56 Freshwater pearl mussels are a critically endangered species that play a vital role in aquatic ecosystems. As large, long-lived filter feeders with a complex life cycle dependent on juvenile salmonid fish, they are highly sensitive to environmental changes and disturbances. Freshwater pearl mussels have high vulnerability to increases in suspended sediment concentrations and associated sedimentation, which can smother and suffocate the mussels, especially during the sedentary overwintering period when females are brooding their eggs. The nearest SACs designated for freshwater pearl mussel (River Dee SAC, River South Esk SAC) are all situated 57km or further from the MHPGC Project. Sediment plumes from the MHPGC Project are not likely to reach these distances, therefore, this receptor is not considered further in the assessment of this impact. Freshwater pearl mussels do have a parasitic larval stage that develops in the gills of Atlantic salmon and brown trout; however, larvae attached to host fish would not be vulnerable to suspended sediment in the same way as sedentary adult mussels. Any indirect pathway would therefore depend on impacts to the host species themselves, whose sensitivity to SSC has been assessed as **low** (see **Paragraph 4.8.2.52**).

4.8.2.57 King scallop are of commercial value to fisheries within the region and are broadly distributed across the northern and central North Sea. The King scallop species can undertake limited swimming, although this is considered to be at a high energy cost and generally associated with predator avoidance, therefore this species is not expected to be able to travel large distances to avoid disturbance. The MarLIN sensitivity review for King scallop (Marshall & Wilson, 2008) identifies it as

having low sensitivity to smothering and to increases in suspended sediment. King scallop are therefore considered to be of low vulnerability, high recoverability and of commercial importance, and therefore the sensitivity of these receptors is **low**.

4.8.2.58 All other shellfish receptors and their respective spawning grounds are distributed widely throughout the northern and central North Sea, and experience exposure to naturally high variability in SSC within their natural range. As a result of this, all other shellfish receptors are considered to be of **low** sensitivity.

Significance of effect

4.8.2.59 Overall, it is considered that the receptor sensitivity is **low** to **medium** and the magnitude of increased in SSC and associated sediment deposition ranges is **low**. Therefore, the effect of increased SSC and associated sediment deposition during the construction phase is considered to be **minor adverse,** which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.2.60 At this stage, no additional mitigation is proposed for increased in SSC and associated sediment deposition in Scottish or English waters. Therefore, the residual effect of increased SSC and associated sediment deposition, during the construction phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Disturbance/remobilisation of sediment bound contaminants

4.8.2.61 Indirect effects of sediment disturbance during construction can include the disturbance and/or the remobilisation of sediment bound contaminants into the water column. This can include remobilisation of heavy metals and hydrocarbons resulting in an increase of contaminant concentrations above background levels. Further information can also be found in **Volume 2, Chapter 2: Offshore Water and Sediment Quality, of the PEIR**.

Magnitude of impact

4.8.2.62 Disturbance and therefore remobilisation of sediment-bound contaminants is expected to be limited to areas within the MHPGC Project PEIR Red Line Boundary where cable installation activities will be occurring. However, the remobilisation of sediment-bound contaminants could have subsequent effects on Fish and Shellfish species beyond the MHPGC Project PEIR Red Line Boundary. The distance to which disturbed/remobilised sediment bound contaminants may travel is expected to be in line with the maximum dispersion distances for increased SSC, of 9km (i.e. the maximum tidal excursion distance).

4.8.2.63 In Scottish waters, during the MHPGC Project-specific subtidal surveys, all polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organotins were below the limit of detection (LOD) and/or did not exceed marine environmental quality standards (EQS). The majority of heavy metals were found below EQS values, with the exception of arsenic (As) which exceeded the threshold for Effects Range Low (ERL) at one sampled location. However, the sediment chemistry in Scottish waters is considered to be consistent with background concentrations in the North Sea (Gardline, 2024a; 2025a) (see **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR**).

4.8.2.64 In Scottish waters, site-specific subtidal benthic surveys undertaken for Morven North and Morven South identified only one station, located in the northern extent of Morven North, whereas concentrations exceeded the Marine Scotland AL1 and the CSQG TEL; however, concentrations remained below the Cefas AL2 and the CSQG PEL (Tetra Tech RPS Energy, 2026a). All other sampling stations recorded As and metal concentrations below the relevant Marine Scotland AL1 and CSQG TEL thresholds. Concentrations of PCBs were generally low, with only four stations recording detectable levels, all of which were below Marine Scotland AL1 and CSQG TEL values, while concentrations of all PAHs remained below their respective CSQG TEL and Marine Scotland AL1 thresholds. Organotin compounds were not detected at any sampling station (Tetra Tech RPS Energy, 2026a).

4.8.2.65 In English waters, MHPGC Project-specific subtidal benthic surveys identified that concentrations of PCBs and organotins did not exceed EQS (Gardline, 2024a; 2025a). When considering heavy metals, cadmium, copper and mercury were also below EQS. However, some metals did exceed Cefas AL 1 (a level above which chemicals and deemed unacceptable for uncontrolled disposal at sea without special handling). The highest concentrations of heavy metals were identified by the landfall where higher proportions of fine sediment are present. However, the concentrations identified in English waters were considered to be consistent with natural background variation.

4.8.2.66 Embedded mitigation has been incorporated into the MHPGC Project design to minimise the potential for contaminant mobilisation and release during construction activities (**Table 4.18**). An Outline OEMP (CoT06/MM-006) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers, and will include, amongst other measures, a chemical risk assessment, provisions for the handling and disposal of waste, and procedures relating to the use, storage and transport of chemicals in accordance with recognised best practice guidance. In addition, an Offshore CMS (CoT14/MM-022) will be implemented prior to construction to manage construction-related activities that may result in seabed disturbance. An Outline MPCP (CoT37) will also be developed as part of the Outline OEMP and will set out the procedures for managing spills and contaminant releases during construction and operation.

4.8.2.67 Based on the chemical analysis results presented in **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR,** it is not anticipated that sediment disturbance and deposition during construction will result in detectable changes in sediment bound contaminants above background levels and natural variation.

4.8.2.68 Sediment bound contaminants are only expected to be disturbed and remobilised for the duration of seabed disturbance along the MHPGC Project PEIR Red Line Boundary, with construction activities lasting for a short period of time in any one place within the MHPGC Project PEIR Red Line Boundary. Furthermore, sediment bound contaminants are expected to be regularly mobilised by natural disturbance such as currents, waves and storm events, and rapidly dispersed following disturbance due to local hydrodynamic conditions (see **Volume 2, Chapter 1: Physical Processes, of the PEIR**). Therefore, any elevated levels of disturbed contaminants above background conditions during construction activities are expected to return to baseline levels rapidly following disturbance.

4.8.2.69 Therefore, it is considered that the magnitude of disturbance/remobilisation of sediment bound contaminants in both Scottish and English waters, during the construction phase is considered to be **negligible**.

Receptor sensitivity

4.8.2.70 Construction activities leading to the resuspension of sediments will have varying levels of impact dependent on the species present and pollutants involved. As sediment-bound contaminants would be expected to be dispersed quickly in the subtidal environment, the level of impact is predicted to be small.

4.8.2.71 Due to their increased mobility, adult fish (including diadromous and elasmobranch species) are less likely to be affected by marine pollution and are therefore not considered to be vulnerable to the release of sediment bound contaminants, and as such the sensitivity of these receptors is considered to be **low**.

4.8.2.72 Fish eggs and larvae are likely to be particularly sensitive, with pollutants having potentially toxic impacts on fish eggs and larvae (Westerhagen, 1988; Kjelland *et al.*, 2015). The resuspension of sediment-bound contaminants (e.g., heavy metals and hydrocarbon pollution) have been found to impact fish eggs and larvae and can include abnormal development, delayed hatching and reduced hatching success (Bunn *et al.*, 2000). On this basis eggs and larvae are considered to be of **medium** sensitivity to the impact.

4.8.2.73 Filter-feeding shellfish are considered to be more sensitive to marine pollution due to the recognised bioaccumulation which occurs within this group. Shellfish also display limited mobility, reducing their

ability to avoid exposure to resuspended sediment-bound contaminants. These receptors are therefore considered to be of **medium** sensitivity to the impact.

Significance of effect

4.8.2.74 Overall, it is considered that the receptor sensitivity ranges from **low to medium** and the magnitude of disturbance/remobilisation of sediments is **negligible**. Therefore, the effect of disturbance/remobilisation of sediments during the construction phase is considered to be **negligible to minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.2.75 At this stage, no additional mitigation is proposed for disturbance/remobilisation of sediments in Scottish or English waters. Therefore, the residual effect of disturbance/remobilisation of sediments, during the construction phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Underwater sound (excluding UXO): mortality, injury, behavioural impacts and auditory masking

4.8.2.76 Sound generating activities (excluding UXO) to be undertaken during the MHPGC Project are outlined in **Volume 2, Annex 5.1: Underwater Sound Report, of the PEIR**. These will arise from general construction noise, from geophysical and geotechnical surveys, vessel movements, seabed preparation works and cable installation, which will generate low levels of impulsive noise (arising from a selection of geophysical surveys), and continuous noise. The introduction of anthropogenic noise into the marine environment, from such activities can cause mortality, injury or behavioural impacts on Fish and Shellfish (behavioural effects can include for example displacement, avoidance, disruption of acoustic communication, reduced reproductive success, altered foraging and predator evasion, and impaired navigation (Radford *et al.*, 2014; De Jong *et al.*, 2020; Hawkins & Myrberg, 1983)).

4.8.2.77 The effect of underwater sound generated by the activities listed in Section 1.3 of **Volume 2, Annex 5.1: Underwater Sound Modelling Report , of the PEIR** depends on the intensity of the sound source, measured in decibels (dB), the impulsive (sound that is broadband, extremely short in duration, with a rapid rise time and a peak level higher than its energy-averaged level) or non-impulsive (sound that is continuous or occurs intermittently but does not exhibit the distinctive features associated with impulsive sound) nature of the sound and the duration of exposure. The majority of these sound generating activities are considered to be non-impulsive sound sources (i.e., continuous), whilst some of the geophysical survey activities (Ultra-High-Resolution Seismic (UHRS) sparker and Ultra-Short Baseline systems (USBL)) are considered to be impulsive sources.

4.8.2.78 Underwater sound can potentially have a negative impact on Fish and Shellfish species ranging from behavioural impacts to physical injury/mortality. In general, biological damage as a result of sound energy is either related to a large pressure change (barotrauma) or to the total quantity of sound energy received by a receptor. Barotrauma injury can result from exposure to a high intensity sound even if the sound is of short duration (i.e., UXO clearance, assessed separately). When considering injury due to the energy of an exposure, the total exposure over time becomes important. Fish and Shellfish are also considered to be sensitive to the particle motion element of underwater sound; an impact considered more important than sound pressure for many species, particularly invertebrates. However, research into this impact on Fish and Shellfish populations is scarce, representing a source of uncertainty in the assessment process.

4.8.2.79 Popper *et al.* (2014) present a range of sound-pressure thresholds for different noise sources, and fish receptors; despite the lack of thresholds for particle motion presented within, Popper *et al.* (2014) currently remains the best available, and industry supported guidance to inform the assessment of underwater sound impacts to Fish and Shellfish (Popper and Hawkins, 2021). Subsequently, to inform this assessment, underwater sound modelling has been undertaken, using the thresholds defined for marine fish in Popper *et al* (2014). **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR** presents the relevant effects criteria and noise source impact

thresholds (associated with the MHPGC Project) as defined by Popper *et al.* (2014), which are used to inform the underwater sound modelling and subsequent assessment. The full results of modelling for a range of noise sources, associated with the MHPGC Project are also detailed in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**.

4.8.2.80 To inform the assessment of fish receptors, all fish VERs have been assigned to one of the hearing groups defined by Popper *et al.* (2014), based on the structure and functionality of their auditory systems. The hearing groups comprise:

- Group 1 species, which lack a swim bladder or possess a swim bladder that is not involved in hearing and are therefore primarily sensitive to particle motion;
- Group 2 species, which possess a swim bladder that is not directly involved in hearing and are also primarily sensitive to particle motion;
- Group 3 species, which possess a swim bladder connected to the auditory system and are therefore sensitive to both particle motion and sound pressure; and
- Eggs and larvae.

4.8.2.81 Different impact thresholds for different noisy activities apply to each hearing group, reflecting differences in hearing sensitivity and susceptibility to underwater sound effects (Popper *et al.*, 2014). The fish VERs assigned to each hearing group are presented in **Table 4.19** below.

Table 4.19: Hearing categories of fish receptors (Popper *et al.*, 2014). (*denotes uncertainty or lack of current knowledge with regards to the potential role of the swim bladder in hearing)

Hearing Group	Description	VERs
Group 1 (no swim bladder (particle motion detection))	Fish species that lack a swim bladder and are sensitive to particle motion and therefore only show sensitivity to a narrow band of frequencies.	Sandeel, lemon sole, plaice, anglerfish, mackerel, elasmobranchs (basking shark, porbeagle, spurdog, tope, spotted ray, common skate, flapper skate, thornback ray, starry smooth-hound), river lamprey and sea lamprey.
Group 2 (swim bladder is not involved in hearing (particle motion detection))	Fishes with swim bladders that do not appear to play a role in hearing. Therefore, they are only sensitive to particle motion and only show sensitivity to a narrow band of frequencies.	Atlantic salmon, brown trout.
Group 3 (swim bladder involved in hearing (primarily pressure detection))	Fishes with swim bladders which are involved in hearing. These species are sensitive to both particle motion and sound pressure, extending up to around 500 Hertz (Hz).	Herring, sprat, cod, whiting, blue whiting, twaite shad, allis shad, ling*, European eel*, European hake, saithe*, Norway pout* and haddock*.
Eggs and larvae	Eggs and larvae are considered a species of increased sensitivity by Popper *et al.* (2014) due to their vulnerability, reduced mobility, and small size.	Eggs and larvae of all spawning VERs in the Fish and Shellfish Ecology Study Area (sprat, whiting, plaice, Sandeel, sole, cod, herring, Norway pout).

4.8.2.82 In the case of shellfish, Popper *et al.* (2014) do not define hearing groups or associated impact thresholds. Therefore, an assessment has been based on a review of peer-reviewed literature on the current understanding of the potential impacts of underwater sound on shellfish species. As shellfish do not possess swim bladders or other gas filled organs, they are generally considered to be more sensitive to particle motion than to sound pressure (e.g. Popper and Hawkins, 2018). Accordingly, the assessment focuses on the potential effects of particle motion associated with underwater sound.

4.8.2.83 The below sections, present the interpretation of the modelling outputs (presented in full in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**) and full assessment of the potential impacts of underwater sound on sensitive Fish and Shellfish receptors.

4.8.2.84 To support this assessment, the criteria developed by Popper *et al.* (2014) have been applied to both impulsive noise sources (e.g., geophysical investigation equipment such as UHRS sparkers) and continuous noise sources (e.g., underwater sound from geophysical investigation equipment such as Sub-Bottom Profiler (SBP) chirp, together with underwater sound from geotechnical investigations, route preparation, cable installation, landfall works, and vessel movements). These noise sources operate at frequencies that overlap with the hearing range of fish species and therefore have the potential to result in auditory injury and/or behavioural responses.

4.8.2.85 Noise sources that fall within the high-frequency range (i.e. sources operating at frequencies greater than 10 kHz), such as Multi-Beam Echosounders (MBES), Side-Scan Sonar (SSS) single-beam echosounders (SBES), high-frequency sub-bottom profilers (SBPs), and USBL acoustic positioning systems, are not considered further in this assessment. This is because these frequencies are above the hearing range of fish species and will therefore not result in any injurious effects or disturbance. Consistent with this, Popper *et al*. (2014) do not define injury or behavioural effect thresholds for fish receptors exposed to these high-frequency noise sources.

4.8.2.86 **Table 4.20** to **Table 4.24** present the impact ranges associated with the relevant survey and installation activities associated with the MHPGC Project, derived through application of the appropriate criteria presented by Popper *et al.* (2014), and based on the maximum noise levels in the water column for each activity. The Popper *et al.* (2014) criteria applied reflect the acoustic characteristics of each noise source, including whether the source is impulsive or continuous and its operating frequency range. Impact ranges are provided for each fish receptor group and reflect the expected extent of impacts from the relevant impulsive and continuous noise sources. In addition to quantitative impact ranges, the Popper *et al.* (2014) criteria incorporate qualitative risk thresholds where insufficient evidence exists, based on the relative risk of effects at various distances from the noise source. These are categorised as near (N), representing distances of tens of metres from the source, intermediate (I), representing distances of hundreds of metres, and far (F), representing distances of thousands of metres. The associated level of risk is described as high, moderate or low, depending on the receptor group and effect considered.

4.8.2.87 **Table 4.20** and **Table 4.21** present the modelled impact ranges for UHRS sparker noise. The UHRS sparker is an impulsive noise source. However, because it emits frequencies of predominantly between 50 Hz and 4 kHz, the Popper *et al*., (2014) criteria for low-frequency and mid-frequency sonar are used as the most appropriate proxies for assessing potential effects.

Table 4.20: Predicted Impact ranges from UHRS sparker geophysical survey equipment generating low frequency sounds

Hearing Group	Mortality and potential injury	Recoverable injury	TTS	Auditory masking	Behaviour
Group 1 (no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	<10m	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low
Group 2 (swim bladder is not involved in hearing (particle motion detection)	<10m	<10m	<10m	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low
Group 3 (swim bladder involved in hearing (primarily	<10m	<10m	<10m	(N) Moderate (I) Low (F) Low	<10m

Hearing Group	Mortality and potential injury	Recoverable injury	TTS	Auditory masking	Behaviour
pressure detection					
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low

* Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near field (N; i.e. 10s of metres), intermediate (I; i.e. 100s of metres), and far field (F; i.e. 1000s of metres); Popper *et al.* (2014).

Table 4.21: Predicted Impact ranges from UHRS sparker geophysical survey equipment generating mid frequency sounds

Hearing Group	Mortality and potential injury	Recoverable injury	TTS	Auditory masking	Behaviour
Group 1 (no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	No thresholds have been defined for these impacts because available evidence is insufficient to establish one, and species in this receptor group generally have limited hearing sensitivity to mid-frequency sounds.		
Group 2 (swim bladder is not involved in hearing (particle motion detection)	<10m	<10m	No thresholds have been defined for these impacts because available evidence is insufficient to establish one, and species in this receptor group generally have limited hearing sensitivity to mid-frequency sounds.		
Group 3 (swim bladder involved in hearing (primarily pressure detection	<10m	<10m	<10m	(N) Low (I) Low (F) Low	<10m
Eggs and larvae	No thresholds have been defined because the available evidence is insufficient to recommend exposure guidelines for fish eggs and larvae.				

* Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near field (N; i.e. 10s of metres), intermediate (I; i.e. 100s of metres), and far field (F; i.e. 1000s of metres); Popper *et al.* (2014).

4.8.2.88 **Table 4.22** presents the modelled impact ranges for SBP chirp, a non-impulsive noise source, which is assessed using mid-frequency sonar criteria (by Popper *et al.*, 2014)

Table 4.22: Predicted Impact ranges from SBP chirp geophysical survey equipment generating mid frequency sounds

Hearing Group	Mortality and potential injury	Recoverable injury	TTS	Auditory masking	Behaviour
Group 1 (no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	No thresholds have been defined for these impacts because available evidence is insufficient to establish one, and species in this receptor group generally have limited hearing sensitivity to mid-frequency sounds.		
Group 2 (swim bladder is not involved in hearing (particle motion detection)	< 10m	< 10m	No thresholds have been defined for these impacts because available evidence is insufficient to establish one, and species in this receptor group generally have limited hearing sensitivity to mid-frequency sounds.		

Group 3 (swim bladder involved in hearing (primarily pressure detection	< 10m	< 10m	< 10m	(N) Low (I) Low (F) Low	< 10m
Eggs and larvae	No thresholds have been defined because the available evidence is insufficient to recommend exposure guidelines for fish eggs and larvae.				

* Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near field (N; i.e. 10s of metres), intermediate (I; i.e. 100s of metres), and far field (F; i.e. 1000s of metres); Popper *et al*. (2014).

4.8.2.89 **Table 4.23** and **Table 4.24** below present the modelled impact ranges resulting from vibro-coring, rock cutting, dredging activities and vessel noise. As these activities generate non-impulsive noise, potential impacts have been assessed in accordance with the continuous noise criteria described by Popper *et al.* (2014). In the absence of suitable criteria for the assessment of noise impacts arising from seismic cone penetration testing (sCPT) activities, given the low level of noise produced by sCPT, sCPT noise has been assessed using the continuous noise criteria defined by Popper *et al.* (2014).

4.8.2.90 In accordance with the guidance by Popper *et al.* (2014), the majority of the thresholds under the Shipping and Continuous Sounds criteria are qualitative, reflecting insufficient evidence to establish quantitative thresholds. These qualitative 'relative risk of effect' thresholds are consistent for all continuous noise sources and are presented in **Table 4.23.** For the recoverable injury and TTS of Group 3 receptors, quantitative thresholds are defined. The impact ranges for the respective noise sources, based on the maximum noise level in the water column for each activity are presented in **Table 4.24.**

Table 4.23: Predicted qualitative impact ranges from all continuous noise sources (Popper *et al.*, 2014)

Hearing Group	Mortality and potential injury	Recoverable injury	TTS	Auditory masking	Behaviour
Group 1 (no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Group 2 (swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Group 3 (swim bladder involved in hearing (primarily pressure detection	(N) Low (I) Low (F) Low	See modelled outputs for this threshold for each respective activity in **Table 4.24**.	See modelled outputs for this threshold for each respective activity in **Table 4.24**.	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

* Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near field (N; i.e. 10s of metres), intermediate (I; i.e. 100s of metres), and far field (F; i.e. 1000s of metres); Popper *et al*. (2014).

Table 4.24: Predicted recoverable injury and TTS impact ranges for Group 3 receptors from activities generating continuous noise (Popper *et al.*, 2014)

Activity	Recoverable injury (exposure over a 48 hour period)	TTS (exposure over a 12 hour period)
sCPT	< 10m	< 10m
Vibro-coring	20m	120m
Rock cutting	20m	190m
Dredging	< 10m	50m
Medium support vessel	10m	100m
Small support vessel	< 10m	< 10m
Cable laying vessel	170m	550m

Magnitude of Impact

4.8.2.91 The magnitude of impact has been informed by the outputs of the underwater sound modelling presented in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**, using the assessment criteria defined by Popper *et al*. (2014). The assessment considers the predicted spatial extent, and duration of the impacts from impulsive and continuous underwater sound sources associated with construction of the MHPGC Project.

4.8.2.92 With regard to the potential impact ranges from impulsive noise to fish receptors, arising from the use of UHRS sparker geophysical survey equipment generating low to mid-frequency sounds, mortality and injurious effects are localised to the source, restricted to within 10 s of metres for all hearing grounds where quantitative thresholds are available. Under the Popper *et al.* (2014) qualitative criteria, the relative risk of effect is assessed as Low at all distances from the noise source. The only exception relates to Group 3 fish, when exposed to low frequency sounds generated by UHRS sparkers where the risk of auditory masking is assessed as Moderate risk in the near field (10s of metres), reducing to Low at intermediate (100s of metres) and far-field (1,000s of metres) ranges. Behavioural effects for this group remain localised, restricted to within 10m of the noise source.

4.8.2.93 Similarly, potential impacts from SBP chirp geophysical survey equipment generating mid frequency sounds are localised to the source for all fish hearing groups, restricted to within 10s of metres for all hearing grounds where quantitative thresholds are available, with a Low risk of effect estimated at all distances from the noise source where qualitative thresholds are available.

4.8.2.94 The risk of mortality or potential mortal injury of fish receptors, associated with continuous noise sources (from activities such as geotechnical investigations, sCPT geophysical surveys, route preparation, cable installation and vessel movements) is predicted to be Low for all hearing groups, regardless of distance from the source, although it should be acknowledged, that there is no direct evidence of mortality or potential mortal injury in fish from continuous noise sources. Similarly, qualitative assessments of recoverable injury are low across all receptor groups at all distances, and the relative risk of TTS is estimated to Moderate for Group 1 and Group 2 receptors in the near field (10s of metres). Where quantitative thresholds are available for Group 3 species for recoverable injury and TTS, predicted impact ranges are generally localised, with the smallest impact ranges associated with the use of sCPT geophysical survey equipment and mobilisation of small survey vessels (recoverable injury and TTS ranges of up to 10m). The largest impact ranges are associated with the cable laying vessel, for which recoverable injury and TTS are predicted to extend to approximately 170m and 550m, respectively. It should be noted however, that these impact ranges assume continuous exposure to the noise sources over a 48-hour period for recoverable injury and a 12-hour period for TTS. Given the mobile nature of fish receptors, the ability of individuals to move away from the source, and the intermittent and transient nature of the survey and construction activities, such prolonged exposure durations are considered unlikely.

4.8.2.95 Regarding auditory masking in fish receptors, the ranges of effects for all receptors are slightly greater, with moderate to high risk estimated at all distances from the source (10s to 100s of metres). However, it should be acknowledged that masking is only considered to occur where project-related noise reduces the signal-to-noise ratio by more than 6 dB (Popper *et al*., 2014) and only persists while the noise source is active. Therefore, although masking may occur in the vicinity of continuous noise sources, any effects would be temporary and reversible, with the potential for masking also reducing rapidly with increasing distance as project-related noise attenuates and approaches ambient noise levels.

4.8.2.96 Behavioural effects in fish receptors from continuous noise are for the most part, only anticipated to occur in the near (10s of metres) to intermediate (100s of metres) distances from the source of noise, with low risk of behavioural impacts predicted at greater distances.

4.8.2.97 It is therefore apparent that a small degree of disturbance to fish receptors may occur during construction, arising from activities such as geophysical surveys, geotechnical investigations, route preparation, cable installation, landfall works and vessel movements. As informed by the underwater sound modelling, and the qualitative relative risk thresholds, mortality and injurious effects in all hearing groups are predicted to be of low risk, and localised to the noise source. Recoverable injury and TTS, have the potential to occur at slightly greater distances from the source (up to 550 for the use of a cable laying vessel), although these estimates are based on the assumptions that receptors will experience 48 hour and 12 hour exposure to continuous noise sources, for recoverable injury and TTS to occur respectively in the most sensitive hearing groups. Taking the limited spatial extent, intermittent nature of the works, and reversible nature of the predicted effects into account, the magnitude of impact, for all fish receptors is assessed as **low**.

4.8.2.98 Regarding the potential for impacts from underwater sound on shellfish receptors, on the basis that they do not possess swim bladders or other gas filled organs, it is considered that shellfish are primarily sensitive to particle motion rather than sound pressure (e.g., Popper and Hawkins, 2018). Geophysical surveys, vessel noise, and other continuous noise sources are recognised as sources of particle motion, generating particle motion in the nearfield (Hazelwood and Macey, 2016). Impacts from particle motion are likely to occur local to the source, with studies having demonstrated the rapid attenuation of particle motion with distance (Mueller-Blenkle *et al*., 2010). Taking the limited spatial extent, intermittent nature of the works, and reversible nature of the predicted effects into account, the magnitude of impact, for all shellfish receptors is assessed as **low**.

Receptor sensitivity

Group 1 fish receptors

4.8.2.99 Group 1 receptors lack a swim bladder and are therefore considered less sensitive to underwater sound than other species. Group 1 receptors that have the potential to be present within the Fish and Shellfish Ecology Study Area include: sandeel, lemon sole, witch flounder, European plaice, mackerel, anglerfish, elasmobranchs (thornback ray, spotted ray, thorny skate, lesser spotted dogfish, spurdog, tope, common smooth-hound, basking shark), river lamprey and sea lamprey.

4.8.2.100 Sandeel high intensity spawning grounds and low intensity nursery grounds interact with the Fish and Shellfish Ecology Study Area. Sandeel are considered static receptors, due to their burrowing nature, substrate dependence, and demersal spawning behaviours, which increases their exposure to underwater sound.. While sandeel may be affected by vibration through the seabed, particularly when buried during hibernation, any small-scale mortality in the affected area is expected to be mitigated at the population level through immigration from suitable habitats located outside of the impacted area. Sandeel are therefore deemed to be of low vulnerability to underwater sound (on account of their absence of a swim bladder), medium recoverability and are of national importance. The sensitivity of the receptor to underwater sound impacts is therefore considered to be **low**.

4.8.2.101 Lemon sole and plaice are Group 1 receptors which have spawning grounds that interact with the Fish and Shellfish Ecology Study Area. These receptors are pelagic spawners and are therefore not limited to specific sedimentary areas for spawning, limiting their exposure to underwater sound. As

Group 1 receptors, they are considered to have a low vulnerability to underwater sound due to the absence of a swim bladder. Based on their wide distribution across the North Sea, and lack of dependency on specific spawning substrates, these species are able to recover relatively quickly from disturbance through recolonisation of affected areas. These Group 1 receptors are widely distributed across the North Sea and therefore in the context of the wider environment, the spatial impacts from underwater sound are considered to be of local scale. The sensitivity of these receptors to underwater sound impacts is therefore considered to be **low**.

4.8.2.102 All other Group 1 receptors are of low vulnerability to underwater sound due to the absence of a swim bladder. Given the wide distribution of these receptors across the North Sea, and the localised and temporary nature of the impact, any exposure to underwater sound is expected to be short-term, with rapid recovery following cessation of the activity.. Taking this into account, the receptors are deemed to be of low vulnerability, high recoverability and are of regional to international importance. The sensitivity of these receptors to underwater sound impacts is therefore considered to be **low**.

