



Morven Hawthorn Pit Grid Connection Project

Preliminary Environmental Information Report

Volume 2, Annex 4.1: Herring and Sandeel
Assessment Technical Report

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Glossary

Term	Meaning
Annex I Habitat	Annex I refers to a habitat as defined under the European Union (EU) Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive).
Annex II Species	Annex II refers to a species as defined under the EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Centre for Environment, Fisheries and Aquaculture Science (Cefas)	The United Kingdom (UK) Government's marine and freshwater science organisation and an executive agency sponsored by the Department for Environment, Food and Rural Affairs (Defra), providing expert scientific advice, data, and monitoring to support the sustainable management of the aquatic environment, fisheries, and aquaculture.
Demersal Fish Species	Fish that live and feed near or on the seabed. Includes species such as haddock, cod, whiting and flatfish.
Development Consent Order (DCO)	An order made under the Planning Act 2008, as amended, granting development consent.
Elasmobranchs	Fish species that have a skeleton composed entirely of cartilage (e.g. sharks, rays and skates).
Environment Agency (EA)	The EA is the public body responsible for protecting and improving the environment in England, including regulating activities that affect land, water, and biodiversity. For a DCO, the EA acts as a statutory consultee, advising on flood risk, water quality and ecological impacts.
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.
EU-Exit	The withdrawal of the UK from the EU.
Exclusive Economic Zone (EEZ)	An area from the outer limit of the territorial sea up to 200 nautical miles (nm) from the coastal baseline, over which a sovereign state has rights regarding marine resources.
Expert Working Group (EWG)	A topic-specific group of specialists formed under the Evidence Plan Process (EPP) to resolve technical issues and agree approaches for environmental assessments.
Fish stock	Any natural population of fish which an isolated and self-perpetuating group of the same species.
Fishing ground	An area of water or seabed targeted by fishing activity.
Fleet	A group of vessels classified together based on shared characteristics (such as nationality, vessel type, ownership or function).
Folk Classification	The Folk classification, in geology, is a technical descriptive classification of sedimentary rocks devised by Robert L. Folk.
Gear type	The method/equipment used for fishing.
Herring	Various species of forage fish, belonging to the order Clupeiformes.

Term	Meaning
Highly Protected Marine Area (HMPA)	Areas of the sea (including the shoreline) that allow the protection and full recovery of marine ecosystems. HPMAs protect all species and habitats and associated ecosystem processes within the site boundary, including the seabed and water column.
Inshore waters	Marine waters from the MHWS extending out to 12 nm.
Interstitial	Referring to the pore spaces between particles in rocks and sediments.
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.
Lowest Astronomical Tide (LAT)	The lowest tide level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.
Maerl	Coralline algae.
Marine Conservation Zone (MCZ)	An area designated under the Marine and Coastal Access Act 2009 for the purpose of conserving marine flora, fauna, habitats, or features of geological or geomorphological interest.
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 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, advising on marine planning, environmental impacts, habitats and compliance with marine licensing regulations.
MHPGC Project Scoping Opinions	Separate scoping opinions received from The Planning Inspectorate (PINS) (on behalf of the Secretary of State) 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.
MHPGC Project Scoping Report	A Scoping Report for the MHPGC Project, scoping the likely significant effects of the project on the environment, was submitted and accepted by PINS and submitted to the Scottish Ministers, via MD-LOT in February 2025.
MHPGC Project Preliminary Environmental Information Report (PEIR)	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (Environmental Impact Assessment) 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.
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), 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.

Term	Meaning
Morven North Offshore Wind Array Project (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 (Morven South)	The Morven South 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 South Boundary.
Nationally Significant Infrastructure Project (NSIP)	Large scale development which requires development consent under the Planning Act 2008.
Natural England (NE)	NE is the UK Government's statutory adviser on the natural environment in England, focusing on conserving biodiversity, landscapes, and access to nature. For a DCO and marine licence, NE provides statutory and technical advice to competent authorities on potential effects on designated sites, habitats and protected species, supporting environmental assessment and decision-making.
NatureScot (NS)	NS is the Scottish Government's nature agency responsible for protecting and promoting Scotland's natural heritage. For a marine licence in Scottish waters, NS advises on impacts to Scottish habitats, species, and designated sites.
Nursery habitat	A habitat where juveniles of a species regularly occur and grow as a population.
Offshore export cables	HVDC cables which bring electricity from either the Morven North or Morven South offshore substation platform to the Transition Joint Bay (TJB) at landfall.
Offshore waters	The area beyond 12nm, extending out to the UK's continental shelf
Pelagic fish species	Fish species that inhabit open water. Examples include Atlantic herring, mackerel and sprat.
Physical processes	The collective term for the following: hydrodynamics (water levels and currents); winds and waves; stratification and frontal systems; geology and seabed sediments (including sediment transport); seabed geomorphology; and coastal geomorphology.
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.
Spawning grounds	The areas of water or seabed where fish/shellfish spawn or produce their eggs.
Special Protection Area (SPA)	Locations within the UK designated to conserve rare, vulnerable, and migratory bird species of European importance, as classified by the Conservation (Natural Habitats, &c.) Regulations 1994 (in Scotland), the Conservation of Habitats and Species Regulations 2017 (in England) and Conservation of Offshore Marine Habitats and Species Regulations 2017 (in Scotland and England).
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 likely significant effects of the MHPGC Project may be experienced by the relevant receptors (i.e. Zone of Influence (ZoI)).
Subtidal	An area below Lowest Astronomical Tide (LAT) that is always submerged by water.

Term	Meaning
The Wildlife Trusts	The Wildlife Trusts are a federation of local conservation charities dedicated to protecting and restoring wildlife and wild places across the UK. For a DCO, The Wildlife Trusts act as a consultee, advising on biodiversity, habitat protection and ecological enhancements to ensure compliance with conservation objectives.
Transition Joint Bay (TJB)	An underground bay housing a joint which connects the offshore export cables to the onshore export cables. The TJB will be located in the vicinity of the onshore side of the landfall.
Zone of Influence (Zol)	The area within which impacts arising from the MHPGC Project could occur upon receptors.

Acronyms

Acronym	Meaning
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DDV	Drop Down Video
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EUNIS	European Union Nature Information System
G	Gravel
GIS	Geographical Information System
GPS	Global Positioning System
gS	Gravelly Sand
HPMA	Highly Protected Marine Area
ICES	International Council for the Exploration of the Sea
IHLS	International Herring Larvae Surveys
KP	Kilometre Point
MCZ	Marine Conservation Zone
MD-LOT	Marine Directorate Licensing Operations
MHPGC	Morven Hawthorn Pit Grid Connection
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
NSAS	North Sea Autumn Spawning
PEIR	Preliminary Environmental Information Report
PIZ	Primary Impact Zone
PSA	Particle Size Analysis
SIZ	Secondary Impact Zone
UK	United Kingdom

Acronym	Meaning
VMS	Vessel Monitoring System
Zol	Zone of Influence

Units

Unit	Meaning
%	Percent
km	Kilometres
m	Metres
m ²	Metres squared
mm	Millimetres

Executive summary

This Technical Report provides an assessment of Atlantic herring (*Clupea harengus*) spawning habitat, and sandeel (Ammodytidae spp.) supporting habitat in relation to the Morven Hawthorn Pit Grid Connection Project (hereafter 'the MHPGC Project'), in Scottish waters (Kilometre Point (KP)250 to KP180) and English waters (KP180 to KP0) (**Figure 1-1**). The assessment also considers relevant baseline data for the full extent of the MHPGC Project Preliminary Environmental Information Report (PEIR) Red Line Boundary in Scottish waters.

Detailed analysis and mapping has been undertaken to better understand Atlantic herring spawning and sandeel supporting habitat locations that are present in the Atlantic Herring and Sandeel Study Area, which is synonymous with the Fish and Shellfish Ecology Study Area used within **Volume 2, Chapter 4: Fish and Shellfish Ecology, of the PEIR** (both study areas comprise a 9km buffer around the MHPGC Project PEIR Red Line Boundary). This technical report supports the assessment of potential effects on Atlantic herring and sandeel resulting from the MHPGC Project.