Group 2 fish receptors

4.8.2.103 Group 2 receptors have a swim bladder and are therefore considered more sensitive to underwater nose than Group 1 species (i.e., the species have an internal air sac which can be affected by sound pressure). Group 2 species identified as of relevance to the MHPGC Project are Atlantic salmon and brown trout. As Group 2 receptors, they are considered to be primarily sensitive to particle motion and are likely to mainly sense underwater sound through movement of the water particles, though are also more sensitive to barotrauma due to the presence of internal air sacs.

4.8.2.104 Atlantic salmon and brown trout are both diadromous species; in late spring to early summer, adult Atlantic salmon return to rivers to spawn, whilst juvenile salmon migrate out to sea to feed. Most brown trout will migrate into rivers in June and then migrate back out to sea in October (Heard, 2007). These receptors are therefore likely to be transient receptors within the Fish and Shellfish Ecology Study Area during their migrations, with any exposure to underwater sound therefore expected to be temporary, with recovery occurring following cessation of the sound source.. These receptors are therefore considered to be of low vulnerability, high recoverability, and national (brown trout) to international (Atlantic salmon are afforded protection under the OSPAR threatened or declining species list) importance. The sensitivity of these receptors to underwater sound impacts is therefore considered to be **low.**

Group 3 fish receptors

4.8.2.105 Group 3 receptors have a swim bladder which is linked to the inner ear and so is directly involved in hearing. These species are considered to be the most sensitive to underwater sound, with direct detection of sound pressure, rather than just particle motion. Group 3 receptors that have the potential to be present within the Fish and Shellfish Ecology Study Area include herring, sprat, ling, European eel, European hake, saithe and haddock.

4.8.2.106 Herring are demersal spawners, depositing their eggs on the seabed and remaining within the spawning area during this period. For the purposes of this assessment, they are therefore treated as stationary receptors during their spawning seasons (Buchan: August–September; Banks: August–October), which increases their potential exposure to underwater sound generated during construction. As outlined in **Section 4.8.1.2**, the Fish and Shellfish Ecology Study Area interacts with both the Buchan and Banks herring spawning grounds. The Buchan element of the Atlantic herring stock lies approximately 0.3km from the MHPGC Project PEIR Red Line Boundary in Scottish waters, while the Banks ground is approximately 6.5km away in English waters. Although the Buchan spawning ground is close to the project boundary, areas of confidence that active spawning is occurring, are located approximately 15.4km from the nearest point of the MHPGC Project PEIR Red Line Boundary, outside of the Fish and Shellfish Ecology Study Area. Herring are classified as Group 3 receptors, as their swim bladder is connected to the auditory system, making them particularly sensitive to underwater sound. Considering their vulnerability to underwater sound, their demersal spawning nature and substrate dependency, herring are assigned a **high** sensitivity to underwater sound.

4.8.2.107 Sprat are pelagic spawners, and have spawning grounds that interact with the Fish and Shellfish Ecology Study Area, and across the northern North Sea. . Although sprat are classified as Group 3 receptors, their wide distribution across the North Sea, and broadcast spawning nature support rapid recovery from disturbance from underwater sound. Sprat are therefore considered to be of **low** sensitivity to underwater sound.

4.8.2.108 All other Group 3 receptors (ling, European eel, European hake, saithe and haddock) are key components of the fish assemblages within the Fish and Shellfish Ecology Study Area, have nursery grounds overlapping the Fish and Shellfish Ecology Study Area, or are of commercial or conservation importance. Based on their mobile nature, these receptors are expected to recover quickly, returning to normal behaviours, recolonising areas shortly after disturbance, therefore, the sensitivity of these receptors to underwater sound is considered to be **low**.

Eggs and larvae

4.8.2.109 Eggs and larvae are considered organisms of concern by Popper *et al.* (2014), due to their vulnerability, reduced mobility and small size, it is on this basis that eggs and larvae are assigned a **medium** sensitivity to underwater sound.

Shellfish

4.8.2.110 On the basis that shellfish do not possess swim bladders or other gas-filled organs, they are considered to be primarily sensitive to particle motion rather than sound pressure (e.g., Popper and Hawkins, 2018). Marine invertebrates thought to detect primarily low-frequency particle motion (Mooney *et al.*, 2010; Mooney *et al.*, 2012), although available evidence suggests that marine invertebrates are generally less sensitive to particle motion than fish (Fay and Simmons, 1999; Roberts and Elliott, 2017).

4.8.2.111 As understanding of marine invertebrate sensitivity to particle motion remains limited (Lewandowski *et al.*, 2016), there is little information available regarding the potential for hearing damage in shellfish resulting from particle motion exposure. Aquatic decapod crustaceans possess a number of receptor types that may respond to both the particle motion component of underwater sound (i.e., the vibration of the water molecules which results in the pressure wave) and ground-borne vibration (Popper *et al.*, 2001). Sensitivity is generally provided by mechanosensory hairs, although other sensory systems may also be capable of detecting vibration.

4.8.2.112 Available studies (although limited and largely based on controlled laboratory experiments) indicate that continuous noise may elicit behavioural and physiological responses in some shellfish species. Observed effects are generally subtle, species-specific and often temporary. Solan *et al.* (2016) exposed *Nephrops* to broadband sound fields representative of offshore shipping noise and reported reduced burying activity and movements together with increased bioirrigation behaviour, whereby individuals increased the pumping of water through their burrows to ventilate them and maintain oxygen levels. Hubert *et al.* (2018) observed reduced foraging behaviour in European green crab (*Carcinus maenas*) and brown shrimp (*Crangon crangon)* exposed to broadband artificial noise, although no effects on feeding rates were recorded. Similarly, Wale *et al.* (2013), observed disrupted feeding behaviour, slower anti-predator response and faster righting times in Shore crab (*Carcinus maenas*) when exposed to recordings of ship noise. Studies of on European spiny lobster (*Palinurus elephas*) also recorded physiological and biochemical responses, including changes in haemolymph parameters, tissue condition and gene expression following exposure to vessel and boat noise (Celi *et al.* 2015 and Filiciotto *et al.* 2014). Collectively, these studies demonstrate that some shellfish species can detect and respond to underwater sound exposure; however, the available evidence is largely derived from short-term experimental studies, and the biological significance of the observed effects remains uncertain. Reported effects are generally transient, species-specific and sub-lethal, with little evidence of mortality, injury or population-level consequences. Taking this evidence into consideration, shellfish VERs within the underwater sound ZoI are considered to have low vulnerability to underwater sound. The sensitivity of these receptors is therefore assessed as **low**.

Significance of effect

4.8.2.113 Overall, it is considered that the receptor sensitivity ranges from low to medium (with the exception of spawning herring) and the magnitude of underwater sound (excluding UXO) is low. Therefore, the effect of underwater sound (excluding UXO) during the construction phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

4.8.2.114 For spawning herring, sensitivity to underwater sound is considered high, while the magnitude of impact is assessed as low. Consequently, the effect of underwater sound during the construction phase (excluding UXO clearance) is considered to be minor to moderate at most. Importantly, the predicted underwater sound impact ranges do not overlap with areas where spawning activity is known to occur with a high degree of confidence, as these areas are located beyond the predicted range of impact. Given the localised nature of the construction noise sources and their distance from important spawning areas, significant disturbance to spawning herring is not anticipated. On the basis of expert judgement, the overall significance of effect is therefore assessed as **minor adverse** and is not significant in EIA terms.

Additional mitigation and residual effect

4.8.2.115 At this stage, no additional mitigation is proposed for underwater sound (excluding UXO) in Scottish or English waters. Therefore, the residual effect of underwater sound (excluding UXO), during the construction phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Underwater sound from UXO clearance: mortality, injury, behavioural impacts and auditory masking

4.8.2.116 Prior to construction of the MHPGC Project, it may be necessary to undertake UXO clearance. Specific information regarding the type and size of the UXO and its location will not be available until dedicated UXO pre construction surveys are undertaken, however, this assessment is informed by a desk-top study (Tetra Tech RPS Energy, 2026)X to ensure a robust assessment is undertaken for DCO submission and Marine Licence application(s). A worst case of 22 UXO detonations and a range of possible charge sizes across the MHPGC Project PEIR Red Line Boundary has been considered for underwater sound propagation modelling, as detailed in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**.

4.8.2.117 It is important to note that the Applicant is seeking consent for low order clearance of UXO only. High order clearance has been included within this assessment for information and completeness only and does not form part of the consent application; should high order clearance subsequently be determined necessary, this will be secured under a separate Marine Licence application.

4.8.2.118 The MHPGC Project assessment excludes UXO clearance activities within the area of the MHPGC Project PEIR Red Line Boundary that overlaps with Morven North and Morven South, as these activities are being assessed and consented separately within the relevant Morven North and Morven South consent applications. This assessment therefore considers potential UXO clearance activities associated with the MHPGC Project, including those within the Scottish marine area ("the funnel") and English waters. In accordance with the MDS (**Section 4.6.2**), up to 22 UXO clearance events have been considered within this assessment. This comprises up to eight UXO clearance events within Scottish waters and up to 14 UXO clearance events within English waters.

4.8.2.119 Underwater sound modelling for both low order and high-order UXO clearance has been undertaken following the standard methodology described in Soloway and Dahl (2014), with full results provided in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**. As aforementioned, the low order modelling outputs have been used to inform the assessment presented herein, whilst the high order modelling outputs are presented for contextual information only and do not inform the assigned magnitude or significance of effect.

Magnitude of impact

4.8.2.120 The magnitude of effect (and resultant significance of effect) presented within this assessment is based on low order clearance only, as this is the activity for which consent is sought. High order clearance has been considered within this assessment for information and to provide context to inform any future application but, as it does not form part of this consent application. As such, a magnitude of effect has not been assigned to it.

4.8.2.121 To inform the assessment, underwater sound modelling has been undertaken for UXO detonations (low order and high order).

4.8.2.122 The modelling for high order detonations is based purely on the charge weight of the UXO. Noting that this estimation does not take into account the design, composition, age, position, orientation, and sediment coverage of the UXO, which leads to a high degree of uncertainty. Due to these uncertainties, a worst-case and therefore precautionary estimation is used for the calculations, assuming the UXO is not buried, degraded or subject to any other significant attenuation. The maximum equivalent charge weight for the potential UXO devices that could be present within the MHPGC Project PEIR Red Line Boundary is estimated as 697 kg. This has been modelled alongside smaller charge weights ranging from 0.08 to 0.75 kg for low order techniques, and 1.2 to 431kg for high order clearance. The estimation of the source noise level for each charge weight (low and high order) was carried out in accordance with the methodology of Soloway and Dahl (2014), which follows Arons (1954) and the Marine Technical Directorate Ltd. (MTD) (1996), and the impact ranges for fish receptors determined using the Popper *et al* (2014) criteria.

4.8.2.123 The full noise modelling outputs are presented in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR** and referred to as appropriate in the following assessments.

4.8.2.124 **Table 4.25** and **Table 4.26** below summarise the results for the relevant criteria against each the UXO detonation scenarios, including high and low-order detonations.

Table 4.25: Impact ranges (m) for low order and high order UXO clearance with regards to mortality and potential mortal injury of fish (Hearing groups 1 to 3)

Charge weight (kg)	Distance Range (m) at which upper and lower bound thresholds are met
Low-order and low-yield donor charge configurations	
0.08	< 10m
0.5	< 10m – 10m
2 x 0.75	< 10m – 20m
4 x 0.75	10m – 20m
High order charge configurations (for information only)	
1.2	< 10m – 10m
3.5	10m – 20m
High order UXO clearance (for information only)	
136	30m – 80m
270	50m – 100m
431	80m – 120m
697	80m – 340m

Table 4.26: Predicted qualitative impact ranges for UXO clearance, with regards to recoverable injury, TTS and behavioural effects of fish

Hearing Group	Recoverable injury	TTS	Behavioural effects
Group 1 (no swim bladder (particle motion detection)	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Group 2 (swim bladder is not involved in hearing (particle motion detection)	(N) High (I) High (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) High (F) Low
Group 3 (swim bladder involved in hearing (primarily pressure detection	(N) High (I) High (F) Low	(N) High (I) High (F) Low	(N) High (I) High (F) Low
Eggs and larvae	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low

* Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near field (N; i.e. 10s of metres), intermediate (I; i.e. 100s of metres), and far field (F; i.e. 1000s of metres); Popper *et al*. (2014).

4.8.2.125 In accordance with the qualitative Popper *et al*. (2014) explosion noise criteria, recoverable injury and TTS ranges from high-order detonations will represent progressively larger areas, with recoverable injury and TTS having the potential to occur in the near (10s of metres) and intermediate fields (100's metres), and low in the far field (1,000s of meters) from the detonation for Group 3 receptors (Popper *et al*., 2014). It should be noted that there are no Popper *et al*. (2014) explosion noise criteria for low order deflagration, although the ranges for recoverable injury and TTS are anticipated to be significantly smaller.

4.8.2.126 It is possible that UXO operations will be planned to take place year-round during the UXO clearance campaign pre-construction and therefore have the potential to interact with the spawning periods of different Fish and Shellfish species. However, each UXO clearance is a discrete event and while this may result in some temporary (but highly localised) disturbance to spawning fish, it is unlikely to result in the displacement of fish from specific spawning grounds. Overall, the magnitude of impact from low order clearance is considered to be **negligible** for fish receptors, given the localised nature of impact (up to 20m) and discrete temporal nature of the detonations.

4.8.2.127 As aforementioned, shellfish receptors do not possess swim bladders or other gas filled organs and are considered primarily sensitive to particle motion rather than sound pressure (e.g., Popper and Hawkins, 2018). UXO clearance activities are recognised as sources of particle motion, generating high levels of particle motion in the nearfield (Hazelwood and Macey, 2016). Impacts from particle motion are likely to occur local to the source, with studies having demonstrated the rapid attenuation of particle motion with distance (Mueller-Blenkle *et al*., 2010). Taking into account that this assessment is based on low-order clearance only, together with the highly localised spatial extent of effects, intermittent and discrete nature of the activity, and the reversible nature of any predicted effects, the magnitude of impact for all shellfish receptors is assessed as **negligible.**

Receptor sensitivity

4.8.2.128 As noted previously, all receptors are considered to be of **low** sensitivity to underwater sound, with the exception of eggs and larvae and spawning herring, which are of **medium** and **high** sensitivity to underwater sound respectively.

Significance of effect

4.8.2.129 Overall, taking account of both underwater sound impacts on fish receptors and particle motion impacts on shellfish receptors, receptor sensitivity ranges from low to high, while the magnitude of

impact associated with low-order UXO clearance is considered negligible due to the highly localised and temporary nature of the effects. Therefore, the effect of underwater sound from UXO low order clearance during the construction phase is considered to be **minor adverse** at most, which is not significant in EIA terms

Additional mitigation and residual effect

4.8.2.130 At this stage, no additional mitigation (above that presented in **Table 4.18**) is proposed for underwater sound from low order UXO clearance in Scottish or English waters. Therefore, the residual effect of underwater sound from low order UXO clearance during the construction phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Increased risk of introduction and spread of invasive non-native species

4.8.2.131 During construction, an increased risk of introduction and spread INNS in the MHPGC Project PEIR Red Line Boundary could result from the use of vessels during construction for route clearance and cable installation. In particular, INNS could be transported via vessel hulls or through the release of ballast water.

Magnitude of impact

4.8.2.132 During construction, an increased risk of introduction of INNS could occur due to the use of vessels in both Scottish and English waters. Offshore, there will be up to 550 return trips by installation vessels. A maximum of 33 vessels will be on site at any one time. At the landfall in English waters, a further 14 vessels could be on site at any one time, with 250 return trips by installation vessels. INNS can be introduced and spread by colonisation of the hulls of vessels and via the release of ballast water.

4.8.2.133 During MHPGC Project-specific subtidal benthic surveys, no INNS were identified in either Scottish or English waters (XOcean Ltd, 2023), however a record of orange-tipped sea squirt was found within the wider Benthic Subtidal Ecology Study Area in English waters see **Volume 2, Annex 3.1: Benthic Ecology Technical Report, of the PEIR**). However, it is important to note that it is an established and a relatively widespread species around the coast of England, including the northeast. Furthermore, it is possible that other INNS are present within the Benthic Subtidal and Intertidal Ecology Study Area. INNS are difficult to detect, and the absence of records does not necessarily equate to true absence.

4.8.2.134 Embedded mitigation has been incorporated into the MHPGC Project design to minimise the risk of introducing and spreading INNS during construction (**Table 4.18**). An Outline MBP (CoT38) will form part of the Outline OEMP (CoT06/MM-006) submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. The Outline MBP will include measures to follow the latest INNS guidance issued by the Great Britain Non-Native Species Secretariat, ensure compliance with the IMO Ballast Water Management Guidelines, and address biosecurity risks associated with offshore installation activities and any cable protection measures. A Detailed MBP will be developed substantially in accordance with the Outline MBP and implemented throughout construction activities.

4.8.2.135 The development and implementation of an Outline MBP (CoT38), secured through the Outline OEMP (CoT06/MM-006), will reduce the risk of INNS introduction and/or spread during construction activities. The measures contained within the MBP will minimise risks associated with vessel movements, ballast water management and biofouling, and will reduce the likelihood of construction activities acting as a pathway for the introduction or spread of INNS. Furthermore, no INNS were identified during the MHPGC Project-specific benthic surveys and only a single established INNS record was identified during the wider desktop review.

4.8.2.136 Therefore, taking account of the embedded mitigation measures described above, the likelihood of introduction and spread of INNS during the construction phase is considered to be very low. Consequently, the magnitude of increased risk of introduction and spread of INNS, during the construction phase in both Scottish and English waters is considered to be **negligible**.

Receptor sensitivity

4.8.2.137 Assessing the sensitivity of Fish and Shellfish to INNS is highly uncertain, as impacts may occur through a range of direct and indirect ecological pathways. For instance, INNS may influence these receptors via changes in prey availability, trophic interactions, resource competition, predation pressure or disease transmission, and these effects can operate across wide spatial scales, particularly with regards to mobile species, or through local habitat modification, particularly for sessile shellfish. Unlike benthic habitats, where INNS effects can often be linked to specific substrate types and direct resource competition, Fish and Shellfish receptors include mobile species which makes INNS responses more difficult to predict and sensitivity assessments (e.g., provided via MarESA and FeAST tools) less readily available.

4.8.2.138 To reflect the high level of ecological uncertainty associated with INNS, a precautionary approach has been applied. Fish and Shellfish receptors are considered to have low to negligible resistance to INNS, consistent with sensitivity criteria indicating limited capacity to adapt behaviourally or physiologically to such pressures. Resilience is assessed as low to very low, reflecting that INNS establishment can result in long-term or irreversible ecological change, with uncertain recovery trajectories for both mobile and sessile species.

4.8.2.139 Based on the assessment methodology outlined in **Section 4.5**, particularly where impacts may alter population structure, key ecological functions or survival, the overall sensitivity of Fish and Shellfish receptors to INNS introduction or spread is assessed as **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.

Significance of effect

4.8.2.140 Overall, it is considered that the receptor sensitivity is **high** and the magnitude of increased risk of introduction and spread of INNS is **negligible**. Therefore, the effect of increased risk of introduction and spread of INNS is during the construction phase is considered to be **minor adverse**, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.2.141 At this stage, no secondary mitigation is proposed for increased risk of introduction and spread of INNS in Scottish or English waters. Therefore, the residual effect of increased risk of introduction and spread of INNS, during the construction phase, is considered to be **minor**, which is not significant in EIA terms.

4.8.3 O&M phase

Long-term habitat loss

4.8.3.1 The long-term presence of infrastructure, including cable protection and cable crossings installed during the construction phase, and any repair works required during the O&M phase have the potential to impact on Fish and Shellfish ecology by the removal of essential habitats for survival (e.g., spawning, nursery and feeding habitats).

4.8.3.2 The presence of cable protection and crossings (installed in the constriction phase), and repair works in the O&M phase both require the placement of protective hard substrates, such as concrete mattresses, rock bags and CPS and rock installation/backfill where minimum burial depth cannot be achieved and at exit pits. Rock protection will also be required at locations where cable crossings with third-party infrastructure occur.

4.8.3.3 At this stage of the assessment, the exact locations of cable protection placement and therefore the habitats directly affected by long term habitat loss are unknown. However, long term habitat loss as a result of cable protection would be restricted to the footprint of the cable protection materials (including cable protection, cable crossings and exit pit protection) and would also be limited to

within the MHPGC Project PEIR Red Line Boundary. Therefore, it has been assumed that hard structures such as cable protection could be placed located anywhere within the MHPGC Project Offshore Export Cable Corridor.

Magnitude of impact

4.8.3.4 Long-term habitat loss is expected to occur for the duration of the 35-year O&M phase of the MHPGC Project, for as long as cable protection is present.

4.8.3.5 Total habitat loss for cable protection is expected to be up to 770,760m^2 and will be localised to within the MHPGC Project PEIR Red Line Boundary. Up to 16 cable crossings will occur along the MHPGC Project PEIR Red Line Boundary which will require either concrete mattresses or rock installation, with a total habitat loss of 57,600m^2..

4.8.3.6 Exit pits associated with the trenchless technique installation of the offshore export cables at the landfall in English waters will also be filled with protection material, resulting in a maximum habitat loss of 28,000m^2. The protection would be installed within the footprint of the excavated exit pits. The landfall is located in predominantly muddy sediments which are widespread in the central and northern North Sea, with areas of rock and boulders.

4.8.3.7 Taking account of cable protection, cable crossings and exit pit protection, the maximum footprint of long-term habitat loss would be up to approximately 828,360m² within the MHPGC Project PEIR Red Line Boundary. The majority of cable crossings and placement of cable protection are expected to predominantly occur within soft sediment habitats which are widespread in the central and northern North Sea in both Scottish and English waters. The placement of cable protection will therefore result in a change in habitat type from soft sediment to hard substrate. However, it should be noted that the use of cable protection will be reduced as far as practicable and, where required, will be installed in accordance with industry standard guidelines, including requirements relating to slope angle and rock grading (CoT38; **Table 4.18**).

4.8.3.8 Cable protection will be reduced as far as possible through implementation of the Offshore CSIP (CoT08/MM-010), which includes cable burial as the preferred option for cable protection, where practicable (**Table 4.18**). Cable installation requirements will be informed by a CBRA and cable protection will only be used where burial cannot be achieved.

4.8.3.9 While the impact will be locally significant and comprise a permanent change in seabed habitat at areas within the MHPGC Project PEIR Red Line Boundary, the footprint of the area affected is highly localised, and the Fish and Shellfish species assemblages and habitats are common and widespread across Scottish and English waters. The magnitude of the impact that permanent habitat loss/ alteration will have on Fish and Shellfish ecology receptors is considered to be **low**.

Receptor sensitivity

Demersal spawners

4.8.3.10 Sandeel are demersal spawners and are reliant upon the presence of suitable substrates for spawning (i.e., sandy sediments); as well as laying demersal eggs, sandeel also have specific habitat requirements throughout their juvenile and adult life history. Consequently, they are considered sensitive to changes in sediment characteristics and habitat quality. As described in **Section 4.4.5** and **Volume 2, Annex 4.1: Herring and Sandeel Assessment, of the PEIR**, project-specific survey data, modelled occurrence data and habitat confidence mapping indicate that suitable sandeel habitat within the MHPGC Project PEIR Red Line Boundary is limited, localised and comprises only a small proportion of the extensive spawning and supporting habitat available across the wider northern and central North Sea. However, the Fish and Shellfish Ecology Study Area overlaps recognised sandeel spawning and nursery grounds, and small areas of suitable spawning habitat are present within the MHPGC Project PEIR Red Line Boundary. Taking into account their substrate dependency, ecological importance as a key prey species, and the broad regional availability of suitable habitat, sandeel are deemed to be of high vulnerability to long-term habitat change, medium recoverability and of national importance (as a PMF and designated feature of Turbot Bank MPA).

The sensitivity of the receptor is therefore assessed as **medium**. This conclusion is consistent with the FeAST sensitivity assessment, which identifies sandeel as having medium sensitivity to the pressure 'physical loss of existing marine habitat'.

4.8.3.11 Herring are demersal spawners that rely on the presence of suitable coarse substrates, typically gravel, for successful egg deposition. Historic spawning habitats are widely distributed across the northern and central North Sea, including the Buchan and Banks spawning grounds (Coull *et al.*, 1998), located 300m northeast and 6.5km west of the MHPGC Project PEIR Red Line Boundary respectively.

4.8.3.12 Taking into account their ecological value as a key prey species, and their substrate dependency for spawning, herring are considered to have medium vulnerability to long term habitat loss. However, habitat suitability assessments indicate that the majority of the MHPGC Project PEIR Red Line Boundary is characterised by sediments unsuitable for herring spawning, with no prime or sub-prime spawning habitat identified and only isolated areas of suitable habitat present. In addition, the MHPGC Project PEIR Red Line Boundary does not overlap recognised herring spawning grounds, and spawning confidence mapping and IHLS larval data indicate low levels of contemporary spawning activity within the Fish and Shellfish Ecology Study Area. This is an important consideration given that ICES (2026) advises that activities on herring spawning habitats should only be undertaken where the effects have been assessed and demonstrated not to be detrimental. Consequently, any habitat lost would represent only a minor proportion of the wider spawning habitat resource available across the northern and central North Sea and would not affect key active spawning grounds associated with the population. Taking these factors into account, herring are considered to be of low vulnerability and medium recoverability and are therefore assessed as having **low** sensitivity to long-term habitat loss.

All other demersal and pelagic fish receptors

4.8.3.13 Atlantic cod, Norway pout, European plaice, lemon sole, witch flounder, sprat, whiting, mackerel, horse mackerel, ling, saithe, haddock, European hake and anglerfish are pelagic spawners and do not display substrate dependency and therefore these species are not considered vulnerable to long-term habitat loss, and as such the sensitivity of these species is considered to be **negligible**.

4.8.3.14 Mobile receptors (without spawning grounds within the vicinity of the project) do not display substrate dependency and therefore are not considered vulnerable to long-term habitat loss, and as such the sensitivity of these species is considered to be **negligible**.

Elasmobranchs

4.8.3.15 All of the identified elasmobranch receptors are mobile species (including basking shark), and while several are oviparous and lay egg cases on the seabed (including thornback ray, spotted ray, cuckoo ray, thorny skate, common skate, flapper skate and lesser-spotted dogfish), they do not rely on highly specific substrate types. Skate and catshark egg cases are deposited on a range of soft seabed habitats and suitable substrates for egg attachment are expected to be widespread outside the MHPGC Project PEIR Red Line Boundary. In contrast, spurdog and tope are viviparous species and give birth to live pups rather than using the seabed for egg deposition. Given this life-history flexibility and lack of strict substrate dependence, elasmobranchs are not considered vulnerable to long-term habitat loss, and their sensitivity is therefore assessed as **negligible**.

Shellfish

4.8.3.16 Shellfish species with limited mobility, such as edible crab, lobster, king scallop and queen scallop, may experience disturbance from habitat loss during construction. However, these species are generally capable of relocating to adjacent suitable areas if displaced. Less mobile infaunal species, have a reduced ability to move individually, but all shellfish considered are expected to recolonise the affected area at the population level once construction activities cease and natural seabed conditions recover. This expectation is supported by their broad distributions across the northern and central North Sea and the typically dynamic nature of shellfish populations. Although shellfish

resource in English and Scottish waters is of continued importance, the species present exhibit sufficient behavioural adaptability, broad habitat tolerance and population-level resilience to avoid sustained adverse effects. As long-term loss of ecological function or population viability is not anticipated, the overall sensitivity of shellfish populations to long-term habitat loss or disturbance is assessed as **low**.

Significance of effect

4.8.3.17 Overall, it is considered that the receptor sensitivity ranges from **negligible** to **medium** and the magnitude of permanent and/or long-term habitat loss/alteration is **low**. Therefore, the effect of permanent and/or long-term habitat loss/alteration during the O&M phase is considered to be **negligible to minor adverse** at most, which is significant in EIA terms.

Additional mitigation and residual effect

4.8.3.18 At this stage, no additional mitigation is proposed for temporary habitat loss and disturbance in Scottish or English waters. Therefore, the residual effect of temporary habitat loss and disturbance, during the O&M phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Temporary habitat loss and disturbance

4.8.3.19 During the O&M phase, temporary habitat loss and disturbance may occur as a result of maintenance and repair activities associated with the offshore export cable(s) and associated cable protection. These activities may include vessel anchoring, seabed preparation, cable inspection, maintenance, repair or remediation activities requiring localised seabed intervention.

Magnitude of impact

4.8.3.20 During the 35-year O&M phase of the MHPGC Project, up to 41 cable repairs are considered likely, resulting in a temporary habitat loss of 40,000m^2 per repair and 1,640,000m^2 in total. Up to 35 cable remediation events are also anticipated, with a total area of disturbance of 18,278,400m^2 over the total O&M phase (522,240m^2 per year). This disturbance will be limited to the construction footprint within the MHPGC Project PEIR Red Line Boundary and therefore any habitat loss will be localised.

4.8.3.21 The magnitude of temporary habitat loss and disturbance during the O&M phase is considered to be no greater than during the construction phase. Therefore, it is considered that the magnitude of temporary habitat loss and disturbance in Scottish and English waters, during the O&M phase will be **low.**

Receptor sensitivity

4.8.3.22 During the O&M phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to temporary habitat loss and disturbance is considered to be the same as during the construction phase. As a result, the sensitivity of receptors is therefore deemed to be **medium** at most (see **Paragraph 4.8.2.31**).

Significance of effect

4.8.3.23 Overall, it is considered that the receptor sensitivity ranges from **negligible to medium** and the magnitude of temporary habitat loss and disturbance is **low**. Therefore, the effect of temporary habitat loss and disturbance during the O&M phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.24 At this stage, no additional mitigation is proposed for temporary habitat loss and disturbance in Scottish or English waters. Therefore, the residual effect of temporary habitat loss and disturbance, during the O&M phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Increased SSC and associated sediment deposition

4.8.3.25 Temporary localised increases in SSC and associated sediment deposition are expected from cable remedial burial and cable repairs during the O&M period.

Magnitude of impact

4.8.3.26 Cable remedial burial, replacement and repair activities during the O&M phase (35 years) will generate localised sediment plumes. During this period, up to 41 export cable repairs may be required across Scottish and English waters, resulting in up to 40,000m² of temporary seabed disturbance per repair (up to 1,640,000m² in total). In addition, up to 4% of the cable route length may require remedial works each year, resulting in up to 522,240m² of temporary seabed disturbance per year (up to 18,278,400m² over the operational lifetime).

4.8.3.27 In the O&M phase, any increases in SSC and deposition are expected to be smaller in both spatial and temporal extent than during construction. Notably, sediment release from cable protection replenishment will also be considerably lower than from cable reburial, as only surface material is disturbed when protection is placed on the seabed, compared with mobilisation of the full trench volume during burial works. Furthermore, the seabed along the route in both Scottish and English waters is dominated by coarse sediments with minor mud content, supporting rapid settling and limited dispersion of disturbed material.

4.8.3.28 Across the operational lifetime, maintenance activities may disturb up to 19,92,000m² of seabed. However, each maintenance event is expected to be discrete, short-lived and spatially limited to within one tidal excursion. On this basis, the magnitude of effect during operation and maintenance is assessed as **low** at most.

Receptor sensitivity

4.8.3.29 During the O&M phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to increased SSC and associated sediment deposition is considered to be the same as during the construction phase. As a result, the sensitivity of receptors is therefore deemed to be **low** to **medium** at most (see **Paragraph 4.8.2.59**).

Significance of effect

4.8.3.30 Overall, it is considered that the receptor sensitivity is **low** to **medium** at most and the magnitude of increased SSC and associated sediment deposition is **low**. Therefore, the effect of increased SSC and associated sediment deposition during the O&M phase is considered to be **minor adverse** at most, which is significant in EIA terms.

Additional mitigation and residual effect

4.8.3.31 At this stage, no additional mitigation is proposed for temporary habitat loss and disturbance in Scottish or English waters. Therefore, the residual effect of temporary habitat loss and disturbance, during the O&M phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Disturbance/remobilisation of sediment bound contaminants

4.8.3.32 Indirect effects of sediment disturbance during the O&M phase can include the disturbance and/or the remobilisation of sediment bound contaminants into the water column. This can include remobilisation of heavy metals and hydrocarbons resulting in an increase of contaminant concentrations above background levels. Further information can also be found in **Volume 2, Chapter 2: Offshore Water and Sediment Quality, of the PEIR**.

Magnitude of impact

4.8.3.33 Disturbance and potential remobilisation of sediment bound contaminants could occur during cable maintenance and repairs of the MHPGC Project during the O&M phase over the 35-year operational lifetime, resulting in the disturbance of up to19,920,000km^2 of seabed.

4.8.3.34 Project-specific subtidal benthic surveys identified generally low levels of sediment contamination across the MHPGC Project PEIR Red Line Boundary (**Volume 2, Annex 3.1 Benthic Ecology Technical Report, of the PEIR**). Concentrations of PCBs, PAHs and organotins were largely below detection limits or relevant assessment thresholds, while most heavy metals were within background levels and below applicable guideline values. Although isolated exceedances of arsenic and some other metals were recorded, these were localised, remained within the range of natural background variation, and were not considered indicative of widespread contamination.

4.8.3.35 Based on the chemical analysis results presented in **Volume 2, Annex 3.1 Benthic Ecology Technical Report, of the PEIR,** it is not anticipated that sediment disturbance and deposition during O&M will result in detectable changes in sediment bound contaminants above background levels and natural variation. Any contaminant remobilisation would be temporary and highly localised to the area of seabed disturbance. Therefore, the magnitude of disturbance/remobilisation of sediment bound contaminants during the O&M phase is considered to be **negligible**.

Receptor sensitivity

4.8.3.36 During the O&M phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to temporary habitat loss and disturbance is considered to be the same as during the construction phase. As a result, the sensitivity of receptors is therefore deemed to be **medium** at most (see **Paragraph 4.8.2.74**).

Significance of effect

4.8.3.37 Overall, it is considered that the receptor sensitivity ranges from **low to medium** and the magnitude of disturbance/remobilisation of sediments is **negligible**. Therefore, the effect of disturbance/remobilisation of sediments during the O&M phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.38 At this stage, no additional mitigation is proposed for disturbance/remobilisation of sediments in Scottish or English waters. Therefore, the residual effect of disturbance/remobilisation of sediments, during the O&M phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Electromagnetic field from subsea electrical cabling

4.8.3.39 Subsea cables are known to generate EMFs, which can be detected by fish and elasmobranch species. EMFs are produced as a result of the electricity passing through the subsea electric cables and comprise three components: electric fields (E-fields); magnetic fields (B-fields); and induced electric fields (iE-fields). Standard industry practice is for the cables used to have sufficient shielding to contain the E-fields generated and the cable system descriptions for the inter-array and export cables have abided by this. However, shielding and/or burial does not reduce B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields only.

4.8.3.40 Several factors should be considered when assessing potential effects from EMF, including cable design, the depth of burial of the cable, sensitivity of surrounding species and local environmental conditions. EMF will be emitted for the duration of the O&M phase from the offshore export cables. However, any potential impacts are considered to be limited to habitats which fall within the MHPGC Project PEIR Red Line Boundary.

Magnitude of impact

4.8.3.41 During the O&M phase, there will be up to four offshore cables consisting of two conductors and two fibre optics, in up to two trenches. Only the conductors are considered capable of producing EMF. The cables will have a voltage of 320kV HVDC, each running a total of up to 324.67km in length through Scottish and English waters from the OSP located in either Morven North or Morven South to the trenchless drill exit pit. The cables will be placed in up to two trenches with a distance of up to 50m between trenches and will have a target burial depth of 0.5m where possible.

4.8.3.42 Embedded mitigation has been incorporated into the MHPGC Project design to reduce potential EMF exposure. An Outline Offshore CSIP (CoT08/MM-010) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. This includes cable burial as the preferred option for cable protection, where practicable, informed by a CBRA.

4.8.3.43 EMFs generated by subsea cables are likely to be detectable above background levels in close proximity to the cables. Recent field measurements indicate that magnetic fields associated with operational subsea power cables may remain detectable for tens of metres from the cable and may extend further than predicted by simple modelling approaches, particularly where multiple cables occur within a cable corridor (Gill *et al.*, 2025).

4.8.3.44 Although burial does not mask EMFs it increases the distance between species that may be affected by EMFs and the source. Similarly, where cable protection is required over shallowly buried or surface-laid sections, the strength of the EMF will not be reduced; however, the increased separation distance between the cable and receptors may help to reduce the potential for behavioural responses (Gill *et al.*, 2025).

4.8.3.45 EMF comprise electrical fields, measured in V/m, and magnetic fields, measured in tesla(T) or gauss (G) (RPS, 2025c). MHPGC Project specific EMF modelling provided in **Volume 2, Annex 4.2: Marine EMF Assessment, of the PEIR** indicates that when considering a separation distance of 25m between cables and a burial depth of 0.5m, magnetic flux density at the seabed is predicted to be 192.42µT for fully bundled cables, 414.06µT for cables separated by 25m and 825.99µT for a fully separated (single-cable) scenario. At 1m above the seabed, these values reduce to 25.68µT, 149.89µT and 299.04µT, respectively. For context, the Earth's natural geomagnetic field typically ranges between approximately 25 and 65µT. The assessment demonstrates that magnetic field strength increases as separation between cable pairs increases due to a reduction in cancellation effects. The values predicted at 1m above the seabed also demonstrate the rapid attenuation of magnetic field strength with increasing distance from the cable. This indicates that elevated magnetic field strengths above natural background levels are largely restricted to areas in close proximity to the cables. As the MHPGC Project MDS allows cable separation distances of up to 50m, both the 25m separation and fully separated scenarios are considered relevant to the assessment to represent the range of potential EMF conditions that may occur across the maximum design envelope. The fully separated scenario represents a conservative worst-case assessment, as increasing separation between cable pairs reduces magnetic field cancellation and results in higher magnetic field strengths. The assessment also demonstrates that magnetic field strength decreases rapidly with increasing burial depth. Under the fully separated scenario, increasing burial depth from 0.5m to 3.0m reduces magnetic flux density at the seabed from 825.99µT to 152.81µT, reflecting the increased distance between the cable and receptors at the seabed. These results indicate that EMF effects are highly localised around the offshore export cable and diminish rapidly with increasing distance from the source. The impact will affect Fish and Shellfish receptors directly, however, given the highly localised spatial extent of the EMF fields, the magnitude of impact is considered to be **low**.

Receptor sensitivity

Pelagic and demersal fish receptors

4.8.3.46 Pelagic and demersal fish do not possess the specialised electroreceptors associated with highly EMF-sensitive species and are generally considered less sensitive to EMFs. Pelagic species predominantly occupy the water column and are therefore less likely to encounter the highest EMF intensities, which occur immediately adjacent to subsea cables. Studies on herring and lesser sandeel larvae reported no behavioural response to EMFs associated with subsea cables (Cresci et al., 2020; Cresci *et al.,* 2022), while field studies of energised subsea power cables have similarly reported no evidence of attraction or avoidance behaviour by fish assemblages associated with cable routes (Love *et al.,* 2016).

4.8.3.47 Demersal fish species are more likely to encounter EMFs due to their close association with the seabed and potential proximity to buried subsea cables. Some studies indicate that demersal fish can detect magnetic or electric fields; however, evidence for consistent behavioural responses remains limited and there is no clear evidence of adverse effects at the population level (Gill *et al.,* 2009; CSA, 2019). Given that EMF strength attenuates rapidly with distance from the cable (Bochert and Zettler, 2006) and that any effects would be restricted to a narrow zone immediately surrounding the cable, any responses are expected to be highly localised and temporary.

4.8.3.48 Given the limited evidence for behavioural effects and the highly localised nature of exposure, pelagic and demersal fish are considered to have **low** sensitivity to EMF.

Elasmobranchs

4.8.3.49 Elasmobranchs (sharks, skates and rays), especially demersal species, are known to be the most electro-receptive of all fish. EMF exposure has been reported to cause attraction to cables and reduced swimming activity in elasmobranchs (Gill and Kimber, 2005). A study by Hutchison *et al.* (2020) observed an increase in exploratory/foraging behaviour in little skate (*Leucoraja erinacea*) in response to EMF exposure. The study was undertaken under field conditions using enclosures positioned over an operational buried HVDC cable and at a nearby control site. Behavioural responses were observed where the maximum magnetic field strength reached 65.3 µT, compared with a background geomagnetic field of 51.3 µT at the control site, representing an increase of approximately 14 µT the earth's magnetic feld. However, a study commissioned by the MMO (2014) found no evidence to suggest that EMF posed a significant risk to elasmobranchs at the site or population level. Several elasmobranch species identified in the Fish and Shellfish Ecology Study Area, including common skate, flapper skate, smooth hound, spurdog, basking shark and tope, are listed on the IUCN Red List as Vulnerable, Endangered or Critically Endangered (**Table 4.11**). The only elasmobranch receptors assessed within FeAST are flapper skate and blue skate, both of which are considered to have low sensitivity to 'EMF changes' due to their mobility. However, given the high conservation value of several elasmobranch species present within the Fish and Shellfish Ecology Study Area, these receptors are considered to be of high value. Taking these factors into account, elasmobranch species are considered to be of **medium** sensitivity to EMF.

Migratory receptors

4.8.3.50 Unlike shark and ray species, migratory fish such as salmon and eels do not have specialised cells to detect magnetic fields. Instead, they contain magnetically sensitive material within their skeletal structure, which they use as a navigational tool for migration. Current research primarily suggests that migratory species are able to derive information from the Earth's magnetic field (Putman, 2018), and recent studies have demonstrated this in juvenile sea turtles, salmon, and eels moving towards nursery habitats (Putman, 2018). Further studies on various salmon species have also shown that alterations in the perceived magnetic field altered their movements (Nisbett-Jones and Lohman 2022). Most migrating salmon swim in the top 5m of the water column (Godfrey and Stewart, 2015), so they would not likely encounter EMFs from buried cables on the seabed, apart from closer to shore. Sea trout, also sensitive to magnetic fields and found at depths up to 190m (MarLIN, 2022d), may be more likely to encounter cable EMFs. However, the area affected by cable EMFs is relatively

small compared to the wider Fish and Shellfish Ecology Study Area. A study found no evidence that EMFs affected movements or behaviour of migratory fish (Armstrong *et al.*, 2015). Another study concluded Atlantic salmon showed no identifiable behavioural response to magnetic fields up to 95μT (Armstrong *et al.*, 2015).

4.8.3.51 Studies have indicated similar results for eel, with European eel altering their swimming direction based on the direction of the magnetic field (Nisbett-Jones *et al.*, 2017; Nisbett-Jones and Lohman, 2022). Studies by Westerberg and Begout-Anras, (2000 and Öhman *et al.* (2007) on European eel, also reported some deviation from migratory routes in response to low (5μT) Direct Current (DC) B-fields however, the impacts were short-term and small scale and not thought to impact on overall migration. Interestingly, no impacts were seen in European eel from Alternating Current (AC) fields of 9.6μT (Orpwood *et al.*, 2015), suggesting that there may be differences in impacts between DC and AC cabling (as the MHPGC Project will utilise DC cables offshore, this distinction is relevant). Reduced swimming rate in migrating European eel (Westerberg and Lagenfelt, 2008) due to EMF exposure has also been reported.

4.8.3.52 A review of potential impacts of EMF on migratory fish for Scottish Natural Heritage (Gill and Bartlett, 2010) identified that there was insufficient evidence to be able to confirm whether any impacts would arise from the field strengths generated by OWF cabling. If their migration routes cross OWF cable routes, there is potential for the EMFs from the cables to affect their behaviour, especially in shallow waters less than 20m deep (Gill *et al.*, 2012). This could lead to avoidance behaviour, delaying their migration. However, studies have shown varying results, so the extent of EMF impacts on migratory fish is currently unclear (Gill & Bartlett, 2010).

4.8.3.53 Migratory fish VERs are of international importance. While these species are capable of detecting magnetic fields and may exhibit behavioural responses to EMFs, the available evidence indicates that such responses are likely to be temporary and reversible. Taking this into consideration, and given the absence of conclusive evidence for significant behavioural or population-level effects, migratory fish are considered to have **low** sensitivity to EMFs.

Shellfish

4.8.3.54 Many marine invertebrates are thought to be magneto-sensitive, with this often being used for navigational purposes (migration etc.). However, evidence for potential impacts from anthropogenic B-fields is limited, with studies generally being species-specific and life-stage specific (Hervé, 2021), and some evidence showing contradictory results even within the same species. Certain groups are also poorly evidenced in the literature, as a result, there continues to be a paucity of data regarding species sensitivity to EMF and the effects upon marine invertebrates, specifically regarding effect thresholds (Hervé, 2021). Studies on decapod crustaceans have observed changes in behaviour, particularly reduced mobility, the production of a stress response, and attraction to EMF sources (Hervé, 2021). Such effects have the potential to alter predator- prey dynamics and other trophic relationships, albeit on a very localised scale. However, a recent review of the global evidence base concluded that no direct impacts of EMF on marine invertebrate survival have been identified in the published literature (Hervé, 2021). Studies on the green shore crab (*Carcinus maenas)* have reported contrasting results, with one study demonstrating reduced aggression in response to AC B-fields matching those from an OWF (Everitt, 2008); however, another study showed no effects from static B-fields (Bochert and Zettler, 2004). Brown shrimp have been recorded as being attracted to B-fields of the magnitude expected from offshore wind cabling (ICES, 2003). One recent study (Hutchinson *et al.*, 2020) suggested potential changes to exploratory behaviour in American lobster *Homarus americanus* in response to DC B-fields when in tanks placed near a subsea cable. Recent studies have also identified both behavioural (Scott *et al.*, 2018) and physiological (Scott *et al.*, 2021) reactions in brown crab from EMF. Scott *et al.* (2018) suggests that the natural roaming behaviour, where individuals will actively seek food and/or mates has been overridden by an attraction to the source of the EMF (strength 2,800μT to 40,000μT). However, the exposure to EMF does not affect the activity levels of the crabs but affects their ability to select a site to rest. Scott *et al.* (2021) investigated the effects of EMF at 250 μT, 500 μT and 1,000 μTon edible crab. Limited physiological and behavioural effects were observed at 250 μT, while EMF strengths of 500μT and above produced physiological stress and altered behavioural patterns, including attraction towards the EMF source.

These experimental field strengths overlap with the range of magnetic field strengths predicted for the MHPGC Project (192.42μT to 825.99μT) with the highest predicted magnetic flux density occurring under a conservative fully separated (single-cable) scenario. However, EMF attenuates rapidly with distance from the cable, meaning that receptors only in a very narrow zone immediately above the cable would experience comparable field strengths.

4.8.3.55 Taking the available information into consideration, including the conclusion of Hervé (2021) that no direct impacts on marine invertebrate survival have been identified globally, marine invertebrates are deemed to be of **low** sensitivity to impacts from EMF.

Significance of effect

4.8.3.56 Overall, it is considered that the receptor sensitivity ranges from **low to medium** and the magnitude of EMF from subsea electrical cabling is **low**. Therefore, the effect of EMF from subsea electrical cabling during the O&M phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.57 At this stage, no additional mitigation is proposed for EMF from subsea electrical cabling in Scottish or English waters. Therefore, the residual effect of EMF from subsea electrical cabling, during the O&M phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Thermal emissions from operational cables

4.8.3.58 Submarine power cables produce heat during operation which, when buried, can increase the temperature of the surrounding seabed sediments (Emeana *et al.*, 2016). Elevated sediment temperatures may cause some infaunal and demersal Fish and Shellfish species to move away from the immediate area surrounding the cable, although sensitivity to thermal emissions varies between species.

Magnitude of impact

4.8.3.59 The release of thermal emissions from subsea cables has the potential to increase sediment temperature and have direct effects on infaunal species. However, there is negligible capacity for thermal emissions from a cable to heat the overlying water column, meaning there is no pathway for effects on pelagic species.

4.8.3.60 During the O&M phase, there will be up to two conductors of 320kV HVDC, each up to 326.67km in length. The cables will have a target burial depth of 0.5m with a distance of up to 50m between up to two trenches. Where the target burial depth cannot be achieved, sections of the cable may require rock protection, which could increase the exposure of Fish and Shellfish receptors to thermal emissions. However, the ingress of seawater around the cable and rock protection is expected to facilitate heat dissipation, thereby reducing thermal effects due to the high heat capacity of water.

4.8.3.61 Embedded mitigation has been incorporated into the MHPGC Project design to reduce thermal emissions and associated exposure of benthic receptors. An Outline Offshore CSIP (CoT08/MM-010) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. This includes cable burial as the preferred option for cable protection, where practicable, informed by a CBRA.

4.8.3.62 Thermal emissions are anticipated along the full length of the offshore export cables. The presence and operation of the subsea cable within the MHPGC Project PEIR Red Line Boundary may lead to localised heating of the seabed affecting infaunal and demersal Fish and Shellfish receptors. Cables that lie directly on the seabed do not appreciably warm the surrounding water because normal water movement disperses any heat generated during operation, whereas buried subsea cables can lead to slightly elevated temperatures in the immediate surrounding sediment; this warming is small and diminishes rapidly with distance from the cable (Worzyk, 2009). A large proportion of the cables will be buried under sediment to a target burial depth of 0.5m. Heat transfer in sediments is known to

vary with sediment particle size composition with coarser sediment experiencing the greatest temperature change to a short distance from the heat source (Emeana *et al.,* 2016). In contrast, finer sediments and sands experience a lower temperature but to a greater distance from the source. As MHPGC Project PEIR Red Line Boundary has a mixed of sandy and muddy sediments with some areas of gravel, the extent of heat transfer is expected to vary along the route.

4.8.3.63 Temperature increases in sediments are expected to be marginal in comparison to ambient temperatures. According to OSPAR (2023), subsea cable thermal emissions will only exceed the threshold of 2°C temperature increase at a sediment depth of 0.2m in rare cases and for limited amounts of time. A field study at the Nysted OWF (one of the few empirical seabed-temperature datasets available (as noted by LionLink, 2025)) recorded measurable warming in the sediment directly above the buried 132kV AC export cable. Sensors were positioned perpendicular to the cable, with the closest sensor located approximately 25 to 30cm above the cable surface and others extending to 50cm above it. Across this 0 to 50cm zone, the maximum temperature difference relative to a nearby control site was 2.5°C, with a mean difference of 0.8°C. Because AC cables typically generate more heat than HVDC cables at comparable power levels, the Nysted measurements provide a conservative analogue for a 320kV HVDC export cable. The planned 1m burial depth at Nysted could not be consistently achieved, resulting in shallower burial in some locations, which increases the relevance of these findings to a proposed 0.5m burial depth. Overall, the Nysted results indicate that warming is highly localised and declines rapidly toward the seabed surface due to strong cooling by overlying seawater (Meißner *et al*., 2006).

4.8.3.64 Thermal modelling reviewed by Meißner *et al.* (2006) predicts typical seabed-temperature profiles for buried power cables, indicating that temperature rises may reach 10–30 °C at the cable surface but attenuate to ~2 to 3°C at 0.5m above the cable, falling to negligible levels at the sediment–water interface. Taken together, the Nysted field measurements and the modelled temperature profiles provide a consistent evidence base showing that sediment heating is modest in magnitude and spatially confined to the immediate cable corridor, with minimal warming at expected at the seabed surface. The broader European HVDC literature, summarised within the LionLink Thermal Emissions Technical Note, also supports these conclusions (LionLink, 2025).

4.8.3.65 Overall, thermal effects are modest and highly localised. For the 0.5m target burial depth, a subsea cable may therefore cause a slight temperature to increase immediately adjacent to the cable; however, the effect remains confined to the near-cable zone (typically within a few centimetres of the cable) and declines rapidly with distance (Worzyk, 2009; Boehlert & Gill, 2010).

4.8.3.66 Overall, the available evidence indicates that thermal emissions from subsea cables are spatially restricted and result in only minor increases in sediment temperature, largely confined to the immediate vicinity of the cable. The potential for associated effects on Fish and Shellfish ecology receptors is therefore expected to be limited.

4.8.3.67 Therefore, it is considered that the magnitude of impacts to Fish and Shellfish receptors due to thermal emissions from the offshore export cables in both Scottish and English waters, during the O&M phase is considered to be **low**.

Receptor sensitivity

4.8.3.68 As thermal emissions from buried subsea cables are expected to be confined to the surrounding sediments, only infaunal and seabed-associated Fish and Shellfish receptors are considered likely to be exposed to any increase in temperature. Pelagic and demersal fish species, elasmobranchs and diadromous fish are not considered key receptors for this impact, as there is negligible potential for thermal emissions to affect the overlying water column.

4.8.3.69 With regards to fish species, sandeel is anticipated to be potentially affected due to its habitat of burrowing 20-50cm in sediment depending on the specific species and sediment type (Holland *et al.*, 2005; Rowley *et al*., 2008). There is therefore the potential for sandeel to be exposed to thermal heating of the sediment around the cable. However, considering this species is mobile and therefore

able to move away from the cable to avoid sustained heating, the sensitivity of this receptor has been assessed as **low**.

4.8.3.70 For shellfish species only those that are infaunal, sessile or exhibit limited mobility are considered likely to be exposed to localised sediment warming. Therefore, potential receptors that could be affected are king scallop, queen scallop, edible crab, velvet swimming crab, European green crab, European lobster and *Nephrops*. However, these species are capable of limited movement within or across the seabed and are therefore able to avoid prolonged exposure to elevated temperatures immediately surrounding the cable. The sensitivity of receptors is therefore assessed as **low**.

Significance of effect

4.8.3.71 Overall, it is considered that the receptor sensitivity is **low** and the magnitude of thermal emissions from the offshore export cables is **low**. Therefore, the effect of thermal emissions from the offshore export cables during the O&M phase is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.72 At this stage, no additional mitigation is proposed for thermal emissions from the offshore export cables in Scottish or English waters. Therefore, the residual effect of thermal emissions from underwater cables, during the O&M phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Increased risk of introduction and spread of invasive non-native species

4.8.3.73 During the O&M phase, an increased risk of introduction of INNS could result from the use of vessels during maintenance operations, whereby INNS (including propagules such as eggs and larvae) could be transported via vessel hulls or through the release of ballast water.

4.8.3.74 The presence of hard infrastructure into the marine environment, such as scour and cable protection, within predominantly sedimentary habitats, could enable the colonisation of marine INNS that would otherwise be unlikely to occur, and the increase in extent of INNS that are already present (thereby potentially increasing INNS abundance). Hard infrastructure may also facilitate marine INNS spread and community connectivity, providing 'stepping stones' that aid dispersal to new locations (Adams *et al.*, 2014; De Mesel *at al.*, 2015; Collen *et al.*, 2020; Dauvin, 2024).

Magnitude of impact

4.8.3.75 During O&M, an increased risk of introduction and spread of INNS could occur due to the use of vessels in both Scottish and English waters and the presence of marine infrastructure including cable protection and cable crossings that INNS could colonise.

4.8.3.76 O&M activities will require a range of vessel types to undertake inspections, remediation and repairs. Routine inspection surveys will involve up to two survey vessels on site at any one time, generating up to 12 return trips per year. In addition, inspections may be undertaken using USVs, with up to four USVs and one GV (five vessels in total) present on site at any one time, generating up to 220 return trips per year. Remediation activities may require up to four vessels on site at any one time, comprising a combination of CSV, SOV, guard vessels, rock dump vessels and/or CTVs/workboats. These activities are expected to generate up to 62 return trips per year. Repair activities may also involve up to four vessels on site simultaneously, comprising a combination of CLV, barges, barge handlers/tugs, jack-up vessels, CSVs, CTVs and/or rock dump vessels. Repair works are anticipated to generate up to 245 return trips over the 35-year operational lifetime.

4.8.3.77 All project vessels will adhere to the IMO Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (IMO, 2023), and the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention).

4.8.3.78 Furthermore, the development of an Outline MBP will reduce the risk of INNS introduction and/or spread (CoT38). Therefore, it is considered that the magnitude of increased risk of introduction and spread of INNS, during the construction phase in both Scottish and English waters is considered to be **negligible**.

Receptor sensitivity

4.8.3.79 During the O&M phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to the introduction and spread of INNS is considered to be the same as during the construction phase. As a result, the sensitivity of receptors is therefore deemed to be **high** at most (see **Paragraph 4.8.2.137** *et seq.*).

Significance of effect

4.8.3.80 Overall, it is considered that the receptor sensitivity is **high** and the magnitude of increased risk of introduction and spread of INNS is **negligible**. Therefore, the effect of increased risk of introduction and spread of INNS is during the O&M phase is considered to be **minor adverse** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.81 At this stage, no additional mitigation is proposed for increased risk of introduction and spread of INNS in Scottish or English waters. Therefore, the residual effect of increased risk of introduction and spread of INNS, during the O&M phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Colonisation of hard structures

4.8.3.82 The presence of hard artificial structures during the operational phase (for example cable protection) may encourage colonisation by new communities which were not previously present. The introduction of hard structures may alter previously soft sediment habitat areas, attract new species with a preference for hard substrate (including INNS, the introduction and spread of which has been separately assessed for O&M) and may increase the habitat complexity/biodiversity of the area, potentially resulting in the creation of artificial reef habitat (Karlsson *et al*., 2022). The establishment or alteration of these benthic habitats and/or biological communities has the potential to extend beyond the footprint of the structures themselves, resulting in ecological halo effects. These changes may result in an increase in the availability and quality of prey resources, which may in turn influence Fish and Shellfish populations in areas surrounding project infrastructure (Inger *et al.*, 2009; Karlsson *et al.*, 2022). Consequently, the presence of hard artificial.

4.8.3.83 Structures may function as fish aggregation devices, (Petersen and Malm, 2006).

Magnitude of impact

4.8.3.84 Several hard structures will be in place during the O&M phase which have the potential to be colonised by benthic organisms. This in turn could provide localised areas of increased habitat complexity, refuge and prey availability for Fish and Shellfish species in the immediate vicinity of the infrastructure.

4.8.3.85 At this stage of the assessment, the exact locations of cable protection placement and therefore the habitats directly affected are unknown. However, all cable protection will be placed within the MHPGC Project PEIR Red Line Boundary. Therefore, it has been assumed that hard structures such as cable protection could be placed within any habitat located in the MHPGC Project PEIR Red Line Boundary.

4.8.3.86 Cable protection is predicted to add approximately 1,013,034m² of hard substrate surface area, while cable crossing structures are predicted to add approximately 71,552m², and protection for export cable pits at landfall are predicted to add 35,600m², resulting in a total addition of 1,120,186m^2 of hard substrate.