The analysis has used guidance and methodology published by Kyle-Henney *et al.* (2024) and Reach *et al.* (2024) for Atlantic herring and sandeel, respectively. This guidance is an update to the previous MarineSpace (Reach *et al.*, 2013 and Latto *et al.*, 2013) guidance. As part of the 2024 guidance, several data sources have been used to assess the confidence in spawning potential of suitable habitat at a regional and population level, as provided within the heat maps for each species (normalised score of 0 to 1). These include:

- Coull *et al.* (1998) for spawning grounds for Atlantic herring and sandeel;
- Sandeel fishing ground locations identified by Wright *et al.* (2019);
- European Marine Observation and Data Network (EMODnet) seabed substrate (250k);
- International Herring Larvae Surveys (IHLS) (2012/13 to 2024/25);
- OneBenthic sandeel presence data;
- Vessel Monitoring System (VMS) for Vessels greater than 15m (2007 to 2020), using pelagic and demersal gear.

In addition to these data sources used for heat mapping, several additional data sources were also reviewed to further investigate Atlantic herring spawning habitat suitability and sandeel supporting habitat suitability within the Atlantic Herring and Sandeel Study Area:

- Ellis *et al.* (2012) spawning and nursery ground for sandeel, and nursery grounds for Atlantic herring;
- OneBenthic Particle Size Analysis (PSA) data;
- A distribution model for the lesser sandeel (*Ammodytes marinus*) (Langton *et al.*, 2021);
- MHPGC Project PSA and Environmental DNA (eDNA) data;
- Morven North and Morven South project-specific PSA data.

Scottish Waters (KP250 to KP180)

In United Kingdom (UK) waters, several geographically distinct Atlantic herring stocks exist (Tappin *et al.*, 2011), with the Atlantic Herring and Sandeel Study Area overlapping the Buchan stock in Scottish waters (approximately 0.3km north of the MHPGC Project PEIR Red Line Boundary at its closest point; **Figure 2-1**), which spawn from August through to September (Coull *et al.*, 1998). Due to a lack of suitable sediment (**Figure 4-1**) and low larval abundances for Atlantic herring within the MHPGC Project PEIR Red Line Boundary in Scottish waters (**Figure 4-6**), it is considered that the area does not provide important habitat for Atlantic herring spawning. The analysis of data and heat mapping indicates that in Scottish waters, the MHPGC Project PEIR Red Line Boundary is located within lower Atlantic herring spawning confidence areas (**Figure 4-8**). Overall, the MHPGC Project PEIR Red Line Boundary is not considered to provide habitat of particular importance for Atlantic herring spawning.

Sandeel supporting habitat is typically widespread across the North Sea where there is a large availability of sandy substrates, preferred for spawning. The MHPGC Project PEIR Red Line Boundary falls within the International Council for the Exploration of the Sea (ICES) Sandeel Area 4, which is the largest of the sandeel stocks in Scottish waters. The MHPGC Project-specific PSA data identified a mixture of suitable and unsuitable sandeel-supporting habitat (**Figure 4-9**), while EMODnet broadscale habitat mapping (**Figure 4-12**) and OneBenthic PSA data (**Figure 4-13**) indicate more widespread potentially suitable habitat. However, data such as predicted buried sandeel densities (Langton *et al.*, 2021; **Figure 4-15**) indicate that high densities of sandeel are located towards the Firth of Forth and Firth of Tay, to the west of the MHPGC Project in Scottish

waters, outside of the MHPGC Project PEIR Red Line Boundary. The MHPGC Project is not located within important sandeel supporting habitats, with alternative suitable habitat located further away, for example the Firth of Forth, where there are known spawning grounds.

English Waters (KP180 to KP0)

The Atlantic herring population in proximity to the MHPGC Project PEIR Red Line Boundary in English waters is the Banks Atlantic herring stock (approximately 6.5km northwest at its closest point), which spawns in the autumn (August to October) in the Central North Sea off the English coast (Ellis *et al.*, 2012). The analysis of available data and heat mapping indicate that, in English waters, the MHPGC Project PEIR Red Line Boundary is primarily located within lower confidence Atlantic herring spawning habitat (**Figure 4-8**). However, MHPGC Project PSA data indicate that the majority of the MHPGC Project PEIR Red Line Boundary comprises unsuitable Atlantic herring spawning habitat, with only one prime and one suitable habitat sample identified within the northern section (**Figure 4-1**). These findings broadly align with the EMODnet broadscale habitat mapping and OneBenthic PSA data (**Figure 4-4** and **Figure 4-5**). Overall, the MHPGC Project PEIR Red Line Boundary in English waters is not considered to provide habitat of particular importance for Atlantic herring spawning.

For sandeel, the northern section of the MHPGC Project PEIR Red Line Boundary, within English Waters, overlaps a discrete area of potentially suitable supporting habitat, where project-specific sediment samples (**Figure 4-9** and **Figure 4-10**), habitat mapping datasets (**Figure 4-12** and **Figure 4-13**) and historical sandeel fishing grounds (**Figure 4-17**) show broad agreement. In contrast, the southern section is predominantly classified as unsuitable supporting habitat. Overall, while the northern section may provide some potential sandeel-supporting habitat, the majority of the MHPGC Project PEIR Red Line Boundary in English waters is considered to comprise lower confidence sandeel-supporting habitat and is not considered to represent an area of particular importance for sandeel populations (**Figure 4-18**).

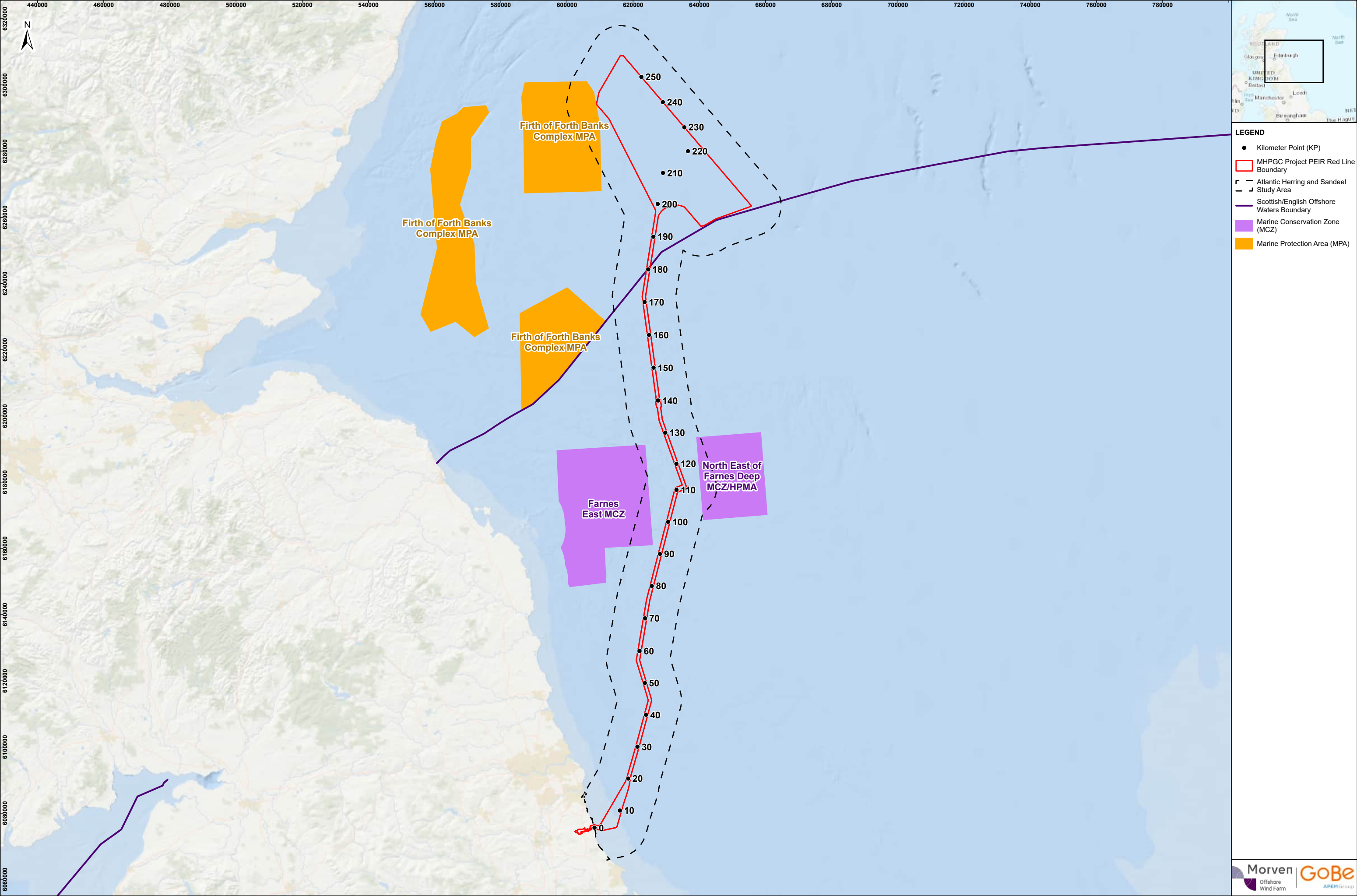
1 Introduction

1.1 Overview

- 1.1.1.1 This technical report presents the Atlantic herring (*Clupea harengus*) spawning habitat, and sandeel (Ammodytidae) supporting habitat analysis for the Morven Hawthorn Pit Grid Connection Project (referred to hereafter as 'the MHPGC Project'). It forms **Volume 2, Annex 4.1: Atlantic Herring and Sandeel Technical Report, of the Preliminary Environmental Information Report (PEIR)** prepared for the MHPGC Project and supports **Volume 2, Chapter 4: Fish and Shellfish Ecology, of the PEIR**.
- 1.1.1.2 The technical report presented is informed by the following technical chapters:
- **Volume 1, Chapter 2: Project Description, of the PEIR;**
 - **Volume 2, Chapter 1: Physical Processes, of the PEIR.**
- 1.1.1.3 Atlantic herring and sandeel are demersal spawners, that are dependent on the seabed across different life stages and are potentially at risk from sediment disturbance associated with the MHPGC Project. The distribution of suitable spawning and supporting habitat is an important factor influencing the location of Atlantic herring spawning grounds and the distribution of sandeel, further highlighting their reliance on seabed conditions. Atlantic herring are also considered to be a high hearing sensitivity fish species (Popper *et al.*, 2014) and so are considered more vulnerable to underwater sound effects.
- 1.1.1.4 Detailed analysis and mapping have therefore been undertaken to better understand the location of spawning within the Atlantic Herring and Sandeel Study Area (**Figure 1-1**).

1.2 Study area

- 1.2.1.1 To assess the footprint of potential effect to Atlantic herring and sandeel as a result of the MHPGC Project, relevant effect-receptor pathways and Zones of Influence (Zol) have been considered, and study areas subsequently defined.
- 1.2.1.2 The study areas for Atlantic herring spawning habitat and sandeel supporting habitat are the same as the study areas that have been determined for fish and shellfish ecology more broadly, due to the consideration of the same effect-receptor pathways and Zols (**Volume 2, Chapter 4: Fish and Shellfish Ecology, of the PEIR**). The study area has therefore been defined as the following:
- The MHPGC Project PEIR Red Line Boundary, extending from KP250 offshore, in Scottish Waters, to KP0 at Mean High Water Springs (MHWS) at the landfall in English Waters. In Scottish waters the MHPGC Project PEIR Red Line Boundary overlaps with Morven North Offshore Wind Array Project (hereafter 'Morven North') and Morven South Offshore Wind Array Project (hereafter 'Morven South'). This area defines the maximum spatial extent within which direct impacts associated with the MHPGC Project are anticipated to occur;
 - The Atlantic Herring and Sandeel Study Area (synonymous with the Fish and Shellfish Ecology Study Area), defined by a 9km buffer around the MHPGC Project PEIR Red Line Boundary, seaward of MHWS. This buffer represents the maximum distance of one spring tidal ellipse, 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.
- 1.2.1.3 The Kyle-Henney *et al.* (2024) and Reach *et al.* (2024) guidance utilise 'Primary Impact Zones (PIZs)' and 'Secondary Impact Zones (SIZs)', developed principally for marine aggregate licence assessments. For the purposes of the MHPGC Project, study areas have instead been defined (see **Figure 1-1**) according to the maximum anticipated extent of direct and indirect impacts, with the MHPGC Project PEIR Red Line Boundary, and the Atlantic Herring and Sandeel Study Area, serving the equivalent purpose in the assessment.

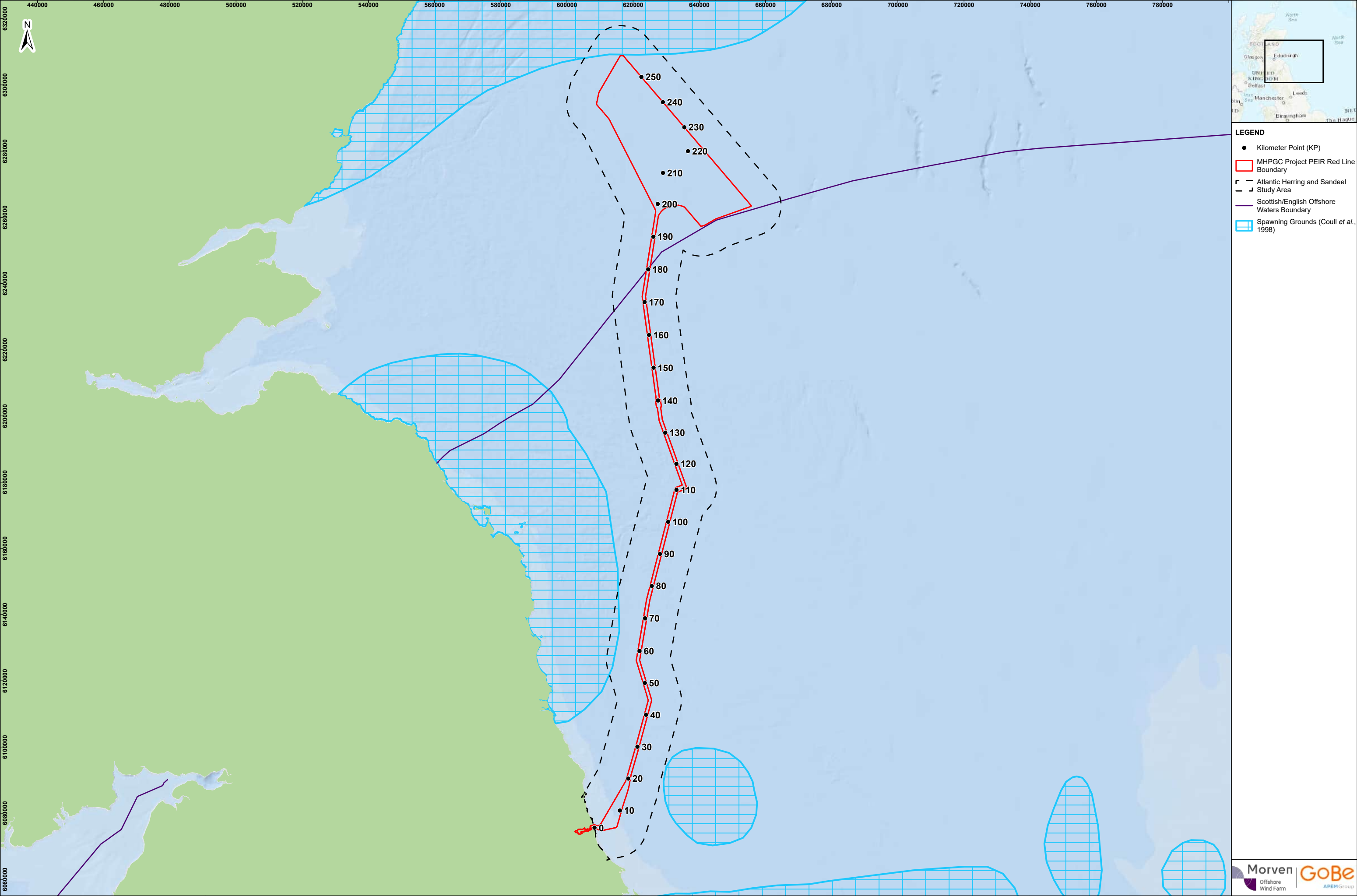


2 Baseline ecological context for Atlantic herring and sandeel

2.1.1.1 The following sections provide the baseline ecological context for Atlantic herring and sandeel within the Study Area. This includes a summary of relevant aspects of the species' ecology, population structure and habitat requirements, together with the current understanding of the distribution of spawning, nursery and supporting habitats in relation to the MHPGC Project PEIR Red Line Boundary and wider Atlantic herring and sandeel within the Study Area (defined to encapsulate the maximum range of anticipated potential direct and indirect impacts associated with the MHPGC project). This information provides context for the interpretation of habitat suitability assessments and heat mapping for both species.