4.8.3.87 Hard substrate is already present within the MHPGC Project PEIR Red Line Boundary in the form of sparse boulders. Consequently, hard-substrate associated species are not entirely absent from the baseline environment, and any colonisation associated with introduced infrastructure would represent a localised increase in hard substrate habitat within the wider benthic environment. Therefore, the colonisation of infrastructure would not introduced novel assemblages to the area.

4.8.3.88 The majority of introduced hard substrate is expected to be placed within soft sediment habitat as this forms a large proportion of the benthic environment in the MHPGC Project PEIR Red Line Boundary (see **Volume 2, Chapter 3: Benthic Subtidal and Intertidal Ecology, of the PEIR)**. As a result, localised changes to benthic community structure and biotopes may occur in the vicinity of the infrastructure. Any changes are expected to occur for the duration of the O&M phase and therefore could be long term, continuing into the decommissioning phase if infrastructure is left *in situ*.

4.8.3.89 Embedded mitigation has been incorporated into the MHPGC Project design to minimise the extent of hard substrate introduced to the seabed. An Outline Offshore CSIP (CoT08/MM-010) will be prepared and submitted with the application for development consent and Marine Licence application(s) to the Scottish Ministers. This includes cable burial as the preferred option for cable protection, where practicable, and a CBRA to inform burial requirements and minimise the need for cable protection.

4.8.3.90 Placement of hard structures on the seabed has been shown to result in ecological halo effects, whereby changes in biological communities extend beyond the physical footprint of the infrastructure through increased epifaunal biomass, altered prey availability and local aggregation of predators. However, such effects are generally most pronounced around large offshore structures, where substantial areas of hard substrate are available for colonisation (Degraer et al., 2020). In contrast, cable protection is predicted to form low-relief seabed features with a maximum design height of 2 m above the seabed. While colonising communities may develop on these structures, the available surface area and structural complexity provided by individual cable protection sections are comparatively limited. Consequently, any ecological halo effects, increases in prey biomass, or aggregation of Fish and Shellfish species are expected to be restricted to the immediate vicinity of the infrastructure and would not be expected to result in measurable effects at the population level. Recent outputs from the PrePARED project support this, with findings showing elevated abundance and biomass of some demersal fish species in close proximity to turbine foundations, with effects declining with increasing distance from structures, suggesting that any aggregation effect is likely to be highly localised around foundations and associated infrastructure (Bicknell et al., 2026).

4.8.3.91 Whilst colonisation may result in localised increases in habitat complexity, epifaunal biomass and prey availability, supporting small-scale aggregation of Fish and Shellfish species around the infrastructure, such effects would remain spatially limited in the context of the wider study area. Any colonisation of hard structures is also considered reversible once the hard structures are removed or replaced, either during maintenance and repair or at the end of the O&M phase. Consequently, any associated changes in prey availability, ecological halo effects and localised fish aggregation would also be expected to diminish over time following removal of the structures.

4.8.3.92 Therefore, given the localised extent of the introduced hard structure, the limited surface area available for colonisation relative to the wider study area, the restricted spatial extent of any associated fish aggregation or ecological halo effects, the embedded measures to minimise cable protection requirements, and the reversibility of any colonisation, the magnitude of impacts in both Scottish and English waters is considered to be **low**.

Receptor sensitivity

4.8.3.93 There is limited research that indicates that marine infrastructure related to subsea cables, such as cable protection and cable crossings, are expected to result in adverse impacts on Fish and Shellfish species.

Demersal spawners

4.8.3.94 Sandeel are closely associated with areas dominated by coarse sediments and sandy habitats and are therefore unlikely to utilise colonised hard substrates or associated artificial reef habitat. The introduction of hard substrate such as cable protection could lead to the displacement of fish species that prefer sandy substrates, such as sandeel. While localised increases in hard-substrate associated epifauna and fish aggregation may occur around infrastructure, these effects are expected to be highly localised and would not materially affect the availability of suitable sandeel habitat or the distribution or abundance of sandeel in the Fish and Shellfish Ecology Study Area. Consequently, the vulnerability of sandeel to impacts arising specifically from the colonisation of hard structures and any associated ecological halo effects is considered low. As a result, sandeel are considered to be of **low** sensitivity to this impact.

4.8.3.95 The colonisation of introduced hard structures may result in localised increases in epifaunal biomass and associated prey resources in the immediate vicinity of the infrastructure. However, herring are highly mobile pelagic fish and are not typically associated with hard-substrate habitats or reef features for feeding, refuge or reproduction. Consequently, any localised aggregation or halo effects associated with colonised infrastructure are unlikely to materially alter herring distribution, behaviour or habitat use in the Fish and Shellfish Ecology Study Area. Therefore, despite the ecological and commercial importance of herring, their vulnerability to impacts arising from the colonisation of hard structures and associated halo effects is considered to be low. Herring are therefore considered to be of **low** sensitivity.

Pelagic and demersal fish receptors

4.8.3.96 Pelagic and demersal fish receptors within the Fish and Shellfish Ecology Study Area are widespread across the northern North Sea. The introduction of hard substrate may increase habitat complexity and prey availability and could result in localised aggregation of some species around project infrastructure (Degraer *et al*., 2020). Notably, a study by Reubens *et al.,* (2013a; 2013b) observed elevated catches of cod at an operational wind farm site in the Belgian part of the North Sea as cod congregated around WTG foundations and areas with hard substrate. However, monitoring studies generally indicate that the potential reef and aggregation effects associated with OWFs are unlikely to result in adverse effects for marine finfish species (Methratta and Dardick, 2019). Pelagic and demersal fish are considered to be of low vulnerability and high recoverability to the impact associated with the colonisation of hard substrate. As a result of this, these receptors are of **low** sensitivity to this impact.

Elasmobranchs

Many elasmobranchs are carnivorous, preying on bottom-dwelling invertebrates and fish, as such they may benefit from localised increases in prey availability, associated with the colonisation of introduced hard substrates, and any resulting fish aggregation effects. Studies monitoring the impacts of wind farms have found that the potential benefits of the artificial reefs and fish aggregations they create, as well as the presence of predators, are unlikely to result in adverse effects on elasmobranch populations. Considering the conservation value of the elasmobranch VERs, and the low vulnerability of the receptors to this impact, the sensitivity of elasmobranchs is assessed to be **low**

Migratory receptors

4.8.3.97 The colonisation of introduced hard structures may result in localised increases in epifaunal biomass, prey availability and the attraction of predatory fish species in the immediate vicinity of the infrastructure. However, diadromous fish species are expected to spend only limited periods within the Fish and Shellfish Ecology Study Area during migration and are therefore unlikely to utilise these areas for foraging, or experience meaningful increases in predation risk. Atlantic salmon are known to migrate rapidly through coastal waters with limited foraging activity, reducing the likelihood of interaction with cable infrastructure or associated predators (Gardiner *et al*., 2018a; 2018b; Newton *et al*., 2019; 2021). Sea trout may have a greater potential to interact with coastal habitats; however,

there is little evidence to suggest that localised reef, aggregation or halo effects associated with project infrastructure would materially affect individuals or populations, or significantly alter predation risk. Considering the conservation value of the diadromous fish VERs, and the low vulnerability of the receptors to this impact, the sensitivity of diadromous fish VERs is assessed to be **low**.

Shellfish

4.8.3.98 There is the potential for positive effects on crustacean species, such as edible crab and European lobster, due to expansion of their natural habitats (Linley *et al.*, 2007) and the creation of additional refuge areas. Novel habitats and prey resources may be created from the colonisation of infrastructure installed in areas of sandy and coarse sediments, which could extend the habitat ranges of some shellfish species. Considering this, shellfish receptors are deemed to have low vulnerability to potential effects from the colonisation of hard substrates, with some species potentially benefiting from the creation of additional habitat and refuge areas. Shellfish are therefore considered to be of **low** sensitivity to this impact.

Significance of effect

4.8.3.99 Overall, it is considered that the receptor sensitivity is **low** and the magnitude of the impact is **low**. Therefore, the effect of colonisation of hard substrates during the O&M phase is considered to be **negligible** at most, which is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.100 At this stage, no additional mitigation is proposed for the colonisation of hard substrates and associated ecological halo effects in Scottish or English waters. Therefore, the residual effect of the colonisation of hard substrates, during the O&M phase, is considered to be negligible, which is not significant in EIA terms.

Underwater sound (excluding UXO): mortality, injury, behavioural impacts and auditory masking

4.8.3.101 Underwater sound levels during the operational phase are predicted to be considerably lower than those of the construction phase, being limited to noise from maintenance vessel traffic, and geophysical surveys.

Magnitude of impact

4.8.3.102 The introduction of anthropogenic noise into the marine environment, from such activities can cause mortality, injury or behavioural impacts on Fish and Shellfish (behavioural effects can include for example displacement, avoidance, disruption of acoustic communication, reduced reproductive success, altered foraging and predator evasion, and impaired navigation (Radford *et al.,* 2014; De Jong *et al*., 2020; Hawkins & Myrberg, 1983)).

4.8.3.103 Underwater sound generated during the operation phase will arise from geophysical surveys and vessel movements, which will generate low levels of impulsive noise (arising from a selection of geophysical surveys), and continuous noise. Over the 35-year O&M period, up to five geophysical surveys per year may be undertaken using the same geophysical equipment as assessed for construction. Routine inspection surveys could comprise up to four surveys per year across the two trenches, resulting in up to 12 return vessel trips per year for conventional survey vessels or up to 220 return vessel trips per year for USV-based surveys. In addition, remediation activities could require up to 62 return vessel trips per year. Repair activities could generate up to 245 return vessel trips over the 35-year operational lifetime.

4.8.3.104 The magnitude of impact has been informed by the outputs of the underwater sound modelling presented in **Volume 2, Annex 5.1: Underwater Sound Modelling Report, of the PEIR**, using the assessment criteria defined by Popper *et al.* (2014), and is detailed for vessel noise and geophysical surveys in **Paragraph 4.8.2.76** *et seq*. As aforementioned, predicted impact ranges of potential

injurious effects, auditory masking and behavioural effects from impulsive noise, arising from the use of geophysical survey equipment, are localised to the source, restricted to within 10s of metres from the source.

4.8.3.105 With regard to the risk of potential effects from vessel noise, the potential injurious impact ranges are similarly localised to the source, restricted to within 10s of metres for all impacts and all receptors from small support vessels. Medium support vessels show slightly larger impact ranges, with TTS effects predicted to occur up to 100m from the source. The range of impacts for auditory masking and behavioural effects is anticipated to range up to 100s of metres from the source.

4.8.3.106 It is therefore apparent that a small degree of disturbance to Fish and Shellfish receptors may occur during construction, arising from activities such as geophysical surveys and vessel movements throughout the O&M phase. However, any underwater sound generated by these activities, will be intermittent and transient. Therefore, taking this into account, and considering the limited spatial extent of the impact, the magnitude of impact, for all fish receptors is assessed as **low**.

Receptor sensitivity

4.8.3.107 During the O&M phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to increase in underwater sound, are considered to be the same as during the construction phase. As a result, all receptors are considered to be of **low** sensitivity to underwater sound, with the exception of eggs and larvae, and spawning herring, which are of **medium** and **high** sensitivity to underwater sound respectively

Significance of effect

4.8.3.108 Overall, it is considered that the receptor sensitivity ranges from low to medium (with the exception of spawning herring) and the magnitude of impact is low. Therefore, the effect of underwater sound during the O&M phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

4.8.3.109 For spawning herring, sensitivity to underwater sound is considered **high**, while the magnitude of impact is assessed as **low**. Consequently, the effect of underwater sound during the O&M phase is considered to be minor to moderate at most. Importantly, the predicted underwater sound impact ranges do not overlap with areas where spawning activity is known to occur with a high degree of confidence, as these areas are located beyond the predicted range of impact. Given the localised nature of the noise impact ranges and their distance from important spawning areas, significant disturbance to spawning herring is not anticipated. On the basis of expert judgement, the overall significance of effect is therefore assessed as **minor adverse**, and is not significant in EIA terms.

Additional mitigation and residual effect

4.8.3.110 At this stage, no additional mitigation is proposed. Therefore, the residual effect of underwater sound, during the operation phase, is considered to be **negligible or minor**, which is not significant in EIA terms.

4.8.4 Decommissioning phase

4.8.4.1 The MHPGC Project has a lifespan of approximately 35 years, after which the project infrastructure will be decommissioned. As this work is planned decades into the future, the exact methodology required for decommissioning is unknown, though it will be based on the best available technology available at the time.

4.8.4.2 In the years leading up to the end of the MHPGC Project's operational life, decommissioning options will be evaluated through environmental, technical, and economic assessments, with the objective being to reduce short- and long-term effects on the environment, whilst ensuring the sea is safe for other users to navigate.

4.8.4.3 The current approach and MDS which has been assessed for decommissioning is the full removal of the cable and associated structures and cable protection where it is practicable and environmentally appropriate. However, in many cases it may be more environmentally beneficial to leave the cable buried *in situ*.

4.8.4.4 In the event of the full removal of the cable and cable protection, this would likely have similar impacts as the construction phase and/or the O&M phase. Should the cable be left *in situ*, there would likely be no further impacts to Fish and Shellfish ecology. Thus, as a worst-case scenario, impacts during decommissioning are likely to be of a similar magnitude to construction phase and/or O&M phase activities, depending upon the decommissioning option selected.

Temporary habitat loss and disturbance

Magnitude of impact

4.8.4.5 During the complete removal of the cable infrastructure, activities associated with cable recovery are expected to result in seabed disturbance that is broadly comparable to that associated with cable installation. Therefore, temporary habitat loss/disturbance is expected to occur over the same area and to the same extent as assessed during the construction phase (**Paragraph 4.8.2.1** *et seq.*). However, UXO clearance is not expected to be required. The habitats present within the MHPGC Project PEIR Red Line Boundary are widespread and mobile, and therefore are expected to recover quickly following disturbance, infilling any areas that have been lost.

4.8.4.6 The magnitude of temporary habitat loss and disturbance during the decommissioning phase is considered to be no greater than during the construction phase. Therefore, it is considered that the magnitude of temporary habitat loss and disturbance in Scottish and English waters, during the decommissioning phase will be **low**.

Receptor sensitivity

4.8.4.7 During the decommissioning phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to temporary habitat loss and disturbance, is considered to be the same as during the construction phase. As a result, all receptors are considered to be of **negligible to medium** sensitivity.

Significance of effect

4.8.4.8 Overall, it is considered that the receptor sensitivity ranges from negligible to medium and the magnitude of temporary habitat loss and disturbance is low. Therefore, the effect of temporary habitat loss and disturbance during the decommissioning phase is considered to be **minor**, which is not significant in EIA terms

Secondary mitigation and residual effect

4.8.4.9 At this stage, no secondary mitigation is proposed for temporary habitat loss/disturbance during decommissioning in Scottish or English waters, in the event that the cable is completely removed. This may be reviewed at the time of decommissioning. Therefore, the residual effect of temporary habitat loss/disturbance, during the decommissioning phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Increased SSCs and associated deposition

Magnitude of impact

4.8.4.10 The magnitude of increased SSCs and associated deposition during the decommissioning phase is considered to be similar to that during the construction phase (**Paragraph 4.8.2.36** *et seq.*). Therefore, it is considered that the magnitude of increased SSCs and associated deposition in Scottish and English waters, during the decommissioning phase will be **low**.

Receptor sensitivity

4.8.4.11 During the decommissioning phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to increased SSC and deposition, is considered to be the same as during the construction phase. As a result, all receptors are considered to be of **negligible to medium** sensitivity.

Significance of effect

4.8.4.12 For both Scottish and English waters, it is considered that the worst-case receptor sensitivity is low and the magnitude of increased SSCs and associated deposition is low. Therefore, the effect of increased SSCs and associated deposition, during the decommissioning phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Secondary mitigation and residual effect

4.8.4.13 At this stage, no secondary mitigation is proposed for increased SSCs and associated deposition during decommissioning in Scottish or English waters, in the event that the cable is completely removed. This may be reviewed at the time of decommissioning. Therefore, the residual effect of temporary habitat loss/disturbance, during the decommissioning phase, is considered to be **negligible to minor adverse,** which is not significant in EIA terms.

Disturbance/remobilisation of sediment bound contaminants

Magnitude of impact

4.8.4.14 The magnitude of disturbance and remobilisation of sediment-bound contaminants during the decommissioning phase is considered to be no greater than during the construction phase (**Paragraph 4.8.2.62** *et seq.*). Therefore, it is considered that the magnitude of disturbance and remobilisation of sediment bound contaminants in Scottish and English waters, during the decommissioning phase will be **negligible**.

Receptor sensitivity

4.8.4.15 During the decommissioning phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to disturbance/remobilisation of sediment bound contaminants, is considered to be the same as during the construction phase. As a result, all receptors are considered to be of **low to medium** sensitivity.

Significance of effect

4.8.4.16 For both Scottish and English waters, it is considered that the worst-case receptor sensitivity is **low to medium** and the magnitude of disturbance and remobilisation of sediment bound contaminants is **negligible**. Therefore, the effect of disturbance and remobilisation of sediment bound contaminants, during the decommissioning phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Secondary mitigation and residual effect

4.8.4.17 At this stage, no secondary mitigation is proposed for disturbance and remobilisation of sediment bound contaminants during decommissioning in Scottish or English waters, in the event that the cable is completely removed. This may be reviewed at the time of decommissioning. Therefore, the residual effect of disturbance/remobilisation of sediment bound contaminants, during the decommissioning phase, is considered to be **negligible to minor adverse**, which is not significant in EIA terms.

Increased risk of introduction and spread of invasive non-native species

Magnitude of impact

4.8.4.18 During the complete removal of the cable infrastructure, the activities used to install the cable will be reversed. Therefore, it is assumed that the same number of vessels will be required as during construction (**Paragraph 4.8.2.132** *et seq.*).

4.8.4.19 The magnitude of increased risk of introduction and spread of INNS during the decommissioning phase is considered to be no greater than during the construction phase. There it is considered that the magnitude of introduction and spread of INNS in Scottish and English waters during the decommissioning phase will be **negligible**.

Receptor sensitivity

4.8.4.20 During the decommissioning phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary introduction and spread of INNS, is considered to be the same as during the construction phase. As a result, all receptors are considered to be of **high** sensitivity.

Significance of effect

4.8.4.21 For both Scottish and English waters, it is considered that the worst-case receptor sensitivity is **high** and the magnitude of increased risk of introduction and spread of INNS is **negligible**. Therefore, the effect of increased risk of introduction and spread of INNS, during the decommissioning phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Secondary mitigation and residual effect

4.8.4.22 At this stage, no secondary mitigation is proposed for increased risk of introduction and spread of INNS during decommissioning in Scottish or English waters, in the event that the cable is completely removed. This may be reviewed at the time of decommissioning.

4.8.4.23 Therefore, the residual effect of increased risk of introduction and spread of INNS, during the decommissioning phase, is considered to be **minor adverse**, which is not significant in EIA terms.

Underwater sound (excluding UXO): mortality, injury, behavioural impacts and auditory masking

4.8.4.24 During decommissioning, all marine infrastructure may be removed. This may result in temporarily elevated underwater sound levels which may have impacts on Fish and Shellfish species. These elevated noise levels may be due to increased vessel movements and removal of infrastructure, with the resulting noise levels dependent on the method used for removal.

Magnitude of impact

4.8.4.25 The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. The impact is predicted to be of highly local spatial extent, short-term duration, intermittent and reversible. Based on the information available at the time of writing, and due to the localised spatial extent, the expected magnitude of impact is considered to be **low** for all Fish and Shellfish receptors.

Receptor sensitivity

4.8.4.26 During the decommissioning phase, the sensitivities of Fish and Shellfish species within the MHPGC Project PEIR Red Line Boundary to increase in underwater sound, is considered to be the same as during the construction and O&M phases. As a result, all receptors are considered to be of **low** sensitivity to underwater sound, with the exception of eggs and larvae and spawning herring, which are of **medium** and **high** sensitivity to underwater sound respectively

Significance of effect

4.8.4.27 Overall, it is considered that the receptor sensitivity ranges from low to medium (with the exception of spawning herring) and the magnitude of impact is low. Therefore, the effect of underwater sound during the decommissioning phase is considered to be **negligible or minor adverse** at most, which is not significant in EIA terms.

4.8.4.28 For spawning herring, sensitivity to underwater sound is considered high, while the magnitude of impact is assessed as **low**. Consequently, the effect of underwater sound during the decommissioning phase is considered to be minor to moderate at most. Importantly, the predicted underwater sound impact ranges do not overlap with areas where spawning activity is known to occur with a high degree of confidence, as these areas are located beyond the predicted range of impact. Given the localised nature of the noise impact ranges and their distance from important spawning areas, significant disturbance to spawning herring is not anticipated. On the basis of expert judgement, the overall significance of effect is therefore assessed as **minor adverse** and is not significant in EIA terms.

Additional mitigation and residual effect

4.8.4.29 At this stage, no additional mitigation is proposed. Therefore, the residual effect of underwater sound, during the decommissioning phase, is considered to be **negligible or minor**, which is not significant in EIA terms.

Removal of hard substrate

4.8.4.30 During decommissioning, all marine infrastructure may be removed. This could affect Fish and Shellfish receptors through the removal of artificial hard substrate that may have provided localised refuge, foraging habitat or prey resources for some species during the operational lifetime of the project. Removal of infrastructure would also return the seabed to predominantly soft sediment habitat in localised areas. Removal of infrastructure would also return the seabed to predominantly soft sediment habitat in localised areas.

Magnitude of impact

4.8.4.31 The removal of hard structures may result in the loss of localised artificial habitat and associated ecological communities that have established during the operational lifetime of the project. However, such habitats are not characteristic of the surrounding environment, which is predominantly composed of naturally occurring soft sediment habitats. Any effects would be restricted to the immediate vicinity of the infrastructure footprint and Fish and Shellfish species would continue to utilise the extensive surrounding habitats available within the Fish and Shellfish Ecology Study Area.

4.8.4.32 The impact is therefore predicted to be of local spatial extent, long-term duration, permanent, and highly reversible at the ecosystem level through recovery of the original soft sediment habitat. The magnitude of impact is therefore considered to be **low**.

Receptor sensitivity

4.8.4.33 Fish and Shellfish receptors within the Fish and Shellfish Ecology Study Area are predominantly associated with widespread soft sediment habitats. Whilst some species may utilise colonised hard structures for foraging or shelter during the operational phase, these structures represent a very small proportion of the available habitat within the Fish and Shellfish Ecology Study Area. Following removal of infrastructure, the seabed would be expected to revert to baseline conditions and support recolonisation by the original benthic communities that form the prey resource for many Fish and Shellfish species.

4.8.4.34 Consequently, Fish and Shellfish receptors are considered to have low vulnerability and high recoverability to the removal of hard structures and are therefore considered to be of **low** sensitivity to this impact.

Significance of effect

4.8.4.35 For both Scottish and English waters, it is considered that the worst-case receptor sensitivity is **low** and the magnitude of impact from the removal of hard substrates is **low**. Therefore, the significant of effect, during the decommissioning phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

Secondary mitigation and residual effect

4.8.4.36 At this stage, no secondary mitigation is proposed for removal of hard structures during decommissioning in Scottish or English waters in the event that the cable is completely removed. This may be reviewed at the time of decommissioning. Therefore, the residual effect of removal of hard structures, during the decommissioning phase, is considered to be **negligible or minor adverse**, which is not significant in EIA terms.

4.9 Whole project assessment and Cumulative Effects Assessment methodology

4.9.1 Methodology

4.9.1.1 The Morven Programme comprises four distinct projects: Morven North, Morven South, the MHPGC Project, and the Morven Branxton Area Grid Connection Project (MBAGC Project).

4.9.1.2 The following assessment scenarios have been considered to identify the LSE of the MHPGC Project in combination with other projects on the same Fish and Shellfish receptor, as follows (and summarised in **Table 4.27**):

- Whole project assessment: to identify the potential impacts associated with the MHPGC Project together with Morven North and Morven South in turn, (Scenario 1: Morven North and Scenario 2: Morven South), each of which would comprise a "Whole Project";
- Morven Programme assessment: to identify potential impacts associated with all four components of the Morven Programme (Morven North, Morven South, the MHPGC Project, and the MBAGC Project) together with other relevant projects, plans and activities (Scenario 3);
- CEA: to identify the potential impacts associated with the MHPGC Project together with relevant projects, plans and activities, including other components of the Morven Programme, using a tiered approach (Scenario 4).

4.9.1.3 The whole project assessment and CEA have been undertaken in accordance with the methodology described in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of the PEIR**.

Table 4.27: Scenarios to be considered in the MHPGC Project whole project assessment and Cumulative Effects Assessment for Fish and Shellfish ecology

Whole project assessment*		Morven Programme assessment (Marine Ornithology and Shipping and Navigation chapters only)	CEA
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
MHPGC Project and Morven North	MHPGC Project and Morven South	MHPGC Project, Morven North, Morven South and MBAGC Project	MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2 and Tier 3 (including MBAGC Project) projects and plans screened in

* Morven Programme assessment (Scenario 3) is applicable to the Marine Ornithology and the Shipping and Navigation chapters only

4.9.1.4 For the purposes of this Fish and Shellfish ecology chapter, Scenarios 1, 2, and 4 have been taken forward for assessment. discussed in **Volume 1, Chapter 4: Approach to Environmental Impact Assessment, of this PEIR**, the Morven Programme assessment (Scenario 3) is only required for specific chapters to provide further context to, and to support, the conclusions of the CEA scenario (Scenario 4), in agreement with the relevant stakeholders for these topics. As Scenario 3 does not form the basis of the CEA conclusions, it is considered a supplementary assessment to the CEA scenario (Scenario 4) for these specific topics. The approach to the CEA presented in this Fish and Shellfish Ecology Chapter complies with the requirements under the EIA Regulations to assess the LSE on the environment arising from a project cumulatively with other relevant plans, projects and activities, and no supplementary assessment of the Morven Programme (Scenario 3) is required or has been requested by relevant stakeholders with regard to Fish and Shellfish ecology.

4.9.1.5 The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see **Volume 1, Annex 4.43 Cumulative Screening and Location Plan, of this PEIR**). For Fish and Shellfish ecology, screening was undertaken within a 9km buffer of

the MHPGC Project PEIR Red Line Boundary. This precautionary buffer was selected to encompass all potential direct and indirect impact pathways relevant to Fish and Shellfish receptors, including habitat disturbance, increases in SSC, sediment deposition and underwater sound and vibration. Each project or plan has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

4.9.1.6 In undertaking the CEA for the MHPGC Project, it should be noted that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside MHPGC Project. Therefore, a tiered approach has been adopted, whereby all third-party projects and plans considered have been allocated into 'tiers' reflecting their current stage within the planning and development process. This provides a framework for placing relative weight upon the potential for each project/plan included in the CEA to ultimately be realised, based upon the project/plan's current stage of maturity and certainty in the project/plan's parameters. The tiered approach utilised within the MHPGC Project CEA employs the following tiers:

- Tier 1 assessment – Existing developments either built (operational) or under construction[1]; approved developments awaiting implementation; and permitted/submitted application(s), but not yet determined, plus Morven North and Morven South.
- Tier 2 assessment – All plans/projects assessed under Tier 1, plus plans/projects where a scoping report has been submitted and is in the public domain.
- Tier 3 assessment – All plans/projects assessed under Tier 1 and 2, plus MBAGC Project, and plans/projects that are reasonably foreseeable (e.g. projects identified in development plans, projects in other plans and programmes, offshore renewable energy projects that have a Crown Estate Scotland Lease Option Agreement).

4.9.1.7 The specific projects and plans screened into the CEA for Fish and Shellfish ecology are outlined in **Table 4.28**.

4.9.1.8 All potential impacts from the MHPGC Project alone assessment that have been considered in the CEA are outlined in **Table 4.29**.

4.9.1.9 Similarly, some of the potential impacts considered within the MHPGC Project alone assessment are specific to a particular phase of development (e.g. construction, O&M or decommissioning). Where cumulative effects with other plans or projects only have potential to occur where there is spatial or temporal overlap with MHPGC Project during certain phases of development, impacts associated with a certain phase may be omitted from further consideration where no plans or projects have been identified that have the potential for cumulative effects during this period.

[1] Note that existing developments are included in Tier 1 CEA long list but are generally screened out of the CEA assessments, aside from the following exceptions:

1) Existing developments which were not present at the time of baseline characterisation, where a potential cumulative impact-receptor pathway has been identified.

2) Existing developments are screened into Tier 1 assessments for specific topics where there is a large conceptual, temporal and spatial overlap between project impacts. In these instances, the potential for ongoing effects through cumulative impact-receptor pathways throughout project lifetime, across the development phases, means that they are considered within quantitative assessment for these topic CEAs (e.g., marine ornithology assessments consider the cumulative effects of operational offshore wind farms).