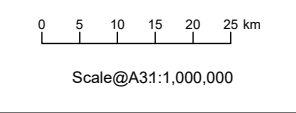
2.2 Atlantic herring

- 2.2.1.1 Atlantic herring are a demersal spawning species that spawn on the seabed in specific habitat and sediment types. Once spawned, eggs remain on the seabed and are sensitive to potential seabed disturbance and habitat loss. Atlantic herring have a preference for spawning grounds, which are located on gravel and similar sediment types, where the water is well-oxygenated including coarse sand, shell and maerl. They also prefer habitats which have a low proportion of fine sediment (Ellis *et al.*, 2012). Atlantic herring do not exhibit site fidelity within spawning grounds, which is in part due to the high mobility of inshore sediment.
- 2.2.1.2 In UK waters, several geographically distinct Atlantic herring stocks exist (Tappin *et al.*, 2011). Within the North Sea, the principal autumn-spawning stocks comprise the Buchan, Shetland, Banks and Downs components, which collectively form part of the North Sea Autumn Spawning (NSAS) population (Payne, 2010; Dickey-Collas *et al.*, 2009).
- 2.2.1.3 The Buchan and Shetland Atlantic herring stock spawns off the Scottish and Shetland coasts between August and September (Ellis *et al.*, 2012). The Buchan element of this Atlantic herring stock is located approximately 0.3km from the MHPGC Project PEIR Red Line Boundary in Scottish waters (**Figure 2-1**). In English waters, the MHPGC Project PEIR Red Line Boundary also lies in proximity to the Banks stock (approximately 6.5km from the nearest point), which spawns in the central North Sea from August to October (Ellis *et al.*, 2012). Autumn spawning Atlantic herring stocks, such as the Buchan, Shetland, Banks and Downs stocks tend to move into offshore waters to spawn on the edge of ocean banks (Tappin *et al.*, 2011).
- 2.2.1.4 The entirety of the MHPGC Project PEIR Red Line Boundary (in Scottish and English waters) overlaps with Atlantic herring nursery grounds identified by both Coull *et al.* (1998) and Ellis *et al.* (2012). In Scottish waters, high intensity nursery ground lies within the western section of the area of the MHPGC Project PEIR Red Line Boundary that overlaps with Morven North and Morven South, with lower intensity nursery ground present throughout the remainder of the MHPGC Project PEIR Red Line Boundary. In Scottish waters, there is no overlap of the MHPGC Project PEIR Red Line Boundary with nursery grounds identified by Coull *et al.* (1998).
- 2.2.1.5 In English waters, nursery grounds identified by Coull *et al.* (1998) overlap with the MHPGC Project PEIR Red Line Boundary from approximately KP80 to landfall (**Figure 2-2**). In addition, Ellis *et al.* (2012) indicate that higher intensity nursery grounds are present within a discrete area of the northern section of the MHPGC Project PEIR Red Line Boundary in English waters, and throughout much of the southern section of the MHPGC Project PEIR Red Line Boundary in English waters. The remainder of the MHPGC Project PEIR Red Line Boundary overlaps with low intensity nursery grounds identified by Ellis *et al.* (2012). Atlantic herring larvae which spawn in the North Sea are known to drift by ocean currents into inshore nursery areas.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING SPAWNING GROUNDS



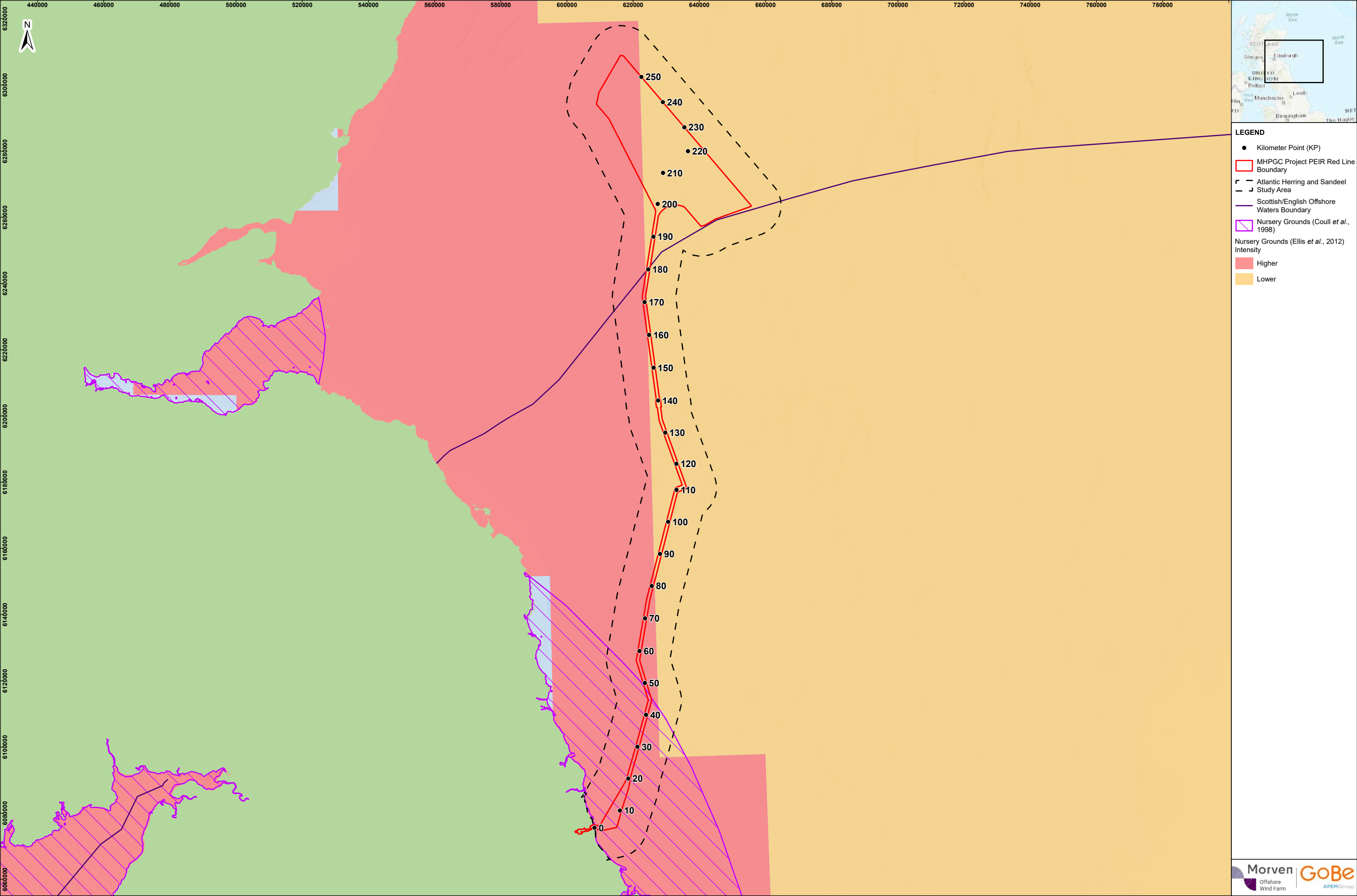
Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