Table 4.28: List of other projects and plans considered within the Cumulative Effects Assessment for Fish and Shellfish ecology

Project/plan	Status	Distance from MHPGC Project (km)	Description of project/plan	Estimated dates of construction (If applicable)	Estimated dates of operation (If applicable)	Overlap with MHPGC Project
Tier 1						
Offshore wind projects and associated cables						
Morven North	Application submitted, awaiting decision	0	Proposed for up to 96 turbines.	2033-2037	2038 to 2073-2077	Yes. Overlap of construction phase or operational phase with the construction or operational phases of MHPGC Project.
Morven South	Application submitted. awaiting decision	0	Proposed for up to 95 turbines.	2033-2037	2038 to 2073-2077	Yes. Overlap of construction phase or operational phase with the construction or operational phases of MHPGC Project.
Berwick Bank Export Cable Corridor (ECC) (Cambois Connection - Northumberland)	Consented	0.25	OWF export cable.	2028-2031	2032 onwards	Yes. Overlap of operational phase with the construction or operational phases of MHPGC Project.
Ossian	Application submitted. awaiting decision	5.5	Ossian Floating Wind project is proposed for up to 3,610MW capacity.	2026-2030	2030-2054	Yes. Potential for construction phase or operational phase to interact with the construction or operational phases of the MHPGC Project.
Other cables and pipelines						

Project/plan	Status	Distance from MHPGC Project (km)	Description of project/plan	Estimated dates of construction (If applicable)	Estimated dates of operation (If applicable)	Overlap with MHPGC Project
Eastern Green Link 1 subsea cable	Under Construction	0.50	Eastern Green Link 1 is a 196km long HVDC link between Torness in East Lothian, Scotland and Hawthorn Pit in County Durham.	2026-2029	2029 onwards	Yes. Overlap of operational phase with the construction or operational phases of MHPGC Project.
Eastern Green Link 2 subsea cable	Under Construction	0	Eastern Green Link 2 is a 505km HVDC cable is connecting Peterhead in Aberdeenshire and Drax in North Yorkshire.	2026-2028	2028 onwards	Yes. Overlap of operational phase with the construction or operational phases of MHPGC Project.
NO UK Telecom cable	Operational	0	700km subsea tele-communications between Stavanger in Norway to Newcastle in the UK,	N/A	N/A	Yes. Overlap of operational phase with the construction or operational phases of the MHPGC Project.
Havhingsten Seg 2 Telecom Cable	Operational	0	940km subsea and terrestrial tele-communications cable linking Ireland, the UK and Denmark	N/A	N/A	Yes. Overlap of operational phase with the construction or operational phases of the MHPGC Project.
North Sea Link North Power Cable	Operational	0	700km subsea tele-power cable between Kvilldal in Norway to Cambois near Blyth in the UK,	N/A	N/A	Yes. Overlap of operational phase with the construction or operational phases of the MHPGC Project.

Project/plan	Status	Distance from MHPGC Project (km)	Description of project/plan	Estimated dates of construction (If applicable)	Estimated dates of operation (If applicable)	Overlap with MHPGC Project
Disposal sites						
Noses Point disposal site TY130	Operational	0.16	Dredge disposal site	N/A	Unknown	Yes. Overlap of operational phase with the construction, operational and decommissioning phases of MHPGC Project.
Souter Point (Outer) disposal site TY081	Operational	4.50	Dredge disposal site	N/A	Unknown	Yes. Overlap of operational phase with the construction, operational and decommissioning phases of MHPGC Project.
Sunderland (Outer) disposal site TY090	Operational	5.43	Dredge disposal site	N/A	Unknown	Yes. Overlap of operational phase with the construction, operational and decommissioning phases of MHPGC Project.
Tier 2						
Other cables and pipelines						
Eastern Green Link 3 subsea cable	Scoping Report Published	2.33	Eastern Green Link 3 is a HVDC connecting Westfield in Scotland to Lincolnshire in England	2029-2032	2032 onwards	Yes. Potential for operational phase to interact with the construction or operational phases of MHPGC Project.

Project/plan	Status	Distance from MHPGC Project (km)	Description of project/plan	Estimated dates of construction (If applicable)	Estimated dates of operation (If applicable)	Overlap with MHPGC Project
Eastern Green Link 4 subsea cable	Scoping Report Published	0	Eastern Green Link 4 is a HVDC cable linking Fife in Scotland with Norfolk in England	2028-2032	2032 onwards	Yes. Potential for operational phase to interact with the construction or operational phases of MHPGC Project.
Tier 3						
Offshore wind projects and associated cables						
MBAGC Project	Pre-application	0	Potential transmission for Morven North or Morven South	Unknown	Unknown	Unknown. Construction, O&M and decommissioning phases may overlap with MHPGC Project construction, O&M and decommissioning phases.
Other cables						
Eastern Green Link 5	Scoping Report published	0	Eastern Green Link 5 is a HVDC cable linking Scotland to Lincolnshire in England	Unknown	Unknown	Yes. Potential for operational phase to interact with the construction or operational phases of the MHPGC Project.

4.9.2 Maximum design scenario – Whole project assessment and Cumulative Effects Assessment

4.9.2.1 The MDSs identified in **Table 4.52** have been selected as those having the potential to result in the greatest potential effect on an identified receptor or receptor group in relation to the whole project assessment and CEA. The MDSs have been based on the MHPGC Project alone assessment MDS (**Table 4.17**), as well as publicly available information on other third-party projects and plans that have been screened into the CEA (**Table 4.28**). Where applicable, the Morven North and Morven South alone assessment MDSs, and project information available for MBAGC Project have also informed the MDSs outlined in **Table 4.52**.

Table 4.29: Maximum Design Scenario considered for the assessment of potential whole project and cumulative effects on Fish and Shellfish ecology

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
Long term habitat loss	×	✓	×	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (O&M phase); – Morven South (O&M phase); – Ossian OWF (O&M phase). • Cables – Eastern Green Link 1 (O&M phase).; – Eastern Green Link 2 (O&M phase); – Berwick Bank OWF ECC (O&M phase). Tier 2 • Cables – Eastern Green Link 3 (O&M phase); – Eastern Green Link 4 (O&M phase). Tier 3	Long term habitat loss effects occur during O&M phases once infrastructure has been placed on the seabed during construction and will remain in place for the lifetime of the MHPGC Project, and potentially during decommissioning. Construction activities are only considered to result in temporary habitat loss effects through sandwave levelling and cable trenching for example. Therefore, long term habitat loss is instead considered during O&M only. During decommissioning, it is possible that hard structures will be removed and therefore established species will be lost. However, previous habitat would be reinstated. The projects listed here will all result in the installation of hard structures on the seabed which will lead to long-term habitat loss. Where spatial and/or temporal overlap occurs with MHPGC Project, these activities may act cumulatively and are therefore considered to represent a precautionary MDS.

[2] C= Construction, O= Operations and maintenance, D= Decommissioning phases

[3] "✓" is used to denote the phase the potential impact can occur, "X" outlines there is no impact within this project phase

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				• Cables – MBAGC Project (O&M phase); – Eastern Green Link 5 (O&M phase).	
Temporary habitat loss and disturbance	✓	✓	✓	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases); – Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases); – Berwick Bank OWF ECC (Construction, O&M and decommissioning phases). – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases);	Temporary habitat loss and/or disturbance could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning. Projects and plans included within these scenarios involve activities that may result in temporary habitat disturbance and/or loss within the Fish and Shellfish Ecology Cumulative Study Area. Where spatial and/or temporal overlap occurs with MHPGC Project, these activities may act cumulatively and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– North Sea Link North Power Cable (Construction, O&M and decommissioning phases). – Tier 2 • Cables – Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases) Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases); – Eastern Green Link 5 (Construction, O&M and decommissioning phase).	
Increased SSCs and associated deposition	✓	✓	✓	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases);	Increased SSCs and associated deposition could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning. The potential for and extent of likely significant cumulative effects will be greatest when the highest number of other projects and plans are considered in combination. The projects and plans within the Fish and Shellfish Ecology Cumulative Study Area are considered to capture the potential overlap of impacts during the construction, O&M and decommissioning phases. Activities from projects and plans that potentially increase SSCs during the temporal overlap with the MHPGC phases have been included as these may create a cumulative impact and LSE on physical features or receptors. Intermittent operations, such as the repair or reburial of offshore cables from

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases); – Berwick Bank OWF ECC (Construction, O&M and decommissioning phases); – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases); – North Sea Link North Power Cable (Construction, O&M and decommissioning phases). • Dredge disposal – Noses Point (Construction, O&M and decommissioning phases); – Souter Point Outer (Construction, O&M and decommissioning phases); – Sunderland (Construction, O&M and decommissioning phases) Tier 2 • Cables – Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases) Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases);	potential upcoming projects, have been included in the cumulative assessment. These activities, although potentially in their O&M phase, are not included within the background assessment as they are not continual and therefore do not contribute to background conditions in a consistent manner. Where spatial and/or temporal overlap occurs with MHPGC Project, these activities may act cumulatively and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– Eastern Green Link 5 (Construction, O&M and decommissioning phases).	
Disturbance/remobilisation of sediment bound contaminants	✓	✓	✓	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases); – Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases); – Berwick Bank OWF ECC (Construction, O&M and decommissioning phases); – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases);	Disturbance and/or remobilisation of sediment bound contaminants could occur during all phases where activities are occurring on the seabed, including cable installation, maintenance and repairs and removal of infrastructure during decommissioning. Projects and plans included within these scenarios involve activities that may result in the disturbance/ remobilisation of sediment along with associated contaminants. Where spatial and/or temporal overlap occurs with MHPGC Project, these activities may act cumulatively and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– North Sea Link North Power Cable (Construction, O&M and decommissioning phases). • Dredge disposal – Noses Point (Construction, O&M and decommissioning phases); – Souter Point Outer (Construction, O&M and decommissioning phases); – Sunderland (Construction, O&M and decommissioning phases) Tier 2 • Cables – Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases) Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases; – Eastern Green Link 5 (Construction, O&M and decommissioning phases).	
Underwater sound (excluding unexploded ordnance)	✓	✓	✓	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1	Underwater sound (excluding UXO) may occur during construction, O&M and decommissioning as a result of activities such as geophysical and geotechnical surveys, vessel movements, seabed preparation works, cable installation, maintenance operations and decommissioning activities. The projects and plans included within these scenarios involve activities capable of generating underwater sound. Where spatial and/or temporal overlap occurs with the MHPGC Project, these activities may act cumulatively and

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				• OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases); – Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases); – Berwick Bank OWF ECC (Construction, O&M and decommissioning phases); – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases); – North Sea Link North Power Cable (Construction, O&M and decommissioning phases). Tier 2 • Cables – Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases) Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases; – Eastern Green Link 5 (Construction, O&M and decommissioning phases).	are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
Underwater sound from unexploded ordnance	✓	×	×	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases); – Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases); – Berwick Bank OWF ECC (Construction, O&M and decommissioning phases); – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases); North Sea Link North Power Cable (Construction, O&M and decommissioning phases). Tier 2 • Cables	Underwater sound from UXO clearance may occur during pre-construction and construction activities where UXO requires clearance prior to installation works. The projects and plans included within these scenarios may require UXO clearance activities capable of generating high-intensity underwater sound. Where spatial and/or temporal overlap occurs with the MHPGC Project, these activities may act cumulatively and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases) Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases); – Eastern Green Link 5 (Construction, O&M and decommissioning phases).	
Increased risk of introduction and spread of INNS	✓	✓	✓	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects: – Morven North (Construction, O&M and decommissioning phases); – Morven South (Construction, O&M and decommissioning phases); – Ossian OWF (Construction, O&M and decommissioning phases). • Cables – Eastern Green Link 1 (Construction, O&M and decommissioning phases).; – Eastern Green Link 2 (Construction, O&M and decommissioning phases);	Increased risk of introduction and spread of INNS could occur throughout the MHPGC Project phases where vessels are used (i.e. transfer through ballast water and on hulls) and where hard structures are placed in otherwise soft sediment. The projects included here will involve vessel movements and result in the installation of hard structures on the seabed which could be colonised by new communities composed of INNS meaning they may also affect habitats that MHPGC will also affect and therefore LSE when considered in combination with MHPGC and are therefore considered to represent a precautionary MDS. .

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– Berwick Bank OWF ECC (Construction, O&M and decommissioning phases); – NO UK Telecom Cable (Construction, O&M and decommissioning phases); – Havhingsten Seg 2 Telecom Cable (Construction, O&M and decommissioning phases); – North Sea Link North Power Cable (Construction, O&M and decommissioning phases). Tier 2 • Cables – Eastern Green Link 3 (Construction, O&M and decommissioning phases); – Eastern Green Link 4 (Construction, O&M and decommissioning phases). Tier 3 • Cables – MBAGC Project (Construction, O&M and decommissioning phases). – Eastern Green Link 5 (Construction, O&M and decommissioning phases)	
EMF	×	✓	×	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1 • OWF projects:	Effects from EMF will only occur in the marine environment when the MHPGC Project is operational. Therefore, this is not considered for construction or decommissioning phases. These projects will have the potential to generate EMFs which could have a cumulative effect alongside MHPGC and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				– Morven North (O&M phase); – Morven South (O&M phase); – Ossian OWF (O&M phase). • Cables – Eastern Green Link 1 (O&M phase).; – Eastern Green Link 2 (O&M phase); – Berwick Bank OWF ECC (O&M phase); – NO UK Telecom Cable (O&M phase); – Havhingsten Seg 2 Telecom Cable (O&M phase); – North Sea Link North Power Cable (O&M phase). Tier 2 • Cables – Eastern Green Link 3 (O&M phase); – Eastern Green Link 4 (O&M phase). • Tier 3 Cables – MBAGC Project (O&M phase); – Eastern Green Link 5 (O&M phase).	
Thermal emissions from subsea electrical cables	×	✓	×	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1	Thermal emissions from the subsea electrical cables will only occur when the MHPGC Project is operational. Therefore, this is not considered for construction or decommissioning phases. These projects will have the potential to generate thermal emissions which could have a cumulative effect alongside MHPGC and are therefore considered to represent a precautionary MDS.

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				• OWF projects: – Morven North (O&M phase); – Morven South (O&M phase); – Ossian OWF (O&M phase). • Cables – Eastern Green Link 1 (O&M phase).; – Eastern Green Link 2 (O&M phase); – Berwick Bank OWF ECC (O&M phase); – NO UK Telecom Cable (O&M phase); – Havhingsten Seg 2 Telecom Cable (O&M phase) – North Sea Link North Power Cable (O&M phase). Tier 2 • Cables – Eastern Green Link 3 (O&M phase); – Eastern Green Link 4 (O&M phase) Tier 3 • Cables – MBAGC Project (O&M phase); – Eastern Green Link 5 (O&M phase).	
Colonisation of hard structures	×	✓	×	**Scenario 1** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven North. **Scenario 2** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with Morven South. **Scenario 4** MDS as described for MHPGC Project (**Section 4.6.2**), assessed cumulatively with the following other projects and plans: Tier 1	Hard structures may be colonised in the O&M phase following placement on the seabed during the construction phase. During decommissioning, the current MDS is to remove hard structures which would prevent further colonisation. If they are left in situ during decommissioning, any change would be considered negligible compared to the O&M phase. These projects will all result in the installation of hard structures on the seabed which could be colonised by new communities within the Fish and Shellfish Ecology CEA Study Area meaning they may also affect habitats that

Potential Effect	Phase[2,3]			Maximum Design Scenario	Justification
	C	O & M	D		
				• OWF projects: – Morven North (O&M phase); – Morven South (O&M phase); – Ossian OWF (O&M phase). • Cables – Eastern Green Link 1 (O&M phase).; – Eastern Green Link 2 (O&M phase); – Berwick Bank OWF ECC (O&M phase). Tier 2 • Cables – Eastern Green Link 3 (O&M phase); – Eastern Green Link 4 (O&M phase) Tier 3 • Cables – MBAGC Project (O&M phase); – Eastern Green Link 5 (O&M phase).	MHPGC will also affect and therefore LSE when considered in combination with MHPGC and are therefore considered to represent a precautionary MDS.

4.10 Whole project assessment and Cumulative Effects Assessment

4.10.1 Overview

4.10.1.1 A description of the significance of whole project and cumulative effects upon Fish and Shellfish ecology receptors arising from each identified impact is given below. The whole project assessment and CEA for MHPGC Project is presented in **Table 4.30** to **Table 4.51**.

4.10.1.2 The Fish and Shellfish CEA Study Area is synonymous with the Fish and Shellfish Ecology Study Area, as defined in **Section 4.4.2.** It is defined by a 9km buffer around the MHPGC Project PEIR Red Line Boundary, representing the maximum spring tidal excursion distance and the likely maximum spatial extent of potential indirect impacts.

4.10.2 Long term habitat loss

4.10.2.1 There is potential for long-term habitat loss as a result of the MHPGC Project's O&M activities alongside OWFs and cables within the Fish and Shellfish CEA Study Area. Long-term habitat loss may result from the presence of cable protection, export cable crossings and trenchless drill exit pit protection, which may result in the permanent alteration or loss of benthic habitat. Where these features overlap spatially with those associated with other OWF and cable projects, there is potential for cumulative long-term habitat loss.

4.10.2.2 Long-term habitat loss may occur as a result of the MHPGC Project. Additionally, OWF projects and cable projects identified within the cumulative assessment may contribute cumulatively to habitat loss where overlap occurs.

4.10.2.3 The summary of the Whole Project assessment for long-term habitat loss is presented in **Table 4.30**, and CEA for long-term habitat loss is presented in **Table 4.31**.

Table 4.30: MHPGC Project whole project assessment for long term habitat loss

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Operations and Maintenance phase		
Magnitude of impact	The presence of the Morven North infrastructure will result in up to 2,052,797m^2 of long-term habitat loss due to the installation of foundations and associated scour protection, cable protection on inter-array and interconnector cables, and cable crossing protection. In combination with the MHPGC Project this equates to a combined area of 3,679,197m^2 of long term habitat loss. The impact is predicted to be of local spatial extent, long-term duration, continuous and low reversibility and it is predicted that the impact will affect receptors directly and will only represent a small area of long-term habitat loss compared to similar nearby habitats which will remain unimpacted. The magnitude is therefore considered to be **low**.	The presence of the Morven South infrastructure will result in up to 1,820,664m^2 of long-term habitat loss due to the installation of foundations and associated scour protection, cable protection on inter-array and interconnector cables, and cable crossing protection. In combination with the MHPGC Project this equates to a combined area of 3,447,784m^2 of long term habitat loss. The impact is predicted to be of local spatial extent, long-term duration, continuous and low reversibility and it is predicted that the impact will affect receptors directly and will only represent a small area of long-term habitat loss compared to similar nearby habitats which will remain unimpacted. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to long-term habitat loss is summarised in **Paragraph 4.8.3.10** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to long-term habitat loss due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish and elasmobranchs are not considered to be dependent on specific seabed substrates and are therefore considered to be of **negligible** sensitivity, whilst shellfish species are considered to be of **low** sensitivity due to their capacity for recolonisation and broad habitat tolerance. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters, the magnitude of the Whole Project impact is deemed to be **low** and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.31: MHPGC Project CEA for long term habitat loss

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects that have the potential to introduce additional long-term habitat loss through the installation of offshore infrastructure. <u>Tier 1</u> Tier 1 includes the following OWF projects which have O&M phases overlapping with the construction of Morven North, with area of habitat loss/disturbance: • Morven North (2,052,797m^2); • Morven South (1,820,664m^2); • Ossian OWF (19,270,958m^2). Tier 1 includes the following cable projects: • Berwick Bank ECC (2,177,214m^2); • Eastern Green Link 1 (779,000m^2); • Eastern Green Link 2 (1,110,000m^2). In total cumulative hard structures associated with the MHPGC Project (1,627,120m^2) and Tier 1 projects is up to 28,837,753m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.004%. The cable projects are also likely to install hard structures such as cable protection and cable crossings. The distances separating projects and lack of connectivity between the long-term habitat loss introduced for each project reduces the potential of this increasing the magnitude overall. The cumulative effect is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. In total cumulative hard structures associated with the MHPGC Project (1,627,120m^2) and Tier 2 projects is up to 1,627,120m^2 (area data not available for Eastern Green Link 3 or Eastern Green Link 4). The cable projects are also likely to install hard structures such as cable protection and cable crossings. The distances separating projects and lack of connectivity between the long-term habitat loss introduced for each project reduces the potential of this increasing the magnitude overall. The cumulative effect is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

	Cumulative Effects Assessment
	Tier 3 Tier 3 includes the following OWF project and the cable project: • MBAGC Project; • Eastern Green Link 5. The programmes for these projects are unknown and therefore there is the potential for the projects to install hard substrate within the MHPGC Project's construction and O&M phases. It is currently not possible to quantify this impact, but it is likely to be of a similar or reduced magnitude compared to the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to long-term habitat loss is summarised in **Paragraph 4.8.3.10** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to long-term habitat loss due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish and elasmobranchs are not considered to be dependent on specific seabed substrates and are therefore considered to be of **negligible** sensitivity, whilst shellfish species are considered to be of **low** sensitivity due to their capacity for recolonisation and broad habitat tolerance. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.
Significance of effect	Tier 1 Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. Tier 3 and all of Scenario 4 Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

4.10.3 Temporary habitat loss and disturbance

4.10.3.1 There is potential for temporary habitat loss and disturbance as a result of the MHPGC Project's construction, O&M and decommissioning activities alongside OWFs and cables within the Fish and Shellfish CEA Study Area. Temporary habitat loss and disturbance may arise from seabed-disturbing activities including route preparation (e.g. pre-lay grapnel runs, boulder clearance and sandwave clearance), UXO clearance, cable installation, trenchless techniques at the landfall, cable repair and remediation activities, vessel seabed interactions (e.g. anchoring and jack-up activities), and the removal of infrastructure during decommissioning. Where these activities overlap spatially and temporally with those associated with other OWF and cable projects, there is potential for cumulative temporary habitat loss and disturbance.

4.10.3.2 Temporary habitat loss and disturbance may occur as a result of the MHPGC Project. Additionally, OWF projects and cable projects identified within the cumulative assessment may contribute cumulatively to habitat loss where overlap occurs.

4.10.3.3 The summary of the Whole Project assessment for temporary habitat loss and disturbance is presented in **Table 4.32**, and CEA for temporary habitat loss and disturbance is presented in **Table 4.33.**

Table 4.32: MHPGC Project whole project assessment for temporary habitat loss and disturbance

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	The construction of the Morven North may occur simultaneously with the construction phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The construction of the Morven North infrastructure will result in up to 74,055,400m^2 of temporary subtidal habitat loss/disturbance due to sandwave clearance, boulder clearance, wind turbine foundation installation, Inter-Array Cable (IAC) installation, UXO removal and jack-up and anchoring activities. In combination with the MHPGC Project this equates to a combined area of 96,857,515m^2 of temporary habitat loss/disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.	The construction of the Morven South may occur simultaneously with the construction phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The construction of the Morven North infrastructure will result in up to 62,596,300m^2 of temporary subtidal habitat loss/disturbance due to sandwave clearance, boulder clearance, wind turbine foundation installation, IAC installation, UXO removal and jack-up and anchoring activities. In combination with the MHPGC Project this equates to a combined area of 85,398,415m^2 of temporary habitat loss/disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to temporary habitat loss and disturbance is summarised in **Paragraph 4.8.2.12** *et seq.* In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to temporary habitat loss and disturbance due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. In contrast, pelagic spawning fish and elasmobranchs are not dependent on specific seabed habitats and are therefore considered to be of negligible sensitivity, whilst diadromous fish and the majority of shellfish receptors are considered to be of low sensitivity due to their mobility, habitat flexibility and/or ability to recolonise disturbed areas. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Operations and maintenance phase		
Magnitude of impact	Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The O&M phase of Morven North	Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The O&M phase of Morven South

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events. Inter-array and inter-connector cable maintenance activities for Morven North will be undertaken in close proximity to the MHPGC Project using similar parameters and techniques to those associated with the MHPGC Project maintenance activities. The maintenance activities, therefore, are likely to result in a similar level of temporary habitat disturbance and loss, with a limited and localised spatial extent and as well occurring highly intermittently across the operational lifetime of the project, and therefore the overall magnitude would be unlikely to increase above that assessed for the MHPGC Project alone at any one time. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events. Inter-array and inter-connector cable maintenance activities for Morven South will be undertaken in close proximity to the MHPGC Project using similar parameters and techniques to those associated with the MHPGC Project maintenance activities. The maintenance activities, therefore, are likely to result in a similar level of temporary habitat loss/disturbance, with a limited and localised spatial extent and as well occurring highly intermittently across the operational lifetime of the project, and therefore the overall magnitude would be unlikely to increase above that assessed for the MHPGC Project alone at any one time. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to temporary habitat loss and disturbance is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.12** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to temporary habitat loss and disturbance due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. In contrast, pelagic spawning fish and elasmobranchs are not dependent on specific seabed habitats and are therefore considered to be of negligible sensitivity, whilst diadromous fish and the majority of shellfish receptors are considered to be of low sensitivity due to their mobility, habitat flexibility and/or ability to recolonise disturbed areas. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18,** is not significant in EIA terms.	
Decommissioning phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers Morven North together with the MHPGC Project. The decommissioning phase of Morven North may occur simultaneously with the decommissioning phase of the MHPGC	The Whole Project assessment for Scenario 1 considers Morven South together with the MHPGC Project. The decommissioning phase of Morven South may occur simultaneously with the decommissioning phase of the MHPGC

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	Project. Due to the relationship of the projects, it is assumed the O&M phase of the Morven North will not occur during the decommissioning phase of the MHPGC Project. There is the potential for Morven North decommissioning activities to include cable removal, although it is anticipated that offshore cables and any offshore cable protection may be left in-situ. Any direct impacts from jack-up vessels and anchor placements will be similar to the construction phase, with similar recovery periods, and therefore the overall magnitude would not be expected to significantly increase compared to just the MHPGC Project. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.	Project. Due to the relationship of the projects, it is assumed the O&M phase of the Morven South will not occur during the decommissioning phase of the MHPGC Project. There is the potential for Morven South decommissioning activities to include cable removal, although it is anticipated that offshore cables and any offshore cable protection may be left in-situ. Any direct impacts from jack-up vessels and anchor placements will be similar to the construction phase, with similar recovery periods, and therefore the overall magnitude would not be expected to significantly increase compared to just the MHPGC Project. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to temporary habitat loss and disturbance is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.12** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to temporary habitat loss and disturbance due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. In contrast, pelagic spawning fish and elasmobranchs are not dependent on specific seabed habitats and are therefore considered to be of negligible sensitivity, whilst diadromous fish and the majority of shellfish receptors are considered to be of low sensitivity due to their mobility, habitat flexibility and/or ability to recolonise disturbed areas. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.33: MHPGC Project CEA for of temporary habitat loss and disturbance

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project with area of habitat loss/disturbance indicated. • Morven North (74,055,400m^2); • Morven South (62,596,300m^2); • Ossian OWF (49,948,548m^2). The OWF projects included within Tier 1 have the potential for construction phase overlap with the MHPGC Project and will result in temporary habitat loss and disturbance associated with activities such as seabed preparation, foundation installation, cable installation, UXO clearance and vessel anchoring activities. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. The cable projects will be primarily in their O&M phase and therefore may result in low levels of temporary habitat disturbance and loss due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative temporary habitat loss/disturbance associated with the MHPGC Project (22,802,115m^2) and Tier 1 projects is up to 209,402,363m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.028%. The cumulative effect is predicted to be of regional spatial extent, short-term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4.

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	These cable projects will be primarily in their O&M phase and therefore may result in low levels of temporary habitat loss/disturbance due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative temporary habitat loss/disturbance hard structures associated with the MHPGC Project (22,802,115m^2) and Tier 2 projects is up to 22,802,115m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.003%. The cumulative effect is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**. <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impacts of these projects are unknown but are likely to be similar, if not much smaller than the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to temporary habitat loss and disturbance are summarised in **Paragraph 4.8.2.12** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to temporary habitat loss and disturbance due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. In contrast, pelagic spawning fish and elasmobranchs are not dependent on specific seabed habitats and are therefore considered to be of negligible sensitivity, whilst diadromous fish and the majority of shellfish receptors are considered to be of low sensitivity due to their mobility, habitat flexibility and/or ability to recolonise disturbed areas. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.
Significance of effect	<u>Tier 1</u> Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. <u>Tier 2</u> Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. <u>Tier 3 and all of Scenario 4</u>

	Cumulative Effects Assessment
	Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC together Project with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project with area of habitat loss/disturbance indicated • Morven North (9,221,800m^2); • Morven South (7,967,400m^2); • Ossian OWF (51,411,500m^2). These projects will be in their O&M phase when the MHPGC Project is in its O&M phase, which will result in temporary habitat loss/disturbance as a result of cable and turbine foundation maintenance. Overall, these projects will contribute 68,600,700m^2 to the cumulative temporary habitat disturbance/loss. Tier 1 includes the following cable projects: • Berwick Bank ECC (120,000m^2); • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. These cable projects will be primarily in their O&M phase and therefore may result in low levels of temporary habitat loss/disturbance due to maintenance. However, it should be noted that for Eastern Green Link 1 and 2 due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative temporary habitat loss/disturbance hard structures associated with the MHPGC Project (19,918,400m^2) and Tier 1 projects is up to 87,799,100m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.012%. The cumulative effect is predicted to be of regional spatial extent, short-term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects:

	Cumulative Effects Assessment
	• Eastern Green Link 3; • Eastern Green Link 4. It should be noted that for Eastern Green Link 3 and 4 due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative temporary habitat loss/disturbance hard structures associated with the MHPGC Project (19,918,400m^2) and Tier 2 projects is up to 19,918,400m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.003%. The cumulative effect is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**. <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impacts of these projects are unknown but are likely to be similar, if not much smaller, than the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of the Fish and Shellfish ecology VERs to temporary habitat loss and disturbance is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.12** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to temporary habitat loss and disturbance due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. The sensitivity of these receptors is therefore considered to be medium. In contrast, pelagic spawning fish and elasmobranchs are not dependent on specific seabed habitats and are therefore considered to be of negligible sensitivity, whilst diadromous fish and the majority of shellfish receptors are considered to be of low sensitivity due to their mobility, habitat flexibility and/or ability to recolonise disturbed areas. The sensitivity of Fish and Shellfish receptors is therefore considered to be at worst-case **medium**.
Significance of effect	<u>Tier 1</u> Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. <u>Tier 2</u> Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms. <u>Tier 3 and all of Scenario 4</u>

	Cumulative Effects Assessment
	Overall, for the VERs in both Scottish and English waters the magnitude is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor significance, with an overall conclusion for both VERs of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Decommissioning phase	
Magnitude of impact	As per construction phase. During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated temporary habitat loss/disturbance. Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction.
Sensitivity of receptor	
Significance of effect	
Further mitigation and residual significance	

4.10.4 Increased SSCs and associated deposition

4.10.4.1 There is potential for SSC and associated deposition as a result of the MHPGC Project's construction, O&M and decommissioning activities associated with the MHPGC Project within the Fish and Shellfish CEA Study Area. Increased SSCs and deposition may result from seabed-disturbing activities, including seabed preparation, cable installation, maintenance and repair activities and the removal of infrastructure during decommissioning. Where these activities occur concurrently with those associated with other OWF, cable and dredge disposal projects, there is potential for cumulative increases in SSCs and associated deposition.