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

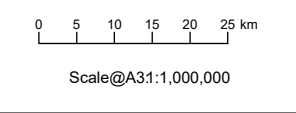
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FIGURE 2-1

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Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING NURSERY GROUNDS



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

Data Sources:
BP, Ordnance Survey

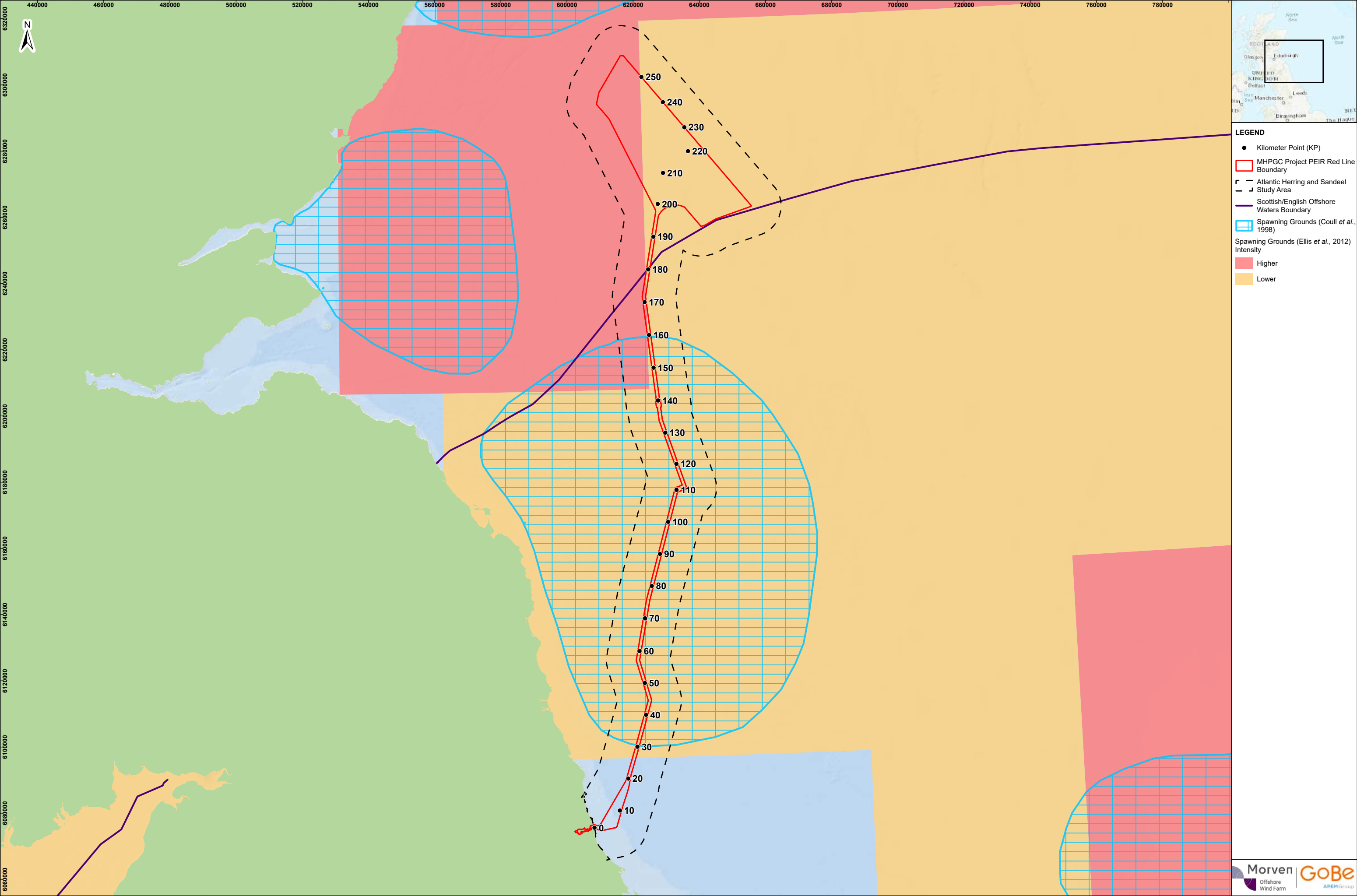
Service Layer Credits:
World Ocean Base: OceanWise, Esri, Garmin, NaturalVue
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS

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FIGURE 2-2

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2.3 Sandeel

- 2.3.1.1 The North Sea sandeel population is dominated by three species of sandeel: greater sandeel (*Hyperloplus lanceolatus*), lesser sandeel (*Ammodytes tobianus*) and Raitt's sandeel (*Ammodytes marinus*) (Reach *et al.*, 2024).
- 2.3.1.2 Sandeel eggs are demersal and remain on the seabed after spawning, meaning they can be sensitive to seabed disturbance. They have a preference for sandy habitats, making sandbanks and other sandy areas important. These habitats typically occur at water depths of 30m to 70m, but also as shallow as 15m and as deep as 120m. Sandeel burrow into sandy habitats, using interstitial water to ventilate their gills. Due to this burrowing activity, sandeel have a very specific habitat requirement and site fidelity. Fine sediment can clog up their gills meaning their distribution is often patchy (Holland *et al.*, 2005; Jensen *et al.*, 2011).
- 2.3.1.3 Sandeel are considered to thrive in seabed environments with a high proportion of medium to coarse sand (particle size ranging from 0.25mm to less than 2mm), and low levels of silt (Holland *et al.*, 2005). In habitats where silt content exceeds 4%, sandeel are generally scarce, and completely absent in areas where silt content exceeds 10% (Wright *et al.*, 2000; Holland *et al.*, 2005).
- 2.3.1.4 In Scottish waters, MHPGC Project PEIR Red Line Boundary does not overlap any important spawning grounds areas identified by Coull *et al.* (1998). However, the northwest section of the MHPGC Project PEIR Red Line Boundary MHPGC Project PEIR Red Line Boundary that overlaps with Morven North and Morven South in Scottish waters intersects high intensity spawning grounds identified by Ellis *et al.* (2012). The rest of the MHPGC Project PEIR Red Line Boundary in Scottish waters overlaps with low intensity spawning grounds (Ellis *et al.*, 2012) (**Figure 2-3**). Data presented by Ellis *et al.* (2012) show that much of the North Sea is covered by low intensity sandeel spawning grounds, with high intensity spawning grounds also present including around the northeast and east coast of Scotland (**Figure 2-3**).
- 2.3.1.5 In English waters, the MHPGC Project PEIR Red Line Boundary overlaps with an important sandeel spawning ground identified by Coull *et al.* (1998), from KP160 to KP30, and both high and low intensity spawning grounds identified by Ellis *et al.* (2012), with high intensity spawning grounds present in the northern section of the MHPGC Project PEIR Red Line Boundary and low intensity spawning grounds present throughout the remainder. The location of these spawning grounds in relation to the MHPGC Project PEIR Red Line Boundary is shown on **Figure 2-3**.
- 2.3.1.6 The MHPGC Project PEIR Red Line Boundary also overlaps with a low intensity sandeel nursery ground in both Scottish and English waters (Coull *et al.*, 1998; Ellis *et al.*, 2012) (**Figure 2-4**), with data from both Coull *et al.* (1998) and Ellis *et al.* (2012) indicating broadscale distribution of nursery grounds across much of the North Sea.
- 2.3.1.7 The MHPGC Project PEIR Red Line Boundary in Scottish waters also runs adjacent to the Firth of Forth Banks Complex MPA. This MPA is designated, in part, for the feature "Offshore subtidal sand sand gravels", with sandy sediments potentially providing suitable habitat for sandeel (**Figure 1-1**).
- 2.3.1.8 There are two designated sites located either side of the MHPGC Project PEIR Red Line Boundary in English waters, the Farnes East Marine Conservation Zone (MCZ) (2.2km to the east) and North East of Farnes Deep MCZ/Highly Protected Marine Area (HPMA) (4.1km to the west) (**Figure 1-1**). Both of these sites are, in part, designated for subtidal sandy habitat, which is considered preferred habitat for sandeel, and they overlap with sandeel spawning grounds identified by Coull *et al.* (1998).