4.10.4.2 Increased SSC and associated deposition may occur as a result of the MHPGC Project. Additionally, OWF projects, cable projects and dredge disposal sites identified within the cumulative assessment may contribute cumulatively to habitat loss where overlap occurs.

4.10.4.3 The summary of the Whole Project assessment for SSC and associated deposition is presented in **Table 4.34**, and CEA for SSC and associated deposition is presented in **Table 4.35**.

Table 4.34: MHPGC Project whole project assessment for increased SSC and associated deposition

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	The construction of the Morven North may occur simultaneously with the construction phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The construction of the Morven North infrastructure will result in the disturbance of up to 28,974,207m^3 of sediment due to sandwave clearance, boulder clearance, wind turbine foundation installation, IAC installation, UXO removal and jack-up and anchoring activities. In combination with the MHPGC Project this equates to 36,187,134m^3 of sediment. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.	The construction of the Morven South may occur simultaneously with the construction phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The construction of the Morven South infrastructure will result in the disturbance of up to 23,675,007m^3 of sediment due to sandwave clearance, boulder clearance, wind turbine foundation , IAC installation, UXO removal and jack-up and anchoring activities. In combination with the MHPGC Project this equates to 30,887,934m^3 of sediment. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low.**
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to temporary increases in SSC and sediment deposition is summarised in **Paragraph 4.8.2.43** *et seq.* In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to increased SSC and deposition due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish, elasmobranchs and diadromous fish are also considered to be of low sensitivity, as they are mobile, not dependent on specific seabed habitats for spawning, and/or are naturally exposed to variable sediment conditions. All shellfish receptors are considered to be of low sensitivity due to their tolerance of elevated SSC and sediment deposition and/or their high recoverability. The sensitivity of Fish and Shellfish ecology receptors to temporary increases in SSC and sediment deposition is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Operations and maintenance phase		
Magnitude of impact	Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The O&M phase of the Morven	Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The O&M phase of the Morven

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	North may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events. Inter-array and inter-connector cable maintenance activities for Morven North will be undertaken in close proximity to the MHPGC Project using similar parameters and techniques to those associated with the MHPGC Project maintenance activities. The maintenance activities, therefore, are likely to result in a similar level of SSC and associated deposition, with a limited and localised spatial extent and as well occurring highly intermittently across the operational lifetime of the project, and therefore the overall magnitude would be unlikely to increase above that assessed for the MHPGC Project alone at any one time. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	South may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events. Inter-array and inter-connector cable maintenance activities for Morven South will be undertaken in close proximity to the MHPGC Project using similar parameters and techniques to those associated with the MHPGC Project maintenance activities. The maintenance activities, therefore, are likely to result in a similar level of SSC and associated deposition, with a limited and localised spatial extent and as well occurring highly intermittently across the operational lifetime of the project, and therefore the overall magnitude would be unlikely to increase above that assessed for the MHPGC Project alone at any one time. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to temporary increases in SSC and sediment deposition is summarised in **Paragraph 4.8.2.43** *et seq.* In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to increased SSC and deposition due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish, elasmobranchs and diadromous fish are also considered to be of low sensitivity, as they are mobile, not dependent on specific seabed habitats for spawning, and/or are naturally exposed to variable sediment conditions. All shellfish receptors are considered to be of low sensitivity due to their tolerance of elevated SSC and sediment deposition and/or their high recoverability. The sensitivity of Fish and Shellfish ecology receptors to temporary increases in SSC and sediment deposition is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Decommissioning phase		
Magnitude of impact	The decommissioning of the Morven North may occur simultaneously with the decommissioning phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The decommissioning of the Morven	The decommissioning of the Morven South may occur simultaneously with the decommissioning phase of the MHPGC Project with site preparation and offshore cable installation being undertaken in close proximity to the MHPGC Project. The decommissioning of the Morven

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	North infrastructure will result in the disturbance of sediment due to the removal of offshore cables and foundations, together with associated jack-up vessel activities and anchor placements. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.	South infrastructure will result in the disturbance of sediment due to the removal of offshore cables and foundations, together with associated jack-up vessel activities and anchor placements. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to temporary increases in SSC and sediment deposition is summarised in **Paragraph 4.8.2.43** *et seq*. In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to increased SSC and deposition due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish, elasmobranchs and diadromous fish are also considered to be of low sensitivity, as they are mobile, not dependent on specific seabed habitats for spawning, and/or are naturally exposed to variable sediment conditions. All shellfish receptors are considered to be of low sensitivity due to their tolerance of elevated SSC and sediment deposition and/or their high recoverability. The sensitivity of Fish and Shellfish ecology receptors to temporary increases in SSC and sediment deposition is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.35: MHPGC Project CEA for increased SSC and associated deposition

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project with volume of disturbed sediment indicated. • Morven North (28,974,207m^3); • Morven South (23,675,007m^3); • Ossian OWF (11,841,602m^3). Morven North and Morven South lie within the northern section of the MHPGHC Project PEIR Red Line Boundary, in Scottish waters. Therefore, construction activities for Morven North and Morven South may be undertaken in close proximity to the MHPGC Project, and should they be undertaken concurrently, there is potential for plumes to interact, however these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The majority of sedimentation would occur within close proximity to each activity due to the low sediment transport rates in the area. Ossian OWF is located 5km from the MHPGC Project PEIR Red Line Boundary directly to the east and southeast and is proposed for up to 265 wind turbines. There will be limited opportunity for the amalgamation of sediment plumes from this project, given the orientation of the tides in a predominantly north northeast to south southwest direction, as evidenced from modelling of sediment plumes. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. Tier 1 also includes the following dredge disposal sites: • Noses Point; • Souter Point Outer; • Sunderland. The cable projects will be primarily in their O&M phase and therefore may result in low levels of SSC and associated deposition due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have

	Cumulative Effects Assessment
	not contributed to the overall cumulative increase in SSC and associated deposition value. Similarly, due to the intermittent nature of dredging work, the dredge disposal projects have not quantified this impact and therefore have not contributed to the overall cumulative increase in SSC and associated deposition value. In total cumulative increase in SSC and associated deposition associated with the MHPGC Project (7,212,927m^3) and Tier 1 projects is up to 71,703,743m^3. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These cable projects will be primarily in their O&M phase and therefore may result in low levels of temporary habitat loss/disturbance due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative temporary habitat loss/disturbance hard structures associated with the MHPGC Project (7,212,927m^3) and Tier 2 projects is up to 7,212,927m^3. The cumulative effect is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application and therefore the scale and specific impact of these projects are unknown but are likely to be similar, if not much smaller than for the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to temporary increases in SSC and sediment deposition is summarised in **Paragraph 4.8.2.43** *et seq.* In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to increased SSC and deposition due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish, elasmobranchs and diadromous fish are also considered to be of low sensitivity, as they are mobile, not dependent on specific seabed habitats for spawning, and/or are naturally exposed to variable sediment conditions. All shellfish receptors are considered to

	Cumulative Effects Assessment
	be of low sensitivity due to their tolerance of elevated SSC and sediment deposition and/or their high recoverability. The sensitivity of Fish and Shellfish ecology receptors to temporary increases in SSC and sediment deposition is therefore considered to be at worst-case **medium**.
Significance of effect	Tier 1 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 3 and all of Scenario 4 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Operations and maintenance	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which will be in their O&M phases concurrently with the O&M phase of the MHPGC Project: • Morven North; • Morven South; • Ossian OWF. Morven North and Morven South lie within the northern section of the MHPGC Project PEIR Red Line Boundary, in Scottish waters. Therefore, O&M activities for Morven North and Morven may overlap spatially and temporally with O&M activities associated with the MHPGC Project. Should they be undertaken concurrently, there is potential for plumes to interact, however these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The majority of sedimentation would occur within close proximity to each activity due to the low sediment transport rates in the area. Ossian OWF is located 5km from the MHPGC Project PEIR Red Line Boundary directly to the east and southeast and is proposed for up to 265 wind turbines. There will be limited opportunity for the amalgamation of sediment plumes from O&M from this project, given the orientation of the tides in a predominantly north northeast to south southwest direction, as evidenced from modelling of sediment plumes. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1;

	Cumulative Effects Assessment
	• Eastern Green Link 2; • NO UK Telecom Cable; • Havhingsten Seg 2 Telecom Cable; • North Sea Link North Power Cable. These cable projects will be in their O&M phase and therefore may result in low levels of increased SSC and associated deposition due to maintenance. The magnitude of the impact is not anticipated to be measurably larger than Scenarios 1 and 2 for this impact with the addition of Tier 1 and the intermittent nature of activities will reduce temporal overlap and therefore prevent significant increases to the magnitude. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These cable projects will be in their O&M phase and therefore may result in low levels of increased SSC and associated deposition due to maintenance. The magnitude of the impact is not anticipated to be measurably larger than Scenarios 1 and 2 for this impact with the addition of Tier 1 and the intermittent nature of activities will reduce temporal overlap and therefore prevent significant increases to the magnitude. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impact of this project is unknown but is likely to be similar, if not much smaller than for the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to temporary increases in SSC and sediment deposition are expect to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.43** *et seq.* In Scottish and English waters, sandeel are considered to be of **medium** sensitivity to increased SSC and deposition due to their reliance on specific seabed substrates for spawning and the overlap with recognised spawning grounds. In contrast, herring are considered to be of **low** sensitivity, reflecting the absence of suitable spawning habitat Fish and Shellfish CEA Study Area, and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish, elasmobranchs and diadromous fish are also considered to be of low sensitivity, as they are mobile, not dependent on specific seabed habitats for spawning, and/or are naturally exposed to variable sediment conditions. All shellfish receptors are considered to

	Cumulative Effects Assessment
	be of low sensitivity due to their tolerance of elevated SSC and sediment deposition and/or their high recoverability. The sensitivity of Fish and Shellfish ecology receptors to temporary increases in SSC and sediment deposition is therefore considered to be at worst-case **medium**.
Significance of effect	Tier 1 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 3 and all of Scenario 4 Overall, for the IEFs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18,** is not significant in EIA terms.
Decommissioning phase	
Magnitude of impact	As per construction phase. During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated increased SSCs and associated deposition. Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction.
Sensitivity of receptor	
Significance of effect	
Further mitigation and residual significance	

4.10.5 Disturbance/remobilisation of sediment bound contaminants

4.10.5.1 Seabed disturbance associated with activities such as cable installation or repair/replacement in all phases could lead to the remobilisation of sediment-bound contaminants that may result in harmful and adverse effects on Fish and Shellfish. There is potential for the disturbance/remobilisation of sediment bound contaminants as a result of seabed-disturbing activities associated with the MHPGC Project and other projects and plans within the Fish and Shellfish CEA Study Area. Such activities may include seabed preparation, cable installation, cable maintenance and repair, dredging and disposal activities, and the removal of infrastructure during decommissioning. Where these activities overlap spatially and temporally, there is potential for cumulative disturbance and remobilisation of sediment-bound contaminants.

4.10.5.2 Disturbance/remobilisation of sediment bound contaminants may occur as a result of the MHPGC Project. Additionally, OWF projects, cable projects and dredge disposal sites identified within the cumulative assessment may contribute cumulatively where spatial and temporal overlap occurs.

4.10.5.3 The summary of the Whole Project assessment for disturbance/remobilisation of sediment bound contaminants is presented in **Table 4.36** and the CEA presented in **Table 4.37**.

Table 4.36: MHPGC Project whole project assessment for disturbance/redistribution of sediment bound contaminants

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	While the construction of the Morven North may occur simultaneously with the construction phase of the MHPGC Project sediment bound contaminants are only expected to be disturbed and remobilised for the duration of activities resulting in seabed disturbance, with construction activities lasting for a short period of time in any one place. Furthermore, sediment bound contaminants are expected to be regularly mobilised by natural disturbance such as currents, waves and storm events, and rapidly dispersed following disturbance due to local hydrodynamic conditions. Therefore, any elevated levels of disturbed contaminants above background conditions during construction activities are expected to return to baseline levels rapidly following disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.	While the construction of the Morven South may occur simultaneously with the construction phase of the MHPGC Project sediment bound contaminants are only expected to be disturbed and remobilised for the duration of activities resulting in seabed disturbance, with construction activities lasting for a short period of time in any one place. Furthermore, sediment bound contaminants are expected to be regularly mobilised by natural disturbance such as currents, waves and storm events, and rapidly dispersed following disturbance due to local hydrodynamic conditions. Therefore, any elevated levels of disturbed contaminants above background conditions during construction activities are expected to return to baseline levels rapidly following disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the release of sediment-bound contaminants is summarised in **Paragraph 4.8.2.70** *et seq*. Fish eggs and larvae are considered to be the most sensitive receptors to this impact due to the potential for sediment-bound contaminants to cause adverse effects on development, hatching success and early life-stage survival. These receptors are therefore considered to be of medium sensitivity. Filter-feeding shellfish are also considered to be of medium sensitivity due to their potential to bioaccumulate contaminants and their limited ability to avoid exposure. In contrast, adult fish, including pelagic and demersal species, elasmobranchs and diadromous fish, are considered to be of low sensitivity owing to their mobility and reduced vulnerability to short-term, localised releases of sediment-bound contaminants. The sensitivity of Fish and Shellfish ecology receptors to the release of sediment-bound contaminants is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be negligible and the sensitivity of the receptor is considered to be at worst-case **medium**. The Whole Project effect will, therefore, be of negligible or minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Operations and maintenance phase		

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Magnitude of impact	The O&M phase of Morven North may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events with potential disturbance/remobilisation of sediment bound contaminants. The impacts are expected to be minimal, with much smaller levels of disturbance/remobilisation of sediment bound contaminants expected than during the construction and decommissioning phases, and the overall magnitude is therefore unlikely to be significantly greater than the alone assessment at any one point. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.	The O&M phase of Morven South may occur simultaneously with the O&M phase of the MHPGC Project and includes cable repair and reburial events with potential disturbance/remobilisation of sediment bound contaminants. The impacts are expected to be minimal, with much smaller levels of disturbance/remobilisation of sediment bound contaminants expected than during the construction and decommissioning phases, and the overall magnitude is therefore unlikely to be significantly greater than the alone assessment at any one point. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the release of sediment-bound contaminants is considered to be not greater than during the construction phase and is summarised in **Paragraph 4.8.2.70** *et seq*. Fish eggs and larvae are considered to be the most sensitive receptors to this impact due to the potential for sediment-bound contaminants to cause adverse effects on development, hatching success and early life-stage survival. These receptors are therefore considered to be of medium sensitivity. Filter-feeding shellfish are also considered to be of medium sensitivity due to their potential to bioaccumulate contaminants and their limited ability to avoid exposure. In contrast, adult fish, including pelagic and demersal species, elasmobranchs and diadromous fish, are considered to be of low sensitivity owing to their mobility and reduced vulnerability to short-term, localised releases of sediment-bound contaminants. The sensitivity of Fish and Shellfish ecology receptors to the release of sediment-bound contaminants is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be negligible and the sensitivity of the receptor is considered to be at worst-case **medium**. The Whole Project effect will, therefore, be of negligible or minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Decommissioning phase		
Magnitude of impact	While the decommissioning of Morven North may occur simultaneously with the decommissioning phase of the MHPGC Project sediment bound contaminants are only expected to be disturbed and remobilised for the duration of activities resulting in seabed disturbance, with decommissioning activities lasting for a short period of time in any one place. Furthermore, sediment bound contaminants are expected to be regularly mobilised by natural	While the decommissioning of Morven South may occur simultaneously with the decommissioning phase of the MHPGC Project sediment bound contaminants are only expected to be disturbed and remobilised for the duration of activities resulting in seabed disturbance, with decommissioning activities lasting for a short period of time in any one place. Furthermore, sediment bound contaminants are expected to be regularly mobilised by natural

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	disturbance such as currents, waves and storm events, and rapidly dispersed following disturbance due to local hydrodynamic conditions. Therefore, any elevated levels of disturbed contaminants above background conditions during decommissioning activities are expected to return to baseline levels rapidly following disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.	disturbance such as currents, waves and storm events, and rapidly dispersed following disturbance due to local hydrodynamic conditions. Therefore, any elevated levels of disturbed contaminants above background conditions during decommissioning activities are expected to return to baseline levels rapidly following disturbance. The Whole Project impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the release of sediment-bound contaminants is considered to be not greater than during the construction phase and is summarised in **Paragraph 4.8.2.70** *et seq*. Fish eggs and larvae are considered to be the most sensitive receptors to this impact due to the potential for sediment-bound contaminants to cause adverse effects on development, hatching success and early life-stage survival. These receptors are therefore considered to be of medium sensitivity. Filter-feeding shellfish are also considered to be of medium sensitivity due to their potential to bioaccumulate contaminants and their limited ability to avoid exposure. In contrast, adult fish, including pelagic and demersal species, elasmobranchs and diadromous fish, are considered to be of low sensitivity owing to their mobility and reduced vulnerability to short-term, localised releases of sediment-bound contaminants. The sensitivity of Fish and Shellfish ecology receptors to the release of sediment-bound contaminants is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be negligible and the sensitivity of the receptor is considered to be at worst-case **medium**. The Whole Project effect will, therefore, be of negligible or minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.37: MHPGC Project CEA for disturbance/redistribution of sediment bound contaminants

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project with volume of disturbed sediment indicated • Morven North (28,974,207m^3); • Morven South (23,675,007m^3); • Ossian OWF (11,841,602m^3). Morven North and Morven South lie within the northern section of the MHPGC Project PEIR Red Line Boundary, in Scottish waters. Therefore, construction activities for Morven North and Morven South may overlap spatially and temporally with construction activities associated with the MHPGC Project. Should they be undertaken concurrently, there is potential for sediment plumes with associated sediment bound contaminants to interact, however these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The majority of redistribution of sediments would occur within close proximity to each activity due to the low sediment transport rates in the area. Ossian OWF is located 5km from the MHPGC Project PEIR Red Line Boundary directly to the east and southeast and is proposed for up to 265 wind turbines. There will be limited opportunity for the amalgamation of sediment plumes and associated sediment bound contaminants from this project, given the orientation of the tides in a predominantly north northeast to south southwest direction, as evidenced from modelling of sediment plumes Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. Tier 1 also includes the following dredge disposal sites: • Noses Point; • Souter Point Outer; • Sunderland. These cable projects will be primarily in their O&M phase and therefore may result in low levels of SSC and associated sediment bound contaminants due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative increase in SSC and associated deposition value. Similarly, due to the intermittent nature of dredging work, the

	Cumulative Effects Assessment
	dredge disposal projects have not quantified this impact and therefore have not contributed to the overall cumulative increase in SSC and associated deposition value. In total cumulative increase in SSC and associated deposition of potentially contaminated sediment associated with the MHPGC Project (7,212,927m^3) and Tier 1 projects is up to 71,703,743m^3. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These cable projects will be primarily in their O&M phase and therefore may result in low levels of SSC and potential sediment bound contaminants due to maintenance. Due to the spatially limited and intermittent nature of this work, these projects have not quantified this impact and therefore have not contributed to the overall cumulative temporary habitat loss/disturbance value. In total cumulative increase in SSC and associated deposition of potentially contaminated sediment associated with the MHPGC Project (7,212,927m^3) and Tier 1 projects is up to 7,217,927m^3. The cumulative effect is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **negligible**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impact of these projects are unknown but are likely to be similar, if not much smaller than for the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible.**
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the release of sediment-bound contaminants is summarised in **Paragraph 4.8.2.70** *et seq.* Fish eggs and larvae are considered to be the most sensitive receptors to this impact due to the potential for sediment-bound contaminants to cause adverse effects on development, hatching success and early life-stage survival. These receptors are therefore considered to be of medium sensitivity. Filter-feeding shellfish are also considered to be of medium sensitivity due to their potential to bioaccumulate contaminants and their limited ability to avoid exposure. In contrast, adult fish, including pelagic and demersal species and diadromous fish, are considered to be of low sensitivity owing to their mobility and reduced vulnerability to short-term, localised releases of sediment-bound contaminants. The sensitivity of Fish and Shellfish ecology receptors to the release of sediment-bound contaminants is therefore considered to be at worst-case **medium**.
Significance of effect	Tier 1

	Cumulative Effects Assessment
	Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 3 and all of Scenario 4 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which will be in their O&M phases concurrently with the O&M phase of the MHPGC Project: • Morven North; • Morven South; • Ossan OWF. Morven North and Morven South lie within the northern section of the MHPGC Project PEIR Red Line Boundary, in Scottish waters. Therefore, O&M activities for Morven North and Morven South may overlap spatially and temporally with O&M activities associated with the MHPGC Project. Should they be undertaken concurrently, there is potential for plumes to interact. However these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The majority of sedimentation would occur within close proximity to each activity due to the low sediment transport rates in the area. Ossian OWF is located 5km from the MHPGC Project PEIR Red Line Boundary directly to the east and southeast and is proposed for up to 265 wind turbines. There will be limited opportunity for the amalgamation of sediment plumes and associated sediment bound contaminants from this project, given the orientation of the tides in a predominantly north northeast to south southwest direction, as evidenced from modelling of sediment plumes. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2 and; • North Sea Link.

	Cumulative Effects Assessment
	These cable projects will be in their O&M phase and therefore may result in low levels of increased SSC and associated deposition due to maintenance. The magnitude of the impact is not anticipated to be measurably larger than Scenarios 1 and 2 for this impact with the addition of Tier 1 and the intermittent nature of activities will reduce temporal overlap and therefore prevent significant increases to the magnitude. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These cable projects will be in their O&M phase and therefore may result in low levels of increased SSC and associated deposition due to maintenance. The magnitude of the impact is not anticipated to be measurably larger than Scenarios 1 and 2 for this impact with the addition of Tier 1 and the intermittent nature of activities will reduce temporal overlap and therefore prevent significant increases to the magnitude. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an applications and therefore the scale and specific impact of these projects are unknown but are likely to be similar, if not much smaller, than for the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the release of sediment-bound contaminants is summarised in **Paragraph 4.8.2.70** *et seq.* Fish eggs and larvae are considered to be the most sensitive receptors to this impact due to the potential for sediment-bound contaminants to cause adverse effects on development, hatching success and early life-stage survival. These receptors are therefore considered to be of medium sensitivity. Filter-feeding shellfish are also considered to be of medium sensitivity due to their potential to bioaccumulate contaminants and their limited ability to avoid exposure. In contrast, adult fish, including pelagic and demersal species and diadromous fish, are considered to be of low sensitivity owing to their mobility and reduced vulnerability to short-term, localised releases of sediment-bound contaminants. The sensitivity of Fish and Shellfish ecology receptors to the release of sediment-bound contaminants is therefore considered to be at worst-case **medium**.
Significance of effect	Tier 1 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

	Cumulative Effects Assessment
	Tier 3 and all of Scenario 4 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Decommissioning phase	
Magnitude of impact	As per construction phase. During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated disturbance/remobilisation of sediment bound contaminants. Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction.
Sensitivity of receptor	
Significance of effect	
Further mitigation and residual significance	

4.10.6 Underwater sound (excluding unexploded ordnance)

4.10.6.1 There is a potential for underwater sound (excluding UXO) as a result of the MHPGC Project's construction, O&M and decommissioning activities within the Fish and Shellfish CEA Study Area. Such activities may include geophysical and geotechnical surveys, vessel movements, seabed preparation works, cable installation activities, maintenance and repair operations and the removal of infrastructure during decommissioning. These activities have the potential to result in mortality, injury, behavioural disturbance and auditory masking in Fish and Shellfish receptors. Where these activities overlap spatially and temporally, there is potential for cumulative underwater sound effects.

4.10.6.2 Underwater sound (excluding UXO) may occur as a result of the MHPGC Project. Additionally, OWF projects and cable projects identified within the cumulative assessment may contribute cumulatively where spatial and temporal overlap occurs.

4.10.6.3 The summary of the Whole Project assessment for underwater sound (excluding UXO) is presented **Table 4.38,** and CEA is presented in **Table 4.39**.

Table 4.38: MHPGC Project whole project assessment for underwater sound (excluding UXO)

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	While the construction of Morven North may occur simultaneously with the construction phase of the MHPGC Project, the majority of construction noise sources are transient, mobile and highly localised. Furthermore, although Morven North may include foundation installation activities, including piling, the MHPGC Project does not include piling activities and project-alone modelling indicates highly localised ranges for mortality, injury and behavioural effects for all receptors. Any overlap of underwater sound fields is therefore expected to be limited both in extent and duration. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	While the construction of Morven South may occur simultaneously with the construction phase of the MHPGC Project, the majority of construction noise sources are transient, mobile and highly localised. Furthermore, although Morven South may include foundation installation activities, including piling, the MHPGC Project does not include piling activities and project-alone modelling indicates highly localised ranges for mortality, injury and behavioural effects for all receptors. Any overlap of underwater sound fields is therefore expected to be limited both in extent and duration. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (excluding UXO) is summarised in **Paragraph 4.8.2.99** *et seq*. Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities, demersal spawning behaviour and potential exposure during spawning periods. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptors is considered to be at worst-case **medium** (with the exception of spawning herring). The Whole Project effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Spawning herring represent the only high-sensitivity receptor group, although areas of high confidence spawning activity are located outside the predicted impact ranges of project underwater sound. In addition, underwater sound sources are temporary, highly localised and intermittent. Applying expert judgement, the overall significance of effect for spawning herring is also considered to be **minor adverse**, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Operation and maintenance phase		

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Magnitude of impact	While the O&M of Morven North may occur simultaneously with the O&M phase of the MHPGC Project, underwater sound from maintenance activities will be transient, mobile and highly localised. Furthermore, project-alone modelling indicates highly localised impact ranges for all receptors. Any overlap of underwater sound fields is therefore expected to be limited in extent and duration. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	While the O&M of Morven South may occur simultaneously with the O&M phase of the MHPGC Project, underwater sound from maintenance activities will be transient, mobile and highly localised. Furthermore, project-alone modelling indicates highly localised impact ranges for all receptors. Any overlap of underwater sound fields is therefore expected to be limited in extent and duration. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (excluding UXO) is summarised in **Paragraph 4.8.2.99** *et seq*. Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities and demersal spawning behaviour. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptors is considered to be at worst-case **medium** (with the exception of spawning herring). The Whole Project effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Spawning herring represent the only high-sensitivity receptor group, although areas of high confidence spawning activity are located outside the predicted impact ranges of project underwater sound. In addition, underwater sound sources are temporary, highly localised and intermittent. Applying expert judgement, the overall significance of effect for spawning herring is also considered to be **minor adverse**, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Decommissioning phase		
Magnitude of impact	While the decommissioning of Morven North may occur simultaneously with the decommissioning phase of the MHPGC Project, the majority of decommissioning noise sources are transient, mobile and highly localised. Furthermore, although Morven North may require decommissioning of offshore infrastructure (such as cutting of WTGs), the MHPGC Project does not include pile removal activities and project-alone modelling indicates highly localised ranges for mortality, injury and behavioural effects. Any overlap of underwater sound fields is therefore expected to be limited in extent and duration.	While the decommissioning of Morven South may occur simultaneously with the decommissioning phase of the MHPGC Project, the majority of decommissioning noise sources are transient, mobile and highly localised. Furthermore, although Morven South may require decommissioning of offshore infrastructure, (such as cutting of WTGs) the MHPGC Project does not include pile removal activities and project-alone modelling indicates highly localised ranges for mortality, injury and behavioural effects. Any overlap of underwater sound fields is therefore expected to be limited in extent and duration.

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (excluding UXO) is summarised in **Paragraph 4.8.2.99** *et seq*. Shellfish receptors and Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities and demersal spawning behaviour. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptors is considered to be at worst-case **medium** (with the exception of spawning herring). The Whole Project effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. Spawning herring represent the only high-sensitivity receptor group, although areas of high confidence spawning activity are located outside the predicted impact ranges of project underwater sound. In addition, underwater sound sources are temporary, highly localised and intermittent. Applying expert judgement, the overall significance of effect for spawning herring is also considered to be **minor adverse**, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.39: MHPGC Project CEA for underwater sound (excluding unexploded ordnance)

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project. • Morven North; • Morven South; • Ossian OWF. Morven North and Morven South lie within the northern section of the MHPGC Project PEIR Red Line Boundary, in Scottish waters. Therefore, construction activities for Morven North and Morven South may overlap spatially and temporally with construction activities associated with the MHPGC Project. Additionally, Ossian OWF is located 5km from the MHPGC Project PEIR Red Line Boundary directly to the east and southeast and is proposed for up to 265 wind turbines. Construction activities may include vessel movements, geophysical surveys, geotechnical surveys, seabed preparation, and cable installation works. Whilst construction programmes may overlap temporally, underwater sound generated by these activities is generally transient, intermittent and localised. Furthermore, the principal sound sources associated with the MHPGC Project are relatively low level compared with impulsive piling activities commonly associated with OWF developments. Any cumulative increase in underwater sound is therefore expected to remain localised and temporary, primarily within the vicinity of active works. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. These cable projects will be primarily in their O&M phase and any maintenance activities may result in the generation of under water sound. However, any underwater sound generated would be transient, intermittent and localised. Any cumulative increase in underwater sound is therefore expected to remain localised and temporary, primarily within the vicinity of active works. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered to be **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3;

	Cumulative Effects Assessment
	• Eastern Green Link 4. Construction activities associated with these projects may generate underwater sound through activities such as vessel movements, geophysical and geotechnical surveys, seabed preparation and cable installation. Whilst there is potential for temporal overlap with the MHPGC Project construction activities, underwater sound associated with these activities is generally intermittent, mobile and localised. In addition, sound levels attenuate rapidly with distance from the source, reducing the potential for substantial overlap of effects at receptors. The cumulative effect is predicted to be of regional spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered to be **low**. <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impact of these projects are unknown but are likely to be similar, if not much smaller than for the MHPGC Project. However, underwater sound effects are expected to be broadly comparable to those associated with offshore cable installation and offshore wind development activities elsewhere in the region. Taking account of all projects within Scenario 4, underwater sound effects will remain temporary, intermittent and geographically dispersed throughout the wider North Sea. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (excluding UXO) is expect to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.99** *et seq*. Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities and demersal spawning behaviour. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.
Significance of effect	<u>Tier 1</u> Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. <u>Tier 2</u> Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. <u>Tier 3 and all of Scenario 4</u>

	Cumulative Effects Assessment
	Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Operation and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have O&M phases overlapping with the O&M of the MHPGC Project. • Morven North; • Morven South; • Ossian OWF. These projects will be in their O&M phase when the MHPGC Project is in its O&M phase. Underwater sound generated during these phases will result from geophysical surveys and geotechnical surveys, vessel movements, maintenance works and operational turbines. Tier 1 also includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. These cable projects will be primarily in their O&M phase when the MHPGC Project is in its O&M phase and therefore may result in low levels of underwater sound, due to maintenance works, surveys and vessel movements. The cumulative effect is predicted to be of local to regional spatial extent, long-term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These projects will be in their O&M phase when the MHPGC Project is in its O&M phase. Underwater sound generated during these phases will result from geophysical surveys and geotechnical surveys, vessel movements and maintenance works.

	Cumulative Effects Assessment
	The cumulative effect is predicted to be of local to regional spatial extent, long-term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application and therefore the scale and specific impacts of these projects are unknown. However, underwater sound generated by activities associated with these projects would be expected to be transient and localised, with the potential for cumulative effects limited to periods where sound-generating activities overlap spatially and temporally with those of the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, intermittent, and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (excluding UXO) is expected to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.99** *et seq.* Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities and demersal spawning behaviour. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.
Significance of effect	Tier 1 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. Tier 2 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. Tier 3 and all of Scenario 4 Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be at worst-case high. The cumulative effect would therefore range from minor to moderate significance. However, given the temporary and localised nature of underwater sound sources, the limited overlap of acoustic footprints, and the absence of piling within the MHPGC Project, the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms.

	Cumulative Effects Assessment
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Decommissioning phase	
Magnitude of impact	As per construction phase. During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated underwater sound (excluding UXO). Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction.
Sensitivity of receptor	
Significance of effect	
Further mitigation and residual significance	

4.10.7 Underwater sound from UXO

4.10.7.1 There is potential for underwater sound from UXO clearance as a result of pre-construction activities associated with the MHPGC Project to occur within the Fish and Shellfish CEA Study Area. UXO clearance activities may generate high-intensity underwater sound capable of causing mortality, injury, behavioural disturbance and auditory masking in Fish and Shellfish receptors. The magnitude and spatial extent of effects are dependent on the type of clearance method employed and the size of the UXO being cleared.

4.10.7.2 Underwater sound from UXO clearance may occur as a result of the MHPGC Project. Additionally, OWF projects and cable projects identified within the cumulative assessment may require UXO clearance prior to construction and may therefore contribute cumulatively where spatial and temporal overlap occurs.

4.10.7.3 The summary of the Whole Project assessment for underwater sound from UXO clearance is presented in **Table 4.40**, and the CEA for underwater sound from UXO clearance is presented in **Table 4.41**.

Table 4.40: MHPGC Project whole project assessment for underwater sound from UXO

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	The Project-alone assessment in **Section 4.8**, considered low order UXO clearance associated with the MHPGC Project offshore export cable corridor, and the funnel area located in Scottish waters, but excluding where there MHPGC Project PEIR Red Line Boundary overlaps with Morven North. The Whole Project assessment considers UXO clearance activities within the Morven North array area, allowing for the assessment of potential cumulative impacts arising from UXO clearance campaigns occurring concurrently across the Whole Project. Should UXO clearance be required for both the MHPGC Project and Morven North, there is potential for a temporal overlap in UXO clearance activities during the pre-construction phase, although the clearance footprints themselves would remain spatially discrete. UXO detonations are discrete events and, where low-order techniques are employed, impact ranges are expected to remain highly localised. Under a scenario where low-order clearance techniques are used at both projects, impacts would be spatially restricted, short-term and associated with individual clearance events lasting only seconds. The Whole Project impact would therefore be of local spatial extent, short-term duration, intermittent and highly reversible, and the magnitude of impact would be considered **negligible**. The Project-alone assessment for the MHPGC Project does not include high-order UXO clearance. However, as a highly precautionary Whole Project scenario, the assessment also considers the potential for high-order detonation to be required at Morven North.Under this scenario, impact ranges from UXO clearance Morven North array area would be larger than those associated with low order clearance for the MHPGC Project; however, effects would remain short-term and associated with individual clearance events lasting only seconds. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered to be **low**.	The Project-alone assessment in **Section 4.8**, considered low order UXO clearance associated with the MHPGC Project offshore export cable corridor, and the funnel area located in Scottish waters, but excluding where there MHPGC Project PEIR Red Line Boundary overlaps with Morven South. The Whole Project assessment considers UXO clearance activities within the Morven South array area, allowing for the assessment of potential cumulative impacts arising from UXO clearance campaigns occurring concurrently across the Whole Project. Should UXO clearance be required for both the MHPGC Project and Morven South, there is potential for a temporal overlap in UXO clearance activities during the pre-construction phase, although the clearance footprints themselves would remain spatially discrete. UXO detonations are discrete events and, where low-order techniques are employed, impact ranges are expected to remain highly localised. Under a scenario where low-order clearance techniques are used at both projects, impacts would be spatially restricted, short-term and associated with individual clearance events lasting only seconds. The Whole Project impact would therefore be of local spatial extent, short-term duration, intermittent and highly reversible, and the magnitude of impact would be considered **negligible**. The Project-alone assessment for the MHPGC Project does not include high-order UXO clearance. However, as a highly precautionary Whole Project scenario, the assessment also considers the potential for high-order detonation to be required at Morven South. Under this scenario, impact ranges from UXO clearance in the Morven South array area would be larger than those associated with low order clearance for the MHPGC Project; however, effects would remain short-term and associated with individual clearance events lasting only seconds. The Whole Project impact is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound (including UXO) is summarised in **Paragraph 4.8.2.99** *et seq.*	

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	Group 1 and Group 2 fish receptors, including sandeel, elasmobranchs, river lamprey, sea lamprey, Atlantic salmon and brown trout, are considered to be of low sensitivity. Most Group 3 receptors are also considered to be of low sensitivity due to their mobility and expected recovery following temporary disturbance. However, spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities and demersal spawning behaviour. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and vulnerability to disturbance. Shellfish receptors are considered to be of low sensitivity owing to their low vulnerability and high recoverability. The sensitivity of Fish and Shellfish ecology receptors to underwater sound (excluding UXO) is therefore considered to be at worst-case **high**.	
Significance of effect	Overall, for the Fish and Shellfish ecology VERs in both Scottish and English waters, the magnitude of the Whole Project impact associated with low-order UXO clearance is considered to be **negligible**, reflecting the highly localised and short-term nature of the resulting underwater sound. Given receptor sensitivities ranging from low to high, effects would be of **negligible to minor adverse** significance and therefore not significant in EIA terms. A highly precautionary Whole Project scenario has also been considered in which high-order UXO clearance may be required within the Morven North or Morven South array areas and occur concurrently with the MHPGC Project low order clearance campaign. Under the highly precautionary scenario, impact ranges from high order UXO clearance events in the Morven North or Morven South array area would be larger than those associated with low order clearance, and should UXO clearance activities occur concurrently across the Whole Project, a greater overall area may be exposed to underwater sound over the course of the clearance campaign. However, there would be no spatial overlap between UXO clearance activities associated with the MHPGC Project and those associated with Morven North or Morven South as clearance activities within overlapping areas are excluded from the MHPGC Project assessment and assessed separately by the relevant Morven project. Furthermore, there will be no spatial overlap in UWN noise impact ranges, given the localised nature of the spatial effects of low order clearance at the MHPGC Project. Accordingly, under this precautionary Whole Project scenario, the magnitude of impact is considered to be **low**. For most Fish and Shellfish ecology receptors, sensitivity is considered to be low to medium and cumulative effects from the Whole Project would therefore be of no more than **minor adverse** significance, which is not significant in EIA terms. For spawning herring, sensitivity to underwater sound is considered high. Under the precautionary Whole Project scenario, the combination of low magnitude and high sensitivity would initially result in an effect of minor or moderate significance. However, there would be no spatial overlap between MHPGC Project and Morven UXO clearance activities, with the assessment only assuming a potential temporal overlap between separate UXO clearance campaigns. The predicted underwater sound impact ranges do not overlap with areas where herring spawning activity is known to occur with a high degree of confidence, with no important spawning grounds identified within the predicted range of impacts. Given the localised and temporary nature of the impact, and the limited potential for spawning activity within the affected area, significant disturbance to spawning herring is not anticipated. Applying expert judgement, the overall significance of effect is therefore assessed as **minor adverse**, which is not significant in EIA terms. Low-order clearance techniques are preferred wherever feasible, and any requirement for high-order UXO clearance would be subject to separate post-consent assessment and licensing.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms. As noted above, the presence of UXO requiring high-order detonation will be investigated through targeted UXO surveys undertaken post-DCO consent. The assessment presented here includes a precautionary consideration of high-order clearance; however, low-order clearance techniques would be used wherever practicable. Should UXO be identified that can only be cleared using high-order detonation, further	

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	assessment would be required to support a Marine Licence application, and any additional mitigation measures necessary to reduce potential effects on Fish and Shellfish ecology would be identified and agreed at that stage.	
Decommissioning phase		
Magnitude of impact	As per construction phase. During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated underwater sound from UXO. Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction, although it is recognised that UXO clearance is unlikely to be required during decommissioning..	
Sensitivity of receptor		
Significance of effect		
Further mitigation and residual significance		

Table 4.41: MHPGC Project CEA for underwater sound (excluding unexploded ordnance)

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of the MHPGC Project. • Morven North; • Morven South; • Ossian OWF. Tier 1 includes the following cable projects: • Berwick Bank ECC; • Eastern Green Link 1; • Eastern Green Link 2; • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. These projects may require UXO clearance activities prior to construction. UXO clearance has the potential to generate high-intensity underwater sound capable of causing mortality, injury, behavioural disturbance and auditory masking in Fish and Shellfish receptors. While low-order techniques are preferred wherever feasible, a precautionary assessment has also assumed that high-order UXO clearance may be required. Unlike other construction noise sources, UXO detonations represent discrete events of very short duration, and the likelihood of multiple detonations occurring simultaneously within overlapping areas is considered low. Under a scenario where low-order clearance techniques are used, underwater sound impacts would remain highly localised and temporary. The cumulative effect would be of local spatial extent, short-term duration, intermittent and highly reversible. The magnitude would therefore be considered **negligible**. Under the precautionary scenario whereby high-order UXO clearance is required and undertaken at overlapping projects, impact ranges would be larger but would remain associated with discrete, short-duration events. The cumulative effect is predicted to be of local spatial extent, short-term duration, intermittent and highly reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4. These projects may also require UXO clearance as part of pre-construction preparation works. The addition of Tier 2 projects increases the number of potential UXO clearance campaigns within the wider region; however, UXO detonations would remain discrete, short-duration events with limited

	Cumulative Effects Assessment
	opportunity for simultaneous overlap at receptor populations. Consequently, the addition of Tier 2 projects is not anticipated to materially increase the magnitude of impact beyond that assessed for Tier 1. Under a scenario where low-order clearance techniques are used, impacts would remain highly localised, temporary and intermittent, and the magnitude would remain **negligible**. Under the precautionary scenario whereby high-order UXO clearance is required at overlapping projects, the cumulative effect is predicted to be of regional spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. Limited information is currently available regarding these projects. However, as a precautionary assumption, it is considered possible that UXO clearance activities comparable to those associated with OWF and cable developments may be required. Taking account of all projects within Scenario 4, UXO clearance effects would remain temporary, intermittent and geographically dispersed throughout the wider North Sea. Under a scenario where low-order clearance techniques are employed, impacts would remain highly localised and the cumulative magnitude would be **negligible**. Under the precautionary scenario whereby high-order UXO clearance is required and undertaken across overlapping projects, UXO clearance effects would remain temporary, intermittent and geographically dispersed throughout the wider North Sea. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, short-term duration, intermittent and highly reversible. The magnitude is therefore considered **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to underwater sound from UXO clearance is summarised in **Paragraph 4.8.2.128** *et seq.* Group 1, Group 2 and most Group 3 fish receptors are considered to be of low sensitivity to underwater sound. Fish eggs and larvae are considered to be of medium sensitivity due to their limited mobility and increased vulnerability to injury. Spawning herring are considered to be of high sensitivity due to their enhanced hearing capabilities, demersal spawning behaviour and potential for increased exposure during spawning periods. Shellfish receptors are considered to be of low sensitivity. The sensitivity of Fish and Shellfish ecology receptors to underwater sound from UXO clearance is therefore considered to be at worst-case **high**.
Significance of effect	Tier 1 Overall, for the Fish and Shellfish ecology VERs in both Scottish and English waters, the magnitude of the cumulative impact is considered to be negligible adverse where low-order UXO clearance techniques are employed and low under the precautionary scenario that high-order UXO clearance is required. Receptor sensitivity ranges from low to medium for most receptors and high for spawning herring. Consequently, effects on most Fish and Shellfish receptors would be of negligible to minor significance and would not be significant in EIA terms. While a low magnitude impact acting on high-sensitivity spawning herring could result in an effect of minor to moderate significance, the temporary and localised nature of UXO clearance activities, the absence of overlap with known key herring spawning grounds, and the low potential for herring spawning within the Fish and Shellfish Ecology CEA Area, mean that the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. Tier 2 Overall, for the Fish and Shellfish ecology VERs in both Scottish and English waters, the magnitude of the cumulative impact is considered to be negligible adverse where low-order UXO clearance techniques are employed and low under the precautionary scenario that high-order UXO clearance is required. Receptor sensitivity ranges from low to medium for most receptors and high for spawning herring. Consequently, effects on most Fish and Shellfish

	Cumulative Effects Assessment
	receptors would be of negligible to minor significance and would not be significant in EIA terms. While a low magnitude impact acting on high-sensitivity spawning herring could result in an effect of minor to moderate significance, the temporary and localised nature of UXO clearance activities, the absence of overlap with known key herring spawning grounds, and the low potential for herring spawning within the Fish and Shellfish CEA Study Area, mean that the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms. <u>Tier 3 and all of Scenario 4</u> Overall, for the Fish and Shellfish ecology VERs in both Scottish and English waters, the magnitude of the cumulative impact is considered to be negligible adverse where low-order UXO clearance techniques are employed and low under the precautionary scenario that high-order UXO clearance is required. Receptor sensitivity ranges from low to medium for most receptors and high for spawning herring. Consequently, effects on most Fish and Shellfish receptors would be of negligible to minor significance and would not be significant in EIA terms. While a low magnitude impact acting on high-sensitivity spawning herring could result in an effect of minor to moderate significance, the temporary and localised nature of UXO clearance activities, the absence of overlap with known key herring spawning grounds, and the low potential for herring spawning within the Fish and Shellfish CEA Study Area, mean that the overall cumulative effect is assessed as **minor adverse**, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms. As noted above, the presence of UXO requiring high-order detonation will be investigated through targeted UXO surveys undertaken post-DCO consent. The assessment presented here includes a precautionary consideration of high-order clearance; however, low-order clearance techniques would be used wherever practicable. Should UXO be identified that can only be cleared using high-order detonation, further assessment would be required to support a Marine Licence application, and any additional mitigation measures necessary to reduce potential effects on Fish and Shellfish ecology would be identified and agreed at that stage.

4.10.8 Increased risk of introduction and spread of INNS

4.10.8.1 There is potential for an increased risk of introduction and spread of INNS as a result of the MHPGC Project's construction, O&M and decommissioning activities within the Fish and Shellfish CEA Study Area. An increased risk of introduction and spread of INNS may arise from increased vessel movements and activity associated with the MHPGC Project, which may facilitate the transfer of INNS via hull fouling and ballast water (where relevant). During the O&M phase, cable protection, export cable crossings and protection associated with trenchless drill exit pits may also provide hard substrate that could facilitate the establishment and spread of INNS. Where these pathways occur in combination with those associated with other OWF and cable projects, there is potential for cumulative effects.

4.10.8.2 Increased risk of introduction and spread of INNS may occur as a result of the MHPGC Project. Additionally, OWF and cable projects identified within the cumulative assessment may contribute cumulatively where there is spatial and/or temporal overlap in vessel activity and the provision of artificial hard substrate.

4.10.8.3 The summary of the Whole Project assessment for an increased risk of introduction and spread of INNS is presented in **Table 4.42** and CEA for an increased risk of introduction and spread of INNS is presented in **Table 4.43**.

Table 4.42: MHPGC Project whole project assessment for increased risk of introduction and spread of INNS

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Construction phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The construction phase of Morven North may occur simultaneously with the construction phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the installation of hard structures, such as cable protection, as well as vessel movement which may occur in all phases of the MHPGC Project. The presence of the Morven North infrastructure will result in the installation of up to 3,139,162m^2 of hard structures while up to 3,060 vessel round trips will be required. In combination with the MHPGC Project this equates to 4,259,346m^2 of hard substrate and 3,610 vessel movements. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The construction phase of Morven South may occur simultaneously with the construction phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the installation of hard structures, such as cable protection, as well as vessel movement which may occur in all phases of the MHPGC Project. The presence of the Morven South infrastructure will result in the installation of up to 3,074,239m^2 of hard structures while up to 2,979 vessel round trips will be required. In combination with the MHPGC Project this equates to 4,194,423m^2 of hard substrate and 3,529 vessel movements. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the introduction and spread of INNS is summarised in **Paragraph 4.8.2.137** *et seq.* Assessing sensitivity to INNS is inherently uncertain, as impacts may occur through a range of direct and indirect ecological pathways, including changes in prey availability, competition for resources, predation, disease transmission and habitat modification. These effects may act across broad spatial scales for mobile fish species or more locally for shellfish receptors. Given the potential for INNS to result in long-term ecological change, Fish and Shellfish receptors are considered to have low to negligible resistance and low to very low resilience to this pressure. Applying a precautionary approach, the sensitivity of all Fish and Shellfish ecology receptors to the introduction and spread of INNS is therefore considered to be **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be high. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms. A significance of moderate adverse has not been assigned because all projects included within the cumulative assessment are anticipated to implement relevant vessel and equipment biosecurity	

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	measures to minimise the risk of INNS introduction and spread, with the MHPGC Project implementing the MBP. These measures substantially reduce the likelihood of INNS being introduced, becoming established and causing ecological effects.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Operations and maintenance phase		
Magnitude of impact	The O&M phase of Morven North may occur simultaneously with the O&M phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the presence of hard structures on the seabed, including foundations, scour protection, cable protection and cable crossings, which may provide substrate for colonisation. There is also potential for the introduction and spread of INNS through maintenance or remediation activities during the O&M phase, including the placement of additional cable protection where required, and through associated vessel movements, which may occur in all phases of the MHPGC Project. The presence of the Morven North infrastructure will result in the installation of up to 3,139,162m^2 of hard structures while up to 293 vessel round trips per year will be required. In combination with the MHPGC Project this equates to 4,259,346m^2 of hard substrate and 595 vessel movements per year. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).	The O&M phase of Morven South may occur simultaneously with the O&M phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the presence of hard structures on the seabed, including foundations, scour protection, cable protection and cable crossings, which may provide substrate for colonisation. There is also potential for the introduction and spread of INNS through maintenance or remediation activities during the O&M phase, including the placement of additional cable protection where required, and through associated vessel movements, which may occur in all phases of the MHPGC Project. The presence of the Morven South infrastructure will result in the installation of up to 3,074,239m^2 of hard structures while up to 293 vessel round trips per year will be required. In combination with the MHPGC Project this equates to 4,194,423m^2 of hard substrate and 595 vessel movements per year. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the introduction and spread of INNS is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.137** *et seq.* Assessing sensitivity to INNS is inherently uncertain, as impacts may occur through a range of direct and indirect ecological pathways, including changes in prey availability, competition for resources, predation, disease transmission and habitat modification. These effects may act across broad spatial scales for mobile fish species or more locally for shellfish receptors. Given the potential for INNS to result in long-term ecological change, Fish and Shellfish receptors are considered to have low to negligible resistance and low to very low resilience to this pressure. Applying a precautionary approach, the sensitivity of all Fish and Shellfish ecology receptors to the introduction and spread of INNS is therefore considered to be **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.	

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be high. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms. A significance of moderate adverse has not been assigned because all projects included within the cumulative assessment are anticipated to implement relevant vessel and equipment biosecurity measures to minimise the risk of INNS introduction and spread, with the MHPGC Project implementing the MBP. These measures substantially reduce the likelihood of INNS being introduced, becoming established and causing ecological effects.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	
Decommissioning phase		
	The decommissioning phase of Morven North may occur simultaneously with the decommissioning phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the presence of artificial structures (such as remaining scour protection, cable protection and cable crossings) as well as vessel movement which may occur in all phases of the MHPGC Project. The presence of the Morven North hard structures left in situ of up to 1,785,234m^2 while up to 3,060 vessel round trips per year will be required. In combination with the MHPGC Project, assuming the same number of vessel round trips as expected for construction, and the full removal of hard substrates, this equates to 1,785,234m^2 of hard structures left in situ and 3,610 vessel round trips. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).	The decommissioning phase of Morven South may occur simultaneously with the decommissioning phase of the MHPGC Project. This may contribute to an increased risk of introduction and spread of INNS through the presence of artificial structures (such as remaining scour protection, cable protection and cable crossings) as well as vessel movement which may occur in all phases of the MHPGC Project. The presence of the Morven North hard structures left in situ of up to 1,554,704m^2 while up to 2,979 vessel round trips per year will be required. In combination with the MHPGC Project, assuming the same number of vessel round trips as expected for construction, and the full removal of hard substrates, this equates to 1,554,704m^2 of hard structures left in situ and 3,529 vessel round trips. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is due to the development of an Outline MBP which will reduce the risk of INNS introduction and/or spread (CoT38).
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the introduction and spread of INNS is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.137** *et seq.* Assessing sensitivity to INNS is inherently uncertain, as impacts may occur through a range of direct and indirect ecological pathways, including changes in prey availability, competition for resources, predation, disease transmission and habitat modification. These effects may act across broad spatial scales for mobile fish species or more locally for shellfish receptors. Given the potential for INNS to result in long-term ecological change, Fish and Shellfish receptors are considered to have low to negligible resistance and low to very low resilience to this pressure. Applying a precautionary approach, the sensitivity of all Fish and Shellfish ecology receptors to the introduction and spread of INNS is therefore considered	

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
	to be **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be high. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms. A significance of moderate adverse has not been assigned because all projects included within the cumulative assessment are anticipated to implement relevant vessel and equipment biosecurity measures to minimise the risk of INNS introduction and spread, with the MHPGC Project implementing the MBP. These measures substantially reduce the likelihood of INNS being introduced, becoming established and causing ecological effects.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.43: MHPGC Project CEA for increased risk of introduction and spread of INNS

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Construction phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of Morven North, with area of hard substrate indicated: • Morven North (3,139,162m^2); • Morven South (3,074,239m^2); • Ossian OWF (19,270,958m^2). Tier 1 includes the following cable projects: • Berwick Bank ECC (2,177,214m^2); • Eastern Green Link 1 (779,000m^2); • Eastern Green Link 2 (1,110,000m^2); • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. NO UK Telecom, Havhingsten Seg 2 and North Sea Link cable are operational and as such any changes to areas of hard substrate will be negligible over the construction phase of the MHPGC Project. In total cumulative hard structures associated with the MHPGC Project (1,120,184m^2) and Tier 1 projects is up to 30,670,757m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.004%. The introduction and spread of INNS would be expected to occur through similar pathways across all projects, namely vessel movements and the provision of additional hard substrate suitable for colonisation. However, successful introduction, establishment and spread of INNS remain uncertain and are dependent upon a range of biological and environmental factors. In addition, offshore infrastructure projects are expected to implement appropriate vessel and equipment biosecurity measures, with the MHPGC Project implementing an MBP (CoT38). Consequently, the addition of Tier 1 projects is not anticipated to materially increase the magnitude of effect. The cumulative effect is predicted to be of regional spatial extent, long-term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is also due to the implementation of an MPB which will reduce the risk of this impact occurring (CoT38). <u>Tier 2</u> Tier 2 includes the following cable projects:

	Cumulative Effects Assessment
	• Eastern Green Link 1; • Eastern Green Link 2. These cable projects will be primarily in their O&M phase. Any increased risk of introduction and spread of INNS would be expected to arise through maintenance-related vessel movements and the presence of hard substrate suitable for colonisation. Whilst project parameters remain limited, the pathways for INNS introduction are expected to be comparable to those identified for the MHPGC Project. Appropriate vessel and equipment biosecurity measures would also be expected to be implemented. The cumulative effect is predicted to be of regional spatial extent, long-term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is also due to the implementation of an MBP which will reduce the risk of this impact occurring (CoT38). <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impact of these projects are unknown. However, any increased risk of introduction and spread of INNS would be expected to arise through similar pathways to those identified for the MHPGC Project, namely vessel movements and the introduction of hard substrate suitable for colonisation. These offshore infrastructure projects would also be expected to implement appropriate vessel and equipment biosecurity measures. As such, these projects have been included within the assessment on a precautionary basis and are not anticipated to materially increase the overall magnitude of effect. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the introduction and spread of INNS is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.137** *et seq.* Assessing sensitivity to INNS is inherently uncertain, as impacts may occur through a range of direct and indirect ecological pathways, including changes in prey availability, competition for resources, predation, disease transmission and habitat modification. These effects may act across broad spatial scales for mobile fish species or more locally for shellfish receptors. Given the potential for INNS to result in long-term ecological change, Fish and Shellfish receptors are considered to have low to negligible resistance and low to very low resilience to this pressure. Applying a precautionary approach, the sensitivity of all Fish and Shellfish ecology receptors to the introduction and spread of INNS is therefore considered to be **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be high. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms. A significance of moderate adverse has not been assigned because all projects included within the cumulative assessment are anticipated to implement relevant vessel and equipment biosecurity measures to minimise the risk of INNS introduction and spread, with the MHPGC Project implementing the MBP. These measures substantially reduce the likelihood of INNS being introduced, becoming established and causing ecological effects.

	Cumulative Effects Assessment
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which have construction phases overlapping with the construction of Morven North, with area of hard substrate indicated: • Morven North (3,139,162m^2); • Morven South (3,074,239m^2); • Ossian OWF (19,270,958m^2). Tier 1 includes the following cable projects: • Berwick Bank ECC (2,177,214m^2); • Eastern Green Link 1 (779,000m^2); • Eastern Green Link 2 (1,110,000m^2); • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. NO UK Telecom, Havhingsten Seg 2 and North Sea Link cable are operational and as such any changes to areas of hard substrate will be negligible over the construction phase of the MHPGC Project. In total cumulative hard structures associated with the MHPGC Project (1,120,184m^2) and Tier 1 projects is up to 30,670,757m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.04%. The introduction and spread of INNS would be expected to occur principally through maintenance-related vessel movements and the continued presence of hard substrate suitable for colonisation. Whilst several projects overlap spatially with the MHPGC Project, the risk of introduction and spread of INNS remains dependent on successful transport, establishment and colonisation. Appropriate vessel and equipment biosecurity measures are also expected to be implemented across offshore infrastructure projects, with the MHPGC Project implementing an MBP (CoT38). Consequently, the addition of Tier 1 projects is not anticipated to materially increase the magnitude of effect. The cumulative effect is predicted to be of regional spatial extent, long-term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is also due to the implementation of an MPB which will reduce the risk of this impact occurring (CoT38). Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 1; • Eastern Green Link 2.