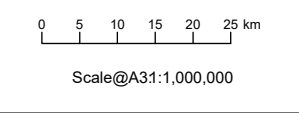


LEGEND

- Kilometer Point (KP)
- MHPGC Project PEIR Red Line Boundary
- Atlantic Herring and Sandeel Study Area
- Scottish/English Offshore Waters Boundary
- Spawning Grounds (Coull *et al.*, 1998)
- Spawning Grounds (Ellis *et al.*, 2012) Intensity
 - Higher
 - Lower

Project Name:
MORVEN HAWTHORN PIT GRID CONNECTION PROJECT

Drawing Title:
SANDEEL SPAWNING GROUNDS



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

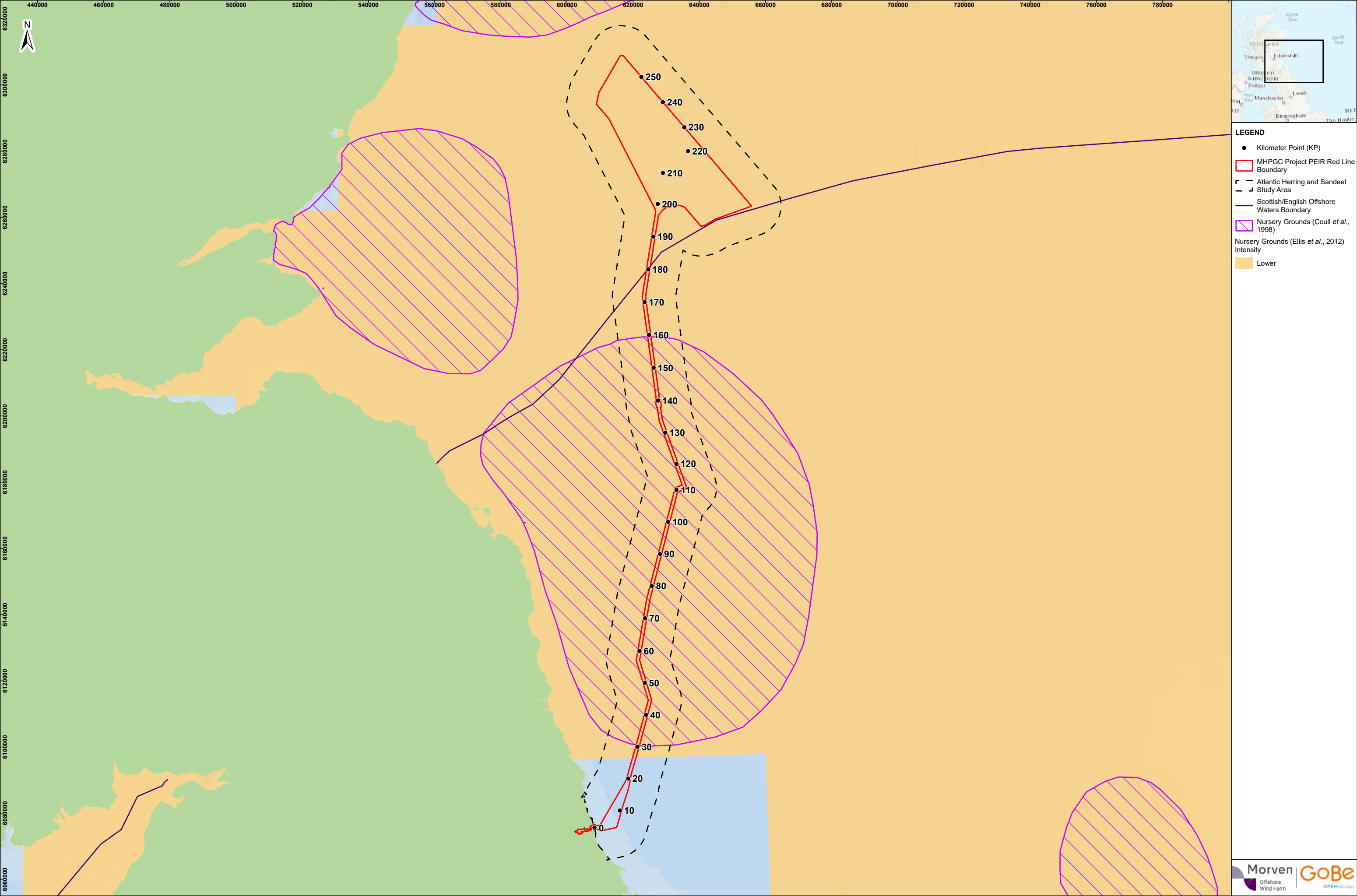
Data Sources:
BP, Ordnance Survey

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

Drawing Number:
FIGURE 2-3

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LEGEND

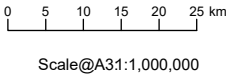
- Kilometer Point (KP)
- MHPGC Project PEIR Red Line Boundary
- Atlantic Herring and Sandeel Study Area
- Scottish/English Offshore Waters Boundary
- Nursery Grounds (Coull *et al.*, 1998)
- Nursery Grounds (Ellis *et al.*, 2012)

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

Lower

Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL NURSERY GROUNDS



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 2-4				
VER	DATE	DETAILS	BY	CHECK
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3 Methodology

- 3.1.1.1 This assessment identifies and characterises potential Atlantic herring spawning habitat and sandeel supporting habitat within the MHPGC Project PEIR Red Line Boundary and the wider Atlantic Herring and Sandeel Study Area. The assessment follows the methodologies presented by Kyle-Henney *et al.* (2024) for Atlantic herring and Reach *et al.* (2024) for sandeel.
- 3.1.1.2 The assessment comprises of two stages: habitat suitability categorisation and the development of spawning potential heat maps. In addition, a range of supplementary datasets are used to ground-truth, validate and contextualise the outputs.
- 3.1.1.3 The datasets used within the assessment are described in **Table 3.1**, and the subsequent sections of this report describe the habitat suitability assessment methodology and the heat mapping methodologies followed.

Table 3.1: Data sources used to inform the characterisation of Atlantic herring spawning habitat and sandeel habitat suitability

Data source	Summary	Applicability to the assessment
EMODnet seabed substrate (250k) (EMODnet, 2018)	A harmonised, regional-scale dataset that maps seabed sediment types across European waters at a scale of 1:250,000. The dataset combines information from multiple sources using a substrate classification scheme based on the modified Folk sediment classification (Folk, 1954), which can be translated to EUNIS-compatible seabed substrate classes and, where source data permit, includes classifications broadly equivalent to Folk 7 and Folk 16 sediment categories. The dataset is widely used to characterise broad-scale seabed habitats, although localised inaccuracies and data discontinuities may be present.	This dataset has been applied to the heat mapping exercise for both Atlantic Herring and sandeel, in accordance with the methodologies described by Kyle-Henney <i>et al.</i> (2024) and Reach <i>et al.</i> (2024), respectively.
Fisheries sensitivity maps in British waters (Coull <i>et al.</i> , 1998)	Provides a historical overview of the principal spawning and nursery grounds of commercially important marine fish species in UK waters, based on expert knowledge and available survey data.	This dataset has been applied to the heat mapping exercise for both Atlantic herring and sandeel, in accordance with the methodologies described by Kyle-Henney <i>et al.</i> (2024) and Reach <i>et al.</i> (2024), respectively.
VMS data for vessels greater than 15m (MMO, 2020)	VMS data were analysed to show the areas within the Atlantic Herring and Sandeel Study Area where pelagic and demersal gear types have been used for fishing (for Atlantic herring and sandeel, respectively). VMS data are derived from Marine Management Organisation (MMO) fishing activity data, more specifically the total weight of fish that were caught by vessels greater in length than 15m, over the period of 2007 to 2020. In each of the VMS spatial rectangles (based on Global Positioning System (GPS)-derived accuracy, which is 0.05 degree sub-rectangles). VMS data do not provide information on species caught but can be interrogated by fishing method which can be used to broadly understand habitat resource areas. It should be noted that the confidence in this data is relatively low as these fishing methods may target a range of species. It is important to note that the VMS dataset spans a period during which sandeel fisheries were subject to a range of management measures, including fishery closures and precautionary restrictions. ICES advice indicates that the fishery was closed in 2006 to 2007 and remained at very low or zero catch levels, under precautionary or monitoring-only regimes, for much of the period up to 2016. Furthermore, there has been a ban on sandeel fishing within ICES Division IVb (within which the MHPGC Project is located) since 2024, and ICES currently advises zero catches for 2026 and 2027 due to poor recruitment (ICES, 2026). Consequently, VMS-derived fishing activity should be interpreted with caution as an indicator of potential sandeel supporting habitat. Given that demersal fishing activity may target a range of species and that sandeel fisheries have been subject to management restrictions throughout much of the dataset period, the use of VMS data is considered precautionary as it and may overestimate the extent of potential sandeel supporting habitat. Further information on the interpretation of VMS data is provided in Volume 2, Chapter 7: Commercial Fisheries of the PEIR.	This dataset has been applied to the heat mapping exercise for both Atlantic Herring and sandeel, in accordance with the methodologies described by Kyle-Henney <i>et al.</i> (2024) and Reach <i>et al.</i> (2024), respectively.

Data source	Summary	Applicability to the assessment
Sandeel fishing grounds; sandeel population structure and connectivity model (Wright <i>et al.</i> , 2019)	This data presents ICES-collated information on sandeel fisheries and grounds. Wright <i>et al.</i> (2019) has refined this fishing area, using supporting information from Jensen <i>et al.</i> (2011), which provides sandeel habitat areas (areas with potentially high density of non-buried sandeel). The mapped fishing grounds are assumed to reflect the foraging habitat of the species (Jensen <i>et al.</i> , 2011; Rindorf <i>et al.</i> , 2022). Sandeel foraging habitat covered 5% of the total area of the North Sea. The scoring has been applied where these areas are present.	This dataset has been applied to the heat mapping exercise for sandeel, in accordance with the methodology described by Reach <i>et al.</i> (2024).
OneBenthic Sandeel Presence (Centre for Environment, Fisheries and Aquaculture Science (Cefas), 2024b)	The OneBenthic Sandeel Presence dataset represents a subset of OneBenthic grab and core sample records and can be obtained as point data via the Cefas Open Science OneBenthic portal, using the Taxa Search Tool. Data was downloaded for the following sandeel species: 'Ammodytes sp.', 'Ammodytes tobianus', 'Ammodytidae', 'Ammodytes marinus', 'Hyperoplus lanceolatus', 'Hyperoplus immaculatus', and 'Gymnammodytes semisquamatus'	This dataset has been applied to the heat mapping exercise for sandeel, in accordance with the methodology described by Reach <i>et al.</i> (2024).
IHLS larval abundance (ICES, 2025)	The ICES IHLS programme is located in the North Sea and adjacent areas. This dataset provides information about the number of Atlantic herring larvae present in the surveyed areas during the IHLS survey campaigns. Data from the 2012/13 to 2024/25 seasons were used in the analysis, representing a 10-year dataset as survey data were not collected in all years during this period. The IHLS data is a key dataset utilised as a proxy to inform the location of actively spawning Atlantic herring. The surveys are designed to provide a quantitative estimate of Atlantic herring larval abundance to be used as a relative index of the changes in Atlantic herring spawning stock biomass (Boyle and New, 2018). The use of this data as proxy is necessary in the absence of time-series data of direct spawning behaviour observations, or the presence of eggs on the seafloor. Additionally, these data represent a single snapshot in time for each year, with annual surveys aligned year to year, as informed by expert judgement, rather than being triggered by environmental factors (such as sea temperature) which may affect the seasonality of spawning. Previous analyses (Boyle and New, 2018) have demonstrated the suitability of the IHLS data to be used to aid in informing the location and extent of active Atlantic herring spawning grounds as an update to the historical spawning grounds as defined by Coull <i>et al.</i> (1998). This method has been broadly accepted for use in Environmental Impact Assessments (EIAs) and is therefore considered the most suitable dataset through which to define areas of active spawning for Atlantic herring.	This dataset has been applied to the heat mapping exercise for herring, in accordance with the methodology described by Kyle-Henney <i>et al.</i> (2024).
Spawning and nursery grounds of selected fish species in UK waters (Ellis <i>et al.</i> , 2012)	Presents the distribution of spawning and nursery grounds for commercially important fish species in UK waters based on available survey data, fish egg and larval records, and expert judgement. The dataset is widely used to support fisheries management and marine spatial planning.	This dataset was not used for heat mapping since Reach <i>et al.</i> (2013) noted that the data were mapped to ICES sub-rectangles, reducing their spatial resolution for environmental assessments compared with the spawning

Data source	Summary	Applicability to the assessment
		ground delineations presented by Coull <i>et al.</i> (1998).
OneBenthic Grab Sample Data (Cefas, 2024a)	Grab sample PSA data taken from the Cefas Open Science OneBenthic portal. The OneBenthic database collates benthic survey and sediment data from a wide range of industry, research and government sources, providing standardised sediment particle size information from grab and core samples collected across UK and European waters.	This dataset is not a habitat layer included in the Reach <i>et al.</i> (2024) or Kyle-Henney <i>et al.</i> (2024) heat mapping methodologies. The dataset was used to characterise seabed sediment composition and identify potential Atlantic herring spawning substrates and sandeel supporting habitat within the Atlantic Herring and Sandeel Study Area.
A distribution model for the lesser sandeel (<i>Ammodytes marinus</i>) (Langton <i>et al.</i> , 2021)	A species distribution model for the lesser sandeel (<i>Ammodytes marinus</i>) that predicts the occurrence and relative density of the species across the North Sea and Celtic Seas based on environmental variables such as sediment type, depth, and seabed slope. The model was validated using independent survey data and provides a spatial assessment of suitable sandeel habitat. The density predictions reported by Langton <i>et al.</i> (2021) are based on modelling which uses count estimate data and corresponding sediment composition from grab samples collected between 1998 and 2003 by Holland <i>et al.</i> (2005). Therefore, this data is considered with caution. This dataset is not a habitat layer included in the Reach <i>et al.</i> (2024) or Kyle-Henney <i>et al.</i> (2024) heat mapping methodologies.	While not used for heat mapping, this data has been used to inform the location of suitable sandeel supporting habitat.
MHPGC Project-specific surveys (Gardline <i>et al.</i> , 2024; Gardline 2025)	Project-specific benthic subtidal surveys undertaken by Gardline Ltd, conducted during June to November 2023 (Gardline Ltd. 2024) and in August and September 2024 (Gardline Ltd. 2025). The surveys included grab and Drop Down Video (DDV) sampling for analysis of fauna, PSA, sediment chemistry, and eDNA analysis. PSA data were used to determine seabed characteristics, including seabed sediments, benthic communities and to identify any habitats of high sensitivity or conservation concern.	This is a site-specific dataset and does not provide regional-scale coverage suitable for application within the Reach <i>et al.</i> (2024) or Kyle-Henney <i>et al.</i> (2024) Grab sample PSA data from these surveys has been used to inform the location of suitable Atlantic herring spawning habitat and sandeel supporting habitat.
Morven North and Morven South surveys (Tetra Tech RPS Energy, 2026)	A benthic subtidal survey was undertaken by Gardline Ltd. from April to August 2022 within the Morven North and Morven South study areas (extending to 5km to 14km around the Morven North Boundary and Morven South Boundary). The survey included grab and DDV sampling for analysis of fauna (including sandeel), PSA, sediment chemistry, and eDNA analysis. PSA data were used to determine seabed characteristics, including seabed sediments, benthic communities and to identify any habitats of high sensitivity or conservation concern.	This is a site-specific dataset and does not provide regional-scale coverage suitable for application within the Reach <i>et al.</i> (2024) or Kyle-Henney <i>et al.</i> (2024) heat

Data source	Summary	Applicability to the assessment
	This is a site-specific dataset and does not provide regional-scale coverage suitable for application within the Reach <i>et al.</i> (2024) or Kyle-Henney <i>et al.</i> (2024) heat mapping methodologies.	mapping methodologies. Data from this survey has been used to inform the location of suitable Atlantic herring spawning habitat and sandeel supporting habitat, and faunal records and eDNA data have been used to validate the outputs.