	Cumulative Effects Assessment
	These cable projects will be primarily in their O&M phase. Any increased risk of introduction and spread of INNS would be expected to arise through maintenance-related vessel movements and the presence of hard substrate suitable for colonisation. Whilst detailed project parameters are not currently available, the pathways for INNS introduction are expected to be comparable to those identified for the MHPGC Project. Appropriate vessel and equipment biosecurity measures would also be expected to be implemented. The cumulative effect is predicted to be of regional spatial extent, long-term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is also due to the implementation of an MBP which will reduce the risk of this impact occurring (CoT38). <u>Tier 3</u> Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application and therefore the scale and specific impacts of these projects are unknown. However, any increased risk of introduction and spread of INNS would be expected to arise through similar pathways to those identified for the MHPGC Project, namely vessel movements and the introduction of hard substrate suitable for colonisation. Comparable offshore infrastructure projects would also be expected to implement appropriate vessel and equipment biosecurity measures. As such, these projects have been included within the assessment on a precautionary basis and are not anticipated to materially increase the overall magnitude of effect. The cumulative effect of all projects in Scenario 4 is predicted to be of regional spatial extent, long-term duration, continuous, and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the introduction and spread of INNS is considered to be no greater than during the construction phase and is summarised in **Paragraph 4.8.2.137** *et seq.* Assessing sensitivity to INNS is inherently uncertain, as impacts may occur through a range of direct and indirect ecological pathways, including changes in prey availability, competition for resources, predation, disease transmission and habitat modification. These effects may act across broad spatial scales for mobile fish species or more locally for shellfish receptors. Given the potential for INNS to result in long-term ecological change, Fish and Shellfish receptors are considered to have low to negligible resistance and low to very low resilience to this pressure. Applying a precautionary approach, the sensitivity of all Fish and Shellfish ecology receptors to the introduction and spread of INNS is therefore considered to be **high**. Whilst the successful introduction of a marine INNS could result in adverse ecological effects, these effects would depend on the species introduced and its ability to establish, spread and cause impacts. Therefore, a very high sensitivity rating is not considered justified.
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be high. The Whole Project effect will, therefore, be of minor to moderate significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms. A significance of moderate adverse has not been assigned because all projects included within the cumulative assessment are anticipated to implement relevant vessel and equipment biosecurity measures to minimise the risk of INNS introduction and spread, with the MHPGC Project implementing the MBP. These measures substantially reduce the likelihood of INNS being introduced, becoming established and causing ecological effects.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

	Cumulative Effects Assessment
Decommissioning phase	
Magnitude of impact	As per construction phase.
Sensitivity of receptor	During decommissioning, infrastructure associated with the MHPGC Project and relevant cumulative projects may be removed, either wholly or partially. As decommissioning methodologies are not yet defined, a precautionary assessment has been undertaken assuming activities and associated increased risk of introduction and spread of INNS. Therefore, the magnitude of impact, receptor sensitivity, significance of effect, mitigation requirements and residual effects associated with the MHPGC Project and cumulative projects are considered to be comparable to those predicted during construction.
Significance of effect	
Further mitigation and residual significance	

4.10.1 Colonisation of hard structures

4.10.1.1 There is potential for the colonisation of hard structures as a result of the MHPGC Project's O&M phase alongside OWFs, and cables within the Fish and Shellfish CEA Study Area. Colonisation of hard structures may occur as a result of the introduction of artificial hard substrate, including cable protection, export cable crossings and protection associated with trenchless drill exit pits, which may provide habitat for epifaunal communities. Where these structures occur in combination with hard substrate associated with other OWF and cable projects, there is potential for cumulative effects.

4.10.1.2 Colonisation of hard structures may occur as a result of the MHPGC Project. Additionally, OWF and cable projects identified within the cumulative assessment may contribute cumulatively where artificial hard substrate is present within the Fish and Shellfish CEA Study Area.

4.10.1.3 The summary of the Whole Project assessment for the colonisation of hard structure is presented in **Table 4.44** and CEA for the colonisation of hard structures is presented in **Table 4.45**.

Table 4.44: MHPGC Project whole project assessment for colonisation of hard substrates

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Operations and maintenance phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The O&M phase of Morven North may occur simultaneously with the O&M phase of the MHPGC Project. The presence of Morven North infrastructure will result in the installation of up to 3,139,162m^2 of hard structures available for colonisation. In combination with the MHPGC Project this equates to 4,259,346m^2 of hard substrate available for colonisation. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The O&M phase of Morven South may occur simultaneously with the O&M phase of the MHPGC Project. The presence of Morven South infrastructure will result in the installation of up to 3,074,239m^2 of hard structures available for colonisation. In combination with the MHPGC Project this equates to 4,194,423m^2 of hard substrate available for colonisation. The Whole Project impact is predicted to be of local spatial extent, long-term duration (across all phases), intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to colonisation of hard structures is summarised in **Paragraph 4.8.3.93** *et seq*. Sandeel are considered to be of medium sensitivity to this impact due to their reliance on specific seabed substrates for spawning and the presence of potential spawning habitat, including overlap with a recognised spawning ground within part of the Fish and Shellfish CEA Study Area . In contrast, herring are considered to be of low sensitivity, reflecting the absence of important spawning habitat within the affected area and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish and other mobile fish receptors are considered to be of low sensitivity as they are not dependent on specific seabed substrates and are widely distributed throughout the North Sea. Shellfish receptors are also considered to be of low sensitivity, as the introduction of hard substrate may provide additional habitat, refuge and foraging opportunities for some species. The sensitivity of Fish and Shellfish ecology receptors to colonisation of hard structures is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.45: MHPGC Project whole project assessment for colonisation of hard substrates

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which may have O&M phases overlapping with the O&M phase of the MHPGC project, with area of hard substrate indicated: • Morven North (3,139,162m^2); • Morven South (3,074,239m^2); • Ossian OWF (19,270,958m^2). Tier 1 includes the following cable projects: • Berwick Bank ECC (2,177,214m^2); • Eastern Green Link 1 (779,000m^2); • Eastern Green Link 2 (1,110,000m^2); • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. NO UK Telecom, Havhingsten Seg 2 and North Sea Link cable are operational and as such any changes to areas of hard substrate available for colonisation will be negligible over the construction phase of the MHPGC Project. In total cumulative hard substrates associated with the MHPGC Project (1,120,184m^2) and Tier 1 projects is up to 30,670,757m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.004%. The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 1; • Eastern Green Link 2. These cable projects will be primarily in their O&M phase when structures such as cable protection and cable crossings may be installed during maintenance activities. The distances separating projects and lack of connectivity between the long-term habitat loss introduced for each project reduces the potential of this increasing the magnitude overall.

	Cumulative Effects Assessment
	The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. This is also due to the implementation of an MBP which will reduce the risk of this impact occurring. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. These projects are yet to submit any documents as part of an application therefore the scale and specific impact of these projects are unknown but are likely to be similar, if not much smaller than the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to colonisation of hard structures is summarised in **Paragraph 4.8.3.93** *et seq.* Sandeel are considered to be of medium sensitivity to this impact due to their reliance on specific seabed substrates for spawning and the presence of potential spawning habitat, including overlap with a recognised spawning ground within part of the Fish and Shellfish CEA Study Area. In contrast, herring are considered to be of low sensitivity, reflecting the absence of important spawning habitat within the affected area and the lack of overlap with recognised herring spawning grounds. Pelagic spawning fish and other mobile fish receptors are considered to be of low sensitivity as they are not dependent on specific seabed substrates and are widely distributed throughout the North Sea. Shellfish receptors are also considered to be of low sensitivity, as the introduction of hard substrate may provide additional habitat, refuge and foraging opportunities for some species. The sensitivity of Fish and Shellfish ecology receptors to colonisation of hard structures is therefore considered to be at worst-case **medium**.
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of minor significance, with an overall conclusion for all VERs of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

4.10.2 Electromagnetic fields

4.10.2.1 There may be impacts to Fish and Shellfish due to EMF during the MHPGC Project's O&M phase within the Fish and Shellfish CEA Study Area. Potential impacts may arise from the presence and operation of active subsea electrical cables. Where operational electrical infrastructure associated with other OWF and subsea cable projects occurs within the Fish and Shellfish CEA Study Area, there is potential for cumulative effects.

4.10.2.2 Potential impacts on Fish and Shellfish associated with EMF may occur as a result of the MHPGC Project. Additionally, OWF projects and subsea cable projects identified within the cumulative assessment may contribute cumulatively where operational electrical infrastructure occurs within the Fish and Shellfish CEA Study Area.

4.10.2.3 The summary of the Whole Project assessment for EMF is presented in **Table 4.46** and CEA for EMF is presented in **Table 4.47**.

Table 4.46: MHPGC Project whole project assessment for impacts due to EMF

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
O&M phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The O&M phase of Morven North may occur simultaneously with the O&M phase of the MHPGC Project and contribute to the cumulative effect of impacts on Fish and Shellfish due to EMF. It is considered unlikely that EMFs will result in a behavioural response that will cause a change in Fish and Shellfish species and communities and that any potential negative effects will be confined to a localised area surrounding the cables. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The O&M phase of Morven South may occur simultaneously with the O&M phase of the MHPGC Project and contribute to the cumulative effect of impacts on Fish and Shellfish due to EMF. It is considered unlikely that EMFs will result in a behavioural response that will cause a change in Fish and Shellfish species and communities and that any potential negative effects will be confined to a localised area surrounding the cables. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to EMF is summarised in **Paragraph 4.8.3.39** *et seq.* Elasmobranchs are considered to be the most sensitive receptors to EMF due to their ability to detect electromagnetic fields and evidence suggesting behavioural responses to EMF exposure. Given their electroreceptive capabilities and the conservation importance of several species, elasmobranchs are considered to be of medium sensitivity. Diadromous fish may also be capable of detecting magnetic fields; however, available evidence indicates that any responses to the low, localised EMF levels associated with subsea power cables are likely to be temporary and not sufficient to affect migration success. Diadromous fish are therefore considered to be of low sensitivity. Pelagic and demersal teleost fish are generally considered to be of low sensitivity due to limited evidence of EMF effects. Shellfish receptors are also considered to be of low sensitivity, as although some species may exhibit behavioural or physiological responses to EMF, these effects are generally limited, localised and unlikely to result in population-level consequences. The sensitivity of Fish and Shellfish ecology receptors to EMF is therefore considered to be at worst-case **medium**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of **minor adverse** which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.47: MHPGC Project CEA for impact due to EMF

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which may have O&M phase overlapping with the O&M phase of the MHPGC Project: • Morven North (424km IAC, 484km ECC); • Morven South (420km IAC, 420km ECC); • Ossian OWF (1,261km IAC, 236km ECC). Tier 1 includes the following cable projects: • Berwick Bank ECC (872km); • Eastern Green Link 1 (196km); • Eastern Green Link 2 (436km); • NO UK Telecom (700km); • Havhingsten Seg 2 (940km); • North Sea Link (700km). In total cumulative cabling associated with the MHPGC Project (653.34km) and Tier 1 projects is up to 7,742.34km. The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3 (575km); • Eastern Green Link 4 (530km). In total cumulative cabling associated with the MHPGC Project (653.34km) and Tier 2 projects is up to 1,758.34km. The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5.

	Cumulative Effects Assessment
	The programmes for these projects are unknown and therefore there is potential for these projects to install and operate subsea cables during the operational lifetime of the MHPGC Project. It is currently not possible to quantify this impact, but any EMF effects generated by these projects are expected to be highly localised around the cable routes and to decrease rapidly with distance from the source, consistent with the EMF effects assessed for the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to EMF is summarised in **Paragraph 4.8.3.39** *et seq*. Elasmobranchs are considered to be the most sensitive receptors to EMF due to their ability to detect electromagnetic fields and evidence suggesting behavioural responses to EMF exposure. Given their electroreceptive capabilities and the conservation importance of several species, elasmobranchs are considered to be of medium sensitivity. Diadromous fish may also be capable of detecting magnetic fields; however, available evidence indicates that any responses to the low, localised EMF levels associated with subsea power cables are likely to be temporary and not sufficient to affect migration success. Diadromous fish are therefore considered to be of low sensitivity. Pelagic and demersal teleost fish are generally considered to be of low sensitivity due to limited evidence of EMF effects. Shellfish receptors are also considered to be of low sensitivity, as although some species may exhibit behavioural or physiological responses to EMF, these effects are generally limited, localised and unlikely to result in population-level consequences. The sensitivity of Fish and Shellfish ecology receptors to EMF is therefore considered to be at worst-case **medium**.
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The Whole Project effect will, therefore, be of **minor adverse** which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

4.10.1 Thermal emissions from subsea electrical cables

4.10.1.1 Submarine power cables produce heat during operation which, when buried, can increase the temperature of the surrounding seabed sediments. Consequently, there may be impacts to Fish and Shellfish due to thermal emissions from the MHPGC Project's subsea electrical cables during the O&M phase within the Fish and Shellfish CEA Study Area. Potential impacts may arise from the presence and operation of active subsea electrical cables. Where operational electrical infrastructure associated with other OWF and subsea cable projects occurs within the Fish and Shellfish CEA Study Area, there is potential for cumulative effects.

4.10.1.2 Potential impacts on Fish and Shellfish associated with thermal emissions may occur as a result of the MHPGC Project. Additionally, OWF projects and subsea cable projects identified within the cumulative assessment may contribute cumulatively where operational electrical infrastructure occurs within the Fish and Shellfish CEA Study Area.

4.10.1.3 The summary of the Whole Project assessment for the thermal emissions from subsea cables is presented in **Table 4.48** and CEA for the thermal emissions from subsea cables is presented in **Table 4.49.**

Table 4.48: MHPGC Project whole project assessment for thermal emissions from subsea electrical cables

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
O&M phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The O&M phase of Morven North may occur simultaneously with the O&M phase of the MHPGC Project and contribute to the cumulative effect of thermal emissions from subsea electrical cables. The release of thermal emissions from a cable has the potential to increase sediment temperature and have direct effects on infaunal species, although thermal increase in surrounding sediment would be highly localised to a very small area within the immediate vicinity of the cable. However, there is negligible capacity for thermal emissions from a cable to heat the overlying water column, meaning effects on fish and epibenthic shellfish species and communities are negligible. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The O&M phase of Morven South may occur simultaneously with the O&M phase of the MHPGC Project and contribute to the cumulative effect of thermal emissions from subsea electrical cables. The release of thermal emissions from a cable has the potential to increase sediment temperature and have direct effects on infaunal species, although thermal increase in surrounding sediment would be highly localised to a very small area within the immediate vicinity of the cable. However, there is negligible capacity for thermal emissions from a cable to heat the overlying water column, meaning effects on fish and epibenthic shellfish species and communities are negligible. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to thermal emissions is summarised in **Paragraph 4.8.3.68** *et seq.* Thermal emissions associated with subsea cables are expected to be highly localised and confined to the immediate vicinity of the cable. Sandeel may be exposed to elevated sediment temperatures due to their burrowing behaviour; however, they are mobile and able to avoid areas of sustained warming. Certain shellfish species associated with the seabed may also be exposed to localised increases in sediment temperature but retain the ability to move away from the source of heating. All other Fish and Shellfish receptors are sufficiently mobile to avoid areas affected by thermal emissions. Consequently, all Fish and Shellfish ecology receptors are considered to be of low sensitivity to thermal emissions, and the sensitivity of Fish and Shellfish ecology receptors is therefore considered to be at worst-case **low**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be low. The Whole Project effect will, therefore, be of **negligible**, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.49: MHPGC Project CEA for thermal emissions from subsea electrical cables

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. Tier 1 Tier 1 includes the following OWF projects which may have O&M phase overlapping with the O&M phase of the MHPGC Project: • Morven North (424km IAC, 484km ECC); • Morven South (420km IAC, 420km ECC); • Ossian OWF (1,261km IAC, 236km ECC). Tier 1 includes the following cable projects: • Berwick Bank ECC (872km); • Eastern Green Link 1 (196km); • Eastern Green Link 2 (436km). • NO UK Telecom (700km); • Havhingsten Seg 2 (940km); • North Sea Link (700km). In total cumulative cabling associated with the MHPGC Project (653.34km) and Tier 1 projects is up to 7,742.34km. The cumulative effect is predicted to be of impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 2 Tier 2 includes the following cable projects: • Eastern Green Link 3 (575km); • Eastern Green Link 4 (530km). In total cumulative cabling associated with the MHPGC Project (653.34km) and Tier 2 projects is up to 7,742.34km. The cumulative effect is predicted to be of impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project:

	Cumulative Effects Assessment
	• MBAGC Project; • Eastern Green Link 5. The programmes for these projects are unknown and therefore there is potential for these projects to install and operate subsea cables during the operational lifetime of the MHPGC Project. It is currently not possible to quantify this impact, but thermal effects associated with operational subsea cables are expected to be highly localised and largely confined to the immediate vicinity of the cable, with sediment temperatures declining rapidly with distance from the source. The cumulative effect of all projects in Scenario 4 is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to thermal emissions is summarised in **Paragraph 4.8.3.68** *et seq*. Thermal emissions associated with subsea cables are expected to be highly localised and confined to the immediate vicinity of the cable. Sandeel may be exposed to elevated sediment temperatures due to their burrowing behaviour; however, they are mobile and able to avoid areas of sustained warming. Certain shellfish species associated with the seabed may also be exposed to localised increases in sediment temperature but retain the ability to move away from the source of heating. All other Fish and Shellfish receptors are sufficiently mobile to avoid areas affected by thermal emissions. Consequently, all Fish and Shellfish ecology receptors are considered to be of low sensitivity to thermal emissions, and the sensitivity of Fish and Shellfish ecology receptors is therefore considered to be at worst-case **low**.
Significance of effect	Overall, for the VERs in both Scottish and English waters the magnitude of the Whole Project impact is deemed to be low and the sensitivity of the receptor is considered to be low. The Whole Project effect will, therefore, be of **negligible**, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

4.10.1 Removal of hard substrate

4.10.1.1 There is potential for the removal of hard substrate as a result of the MHPGC Project's decommissioning activities within the Fish and Shellfish CEA Study Area. Removal of hard substrate may result from the decommissioning of hard structures: cable protection, export cable crossings and protection associated with trenchless drill exit pits. Where these structures occur in combination with hard structures associated with other OWF, cable and pipeline projects, there is potential for cumulative effects.

4.10.1.2 Removal of hard substrate may occur as a result of the MHPGC Project. Additionally, OWF projects, cable and pipeline projects identified within the cumulative assessment may contribute cumulatively where hard substrate is removed within the Fish and Shellfish CEA Study Area.

4.10.1.3 The summary of the Whole Project assessment for the removal of hard substrate is presented in **Table 4.50** and CEA for the removal of hard substrate is presented in **Table 4.51**.

Table 4.50: MHPGC Project whole project assessment for removal of hard substrate

	Whole project assessment	
	Scenario 1: MHPGC Project and Morven North	**Scenario 2: MHPGC Project and Morven South**
Decommissioning phase		
Magnitude of impact	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven North. The decommissioning phase of Morven North may occur simultaneously with the decommissioning phase of the MHPGC Project and contribute to the cumulative effect of hard substrate removal through the removal of artificial structures, such as cable protection. Decommissioning of Morven North may result in the removal of up to 3,139,162m^2 of hard substrate. In combination with the MHPGC Project this equates to the removal of 4,259,346m^2 of hard substrate. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	The Whole Project assessment for Scenario 1 considers the MHPGC Project together with Morven South. The decommissioning phase of Morven South may occur simultaneously with the decommissioning phase of the MHPGC Project and contribute to the cumulative effect of hard substrate removal through the removal of artificial structures, such as cable protection. Decommissioning of Morven South may result in the removal of up to 3,074,239m^2 of hard substrate. In combination with the MHPGC Project this equates to the removal of 4,194,423m^2 of hard substrate. The Whole Project impact is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the removal of hard structures is summarised in **Paragraph 4.8.4.33** *et seq*. Fish and Shellfish receptors within the Fish and Shellfish CEA Study Area are predominantly associated with widespread soft sediment habitats. Whilst some species may utilise project infrastructure and associated epifaunal growth for refuge, foraging and prey resources during the operational lifetime of the project, these artificial hard substrates comprise only a very small proportion of the habitat available within the Fish and Shellfish CEA Study Area. Following decommissioning and removal of infrastructure, the seabed would be expected to recover to baseline soft sediment conditions and continue to support Fish and Shellfish communities characteristic of the area. Consequently, Fish and Shellfish receptors are considered to have low vulnerability and high recoverability to the removal of hard structures. The sensitivity of Fish and Shellfish ecology receptors to the removal of hard structures is therefore considered to be **low**.	
Significance of effect	Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of negligible to **minor adverse** significance, which is not significant in EIA terms.	
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.	

Table 4.51: MHPGC Project CEA for removal of hard substrate

	Cumulative Effects Assessment
	Scenario 4: MHPGC Project, Tier 1 (including Morven North and Morven South), Tier 2, and Tier 3 (including MBAGC Project) Projects
Operations and maintenance phase	
Magnitude of impact	The CEA for Scenario 4 considers the MHPGC Project together with the Tier 1, Tier 2 and Tier 3 projects below. <u>Tier 1</u> Tier 1 includes the following OWF projects which may have decommissioning phases overlapping with the decommissioning of the MHPGC Project, with area of hard substrate indicated: • Morven North (3,139,162m^2); • Morven South (3,074,239m^2); • Ossian OWF (19,270,958m^2) Tier 1 includes the following cable projects: • Berwick Bank ECC (2,177,214m^2); • Eastern Green Link 1 (779,000m^2); • Eastern Green Link 2 (1,110,000m^2); • NO UK Telecom; • Havhingsten Seg 2; • North Sea Link. The extent of hard substrates associated with the NO UK Telecom, Havhingsten Seg 2 and North Sea Link cables is unknown and therefore there is potential for the project to remove hard substrate within the MHPGC Project's decommissioning phase. It is currently not possible to quantify this impact but it is likely to be of a similar or reduced magnitude compared to the MHPGC Project. In total cumulative hard substrates associated with the MHPGC Project (1,120,184m^2) and Tier 1 projects is up to 30,670,757m^2 which, in comparison to the surface area of the North Sea (750,000km^2), equates to 0.004%. The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. <u>Tier 2</u> Tier 2 includes the following cable projects: • Eastern Green Link 3; • Eastern Green Link 4.

	Cumulative Effects Assessment
	In total cumulative hard structures associated with the MHPGC Project (1,627,120m^2) and Tier 2 projects is up to 1,627,120m^2 (area data not available for Eastern Green Link 3 or Eastern Green Link 4). The cable projects are also likely to remove hard structures during decommissioning such as cable protection and cable crossings. The distances separating projects and lack of connectivity between the long-term habitat change introduced for each project reduces the potential of this increasing the magnitude overall. The cumulative effect is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**. Tier 3 Tier 3 includes the following OWF project and the following cable project: • MBAGC Project; • Eastern Green Link 5. The programmes for these projects are unknown and therefore there is potential for the projects to remove hard substrate within the MHPGC Project's decommissioning phase. It is currently not possible to quantify this impact but it is likely to be of a similar or reduced magnitude compared to the MHPGC Project. The cumulative effect of all projects in Scenario 4 is predicted to be of local spatial extent, long-term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **low**.
Sensitivity of receptor	The sensitivity of Fish and Shellfish ecology VERs to the removal of hard structures is summarised in **Paragraph 4.8.4.33** *et seq*. Fish and Shellfish receptors within the Fish and Shellfish CEA Study Area are predominantly associated with widespread soft sediment habitats. Whilst some species may utilise project infrastructure and associated epifaunal growth for refuge, foraging and prey resources during the operational lifetime of the project, these artificial hard substrates comprise only a very small proportion of the habitat available within the Fish and Shellfish CEA Study Area. Following decommissioning and removal of infrastructure, the seabed would be expected to recover to baseline soft sediment conditions and continue to support Fish and Shellfish communities characteristic of the area. Consequently, Fish and Shellfish receptors are considered to have low vulnerability and high recoverability to the removal of hard structures. The sensitivity of Fish and Shellfish ecology receptors to the removal of hard structures is therefore considered to be **low**.
Significance of effect	Overall, for the VERs in both Scottish and English waters, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of negligible to **minor adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No mitigation measures for Fish and Shellfish ecology are considered necessary because the likely effect in the absence of further mitigation, beyond the designed in measures outlined in **Table 4.18**, is not significant in EIA terms.

4.11 Transboundary effects

4.11.1.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to Fish and Shellfish ecology from the construction, O&M and decommissioning phases of the MHPGC Project upon interests of other states has been assessed to accompany the PEIR. The potential transboundary impacts are screened within **Volume 1, Annex 4.3: Transboundary Screening, of the PEIR**.

4.11.1.2 The offshore components of the MHPGC Project and the Fish and Shellfish Ecology Study Area are located within UK territorial waters, which were considered as part of the baseline assessment (see **Section 4.4.2)**. Any impacts on Fish and Shellfish ecology receptors due to construction, O&M and decommissioning activities are likely to be confined to within 9km of the MHPGC Project PEIR Red Line Boundary (as a worst-case scenario). Therefore, no transboundary impacts with regards to Fish and Shellfish ecology are anticipated and no significant effects would arise.

4.11.1.3 Any disturbance expected as a result of the MHPGC Project is short term and highly localised. Therefore, any potential impacts are not considered sufficient to influence Fish and Shellfish ecology receptors beyond UK waters (Scottish and English) which would cause transboundary effects.

4.12 Inter-related effects

4.12.1.1 Inter-related effects are the combined impact of multiple aspects of the MHPGC Project on a single receptor. These are as follows:

- **Project lifetime effects**: effects that occur throughout more than one phase of the MHPGC Project (construction, O&M and decommissioning) and interact to create an effect of greater significance on a receptor than when assessed in isolation across these three phases.
- **Receptor-led effects**: multiple effects which interact spatially and temporally, including inter-relationships between environmental topics, to create (including inter-relationships between environmental topics) to interact, spatially and temporally, to create inter-related effects on a receptor.

4.12.1.2 There may be the small potential for inter-related effects on Fish and Shellfish receptors during the construction, O&M and decommissioning phases of the MHPGC Project. However, inter-related effects on Fish and Shellfish receptors are expected to be no more significant than individual impacts assessed in isolation in **Section 4.8** due to the highly localised and limited effects expected to occur. Therefore, these have not been considered further.

4.12.1.3 Therefore, for Fish and Shellfish ecology, all pathways have been scoped out for inter-related effects.

4.13 Summary

4.13.1 Summary of effects

4.13.1.1 This chapter has assessed the potential impacts on Fish and Shellfish ecology from the construction, O&M and decommissioning phases of the MHPGC Project. **Table 4.52** presents a summary of impacts and confirms the residual effects.

4.13.2 Summary of secondary mitigation and monitoring

4.13.2.1 No additional mitigation or monitoring is proposed at this stage of the MHPGC Project further to the embedded commitments provided in **Table 4.18** as no significant residual effects have been identified. **Table 4.52** presents a summary of the secondary mitigation and monitoring proposed.

Table 4.52: Summary of potential impacts and residual effects

Impact	Jurisdiction	Magnitude of impact	Sensitivity of receptor	Significance of impact	Secondary mitigation and monitoring	Residual effect
Construction phase						
Temporary habitat loss and disturbance	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Increased SSCs and associated deposition	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Disturbance/ remobilisation of sediment bound contaminants	Scotland England	Negligible	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Underwater sound (excluding UXO clearance): mortality, injury, behavioural impacts and auditory masking	Scotland England	Low	Low to high	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Underwater sound from UXO clearance: mortality, injury, behavioural impacts and auditory masking	Scotland England	Negligible	Low to high	Minor adverse	N/A	Minor adverse
Increased risk of introduction and spread of INNS	Scotland England	Negligible	High	Minor adverse	N/A	Minor adverse
O&M phase						
Long term habitat loss	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Temporary habitat loss and disturbance	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse

Impact	Jurisdiction	Magnitude of impact	Sensitivity of receptor	Significance of impact	Secondary mitigation and monitoring	Residual effect
Increased SSCs and associated deposition	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Disturbance/ remobilisation of sediment bound contaminants	Scotland England	Negligible	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Electromagnetic field from subsea electrical cabling	Scotland England	Low	Low to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Thermal emissions from operational cables	Scotland England	Low	Low	Negligible or Minor adverse	N/A	Negligible or Minor adverse
Increased risk of introduction and spread of INNS	Scotland England	Negligible	High	Minor adverse	N/A	Minor Adverse
Colonisation of hard structures	Scotland England	Low	Low	Negligible	N/A	Negligible
Underwater sound (excluding UXO clearance): mortality, injury, behavioural impacts and auditory masking	Scotland England	Low to High	Low	Negligible to Minor adverse	N/A	Negligible to Minor adverse
Decommissioning phase						
Temporary habitat loss and disturbance	Scotland England	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse

Impact	Jurisdiction	Magnitude of impact	Sensitivity of receptor	Significance of impact	Secondary mitigation and monitoring	Residual effect
Increased SSCs and associated deposition	Scotland	Low	Negligible to medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
	England					
Disturbance/remobilisation of sediment bound contaminants	Scotland	Negligible	Low medium	Negligible to Minor adverse	N/A	Negligible to Minor adverse
	England					
Underwater sound (excluding UXO clearance): mortality, injury, behavioural impacts and auditory masking	Scotland	Low	Low to high	Negligible to Minor adverse	N/A	Negligible to Minor adverse
	England					
Removal of hard substrates	Scotland	Low	Low	Negligible or Minor adverse	N/A	Negligible or Minor adverse
	England					

4.14 References

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