3.2 Habitat suitability categorisation

3.2.1.1 Habitat suitability categorisation was undertaken in accordance with the methodologies and classifications presented by Kyle-Henney *et al.* (2024) for Atlantic herring and Reach *et al.* (2024) for sandeel, using project-specific sediment PSA data collected during site-specific surveys of the MHPGC Project, together with PSA data from the Morven North and Morven South surveys and wider Atlantic Herring and Sandeel Study Area. EMODnet broadscale habitat mapping and OneBenthic PSA data (regional datasets) were also classified accordingly, to provide broader spatial context across the wider Atlantic Herring and Sandeel Study Area.

3.2.1.2 Collectively, these datasets were used to assess habitat suitability for Atlantic herring spawning habitat and sandeel supporting habitat within and adjacent to the MHPGC Project PEIR Red Line Boundary, and across the wider Atlantic Herring and Sandeel Study Area. These datasets are summarised in **Table 3.1**, and their application within the habitat suitability assessment is described below.

3.2.2 PSA datasets used for habitat suitability assessment

3.2.2.1 Habitat suitability assessments were informed by PSA data collected during MHPGC Project surveys and supplementary PSA data available from the Morven North and Morven South projects.

MHPGC Project-specific PSA data

3.2.2.2 To identify potential Atlantic herring spawning habitat and sandeel supporting habitat within the MHPGC Project PEIR Red Line Boundary, habitat suitability was assessed using the methodologies presented by Kyle-Henney *et al.* (2024) for Atlantic herring and Reach *et al.* (2024) for sandeel. These methodologies classify habitat into the categories of 'prime', 'sub-prime', 'suitable' and 'unsuitable' based on sediment composition derived from PSA data. While, these categories can also be grouped into the broader habitat classes of 'preferred', 'marginal' and 'unsuitable', the four-category classification provides a more detailed assessment of habitat suitability. MHPGC Project PSA data include the sediment compositions of gravel, sand and mud required to apply these classifications.

3.2.2.3 A total of 69 grab samples were successfully collected for PSA (seven in Scottish waters and 62 in English waters) during the 2023 and 2024 subtidal benthic surveys within the MHPGC Project PEIR Red Line Boundary (Gardline *et al.*, 2024; Gardline *et al.*, 2025). The habitat suitability categories applied to the project-specific PSA data are provided in **Table 3.2** and **Table 3.3**.

Morven North and Morven South PSA data

3.2.2.4 Additional PSA data were available from surveys undertaken for the Morven North and Morven South projects (Tetra Tech RPS Energy, 2026), which overlap the northern section of the MHPGC Project PEIR Red Line Boundary in Scottish waters. These data were considered to provide additional context for habitat suitability across the northern part of the Atlantic Herring and Sandeel Study Area.

3.2.2.5 A total of 100 grab samples were successfully collected for PSA (all within Scottish waters) during the 2022 subtidal benthic survey, within the boundary of Morven North and Morven South, including their respective study areas (5km to 14km buffers around each boundary). In the Morven North and Morven South assessment, PSA data were presented using the broader habitat categories of 'preferred', 'marginal' and 'unsuitable', as derived from the methodologies described by Kyle-Henney *et al.* (2024) (originally defined by Reach *et al.* (2013)) and Reach *et al.* (2024) (originally defined by Latto *et al.* (2013)) (**Table 3.2** and **Table 3.3**).

3.2.3 Regional habitat mapping datasets

3.2.3.1 In addition to the site-specific PSA datasets described above, regional habitat mapping and PSA datasets were used to provide broader spatial context across the Atlantic Herring and Sandeel Study Area.

3.2.3.2 The EMODnet broadscale habitat mapping data (EMODnet, 2018) and OneBenthic PSA data (Cefas, 2024a) were used to provide wider spatial context across the Atlantic Herring and Sandeel Study Area.

- 3.2.3.3 Similar to the Morven North and Morven South PSA data, the OneBenthic PSA data are presented using the broader habitat categories of 'preferred', 'marginal' and 'unsuitable', as derived from the methodologies described by Kyle-Henney *et al.* (2024) (originally defined by Reach *et al.* (2013)) and Reach *et al.* (2024) (originally defined by Latto *et al.* (2013)) (**Table 3.2** and **Table 3.3**).
- 3.2.3.4 The EMODnet broadscale habitat mapping data provide broad-scale seabed substrate classifications that can be related to Folk sediment categories, including 'Gravel' (G), 'sandy Gravel' (sG) and 'gravelly Sand' (gS), and can therefore be used to identify potentially suitable Atlantic herring spawning habitat and sandeel supporting habitat. However, as EMODnet data do not provide the sediment fraction information required to apply the full 'prime', 'sub-prime', 'suitable' and 'unsuitable' classification framework, habitat suitability was instead classified using the broader 'preferred', 'marginal' and 'unsuitable' categories described above. The classifications are described **Table 3.2** and **Table 3.3**.

Table 3.2: Atlantic herring spawning habitat categories of 'prime', 'sub-prime', 'suitable' and 'unsuitable' as defined by Kyle-Henney *et al.* (2024) (originally defined by (Reach, *et al.*, 2013)).

Habitat description	Broad-scale habitat category classification	Sediment type (Folk Classification, as per Folk (1954))	Spawning habitat suitability confidence
Prime	Preferred	G and the gravel rich portion of sG ($\geq 50\%$ gravel, $< 5\%$ mud)	Higher confidence: most suitable for spawning
Sub-prime	Preferred/Marginal	sG and the gravel rich portion of gS ($> 10\%$ gravel, $< 5\%$ mud)	Moderate confidence: suitable for spawning but less optimal than Prime habitat
Suitable	Marginal	gS ($> 25\%$ gravel, $< 5\%$ mud)	Moderate confidence: suitable for spawning but less optimal than Sub-prime habitat
Unsuitable	Unsuitable	All other Folk sediment classes ($> 5\%$ mud or $< 10\%$ gravel)	Lower confidence: not suitable for spawning

Table 3.3: Sandeel supporting habitat categories of 'prime', 'sub-prime', 'suitable' and 'unsuitable' as defined by Reach *et al.* (2024) (originally defined by Latto *et al.* (2013)).

Habitat description	Broad-scale habitat category classification	Sediment type (Folk Classification, as per Folk (1954))	Supporting habitat suitability confidence
Prime	Preferred	S, slightly gS, gS (subset with $< 30\%$ gravel, $< 10\%$ mud)	Higher confidence: most suitable for spawning
Sub-prime	Preferred / Marginal ¹	gS and sG ($30-50\%$ gravel, $< 10\%$ mud)	Moderate confidence: suitable for spawning but less optimal than Prime habitat
Suitable	Preferred	S, slightly gS, gS divisions ($< 50\%$ gravel, $< 10\%$ mud)	Moderate confidence: encompasses the broader range of suitable spawning habitat.
Unsuitable	Unsuitable	Muddy sands, gravels, silts, clays ($> 10\%$ mud or $> 80\%$ gravel)	Lower confidence: not suitable for spawning

3.3 Ground-truthing of the habitat suitability assessment

- 3.3.1.1 In addition to the data incorporated directly within the habitat suitability characterisation, supplementary datasets were used to ground-truth and validate the habitat suitability assessments.

¹ 'Sub-prime' habitat spans the boundary between Gravelly Sand (gS) and Sandy Gravel (sG) and may therefore occur within both 'preferred' and 'marginal' EMODnet habitat categories.

These include the sandeel distribution model data (Langton *et al.*, 2021) and the MHPGC Project eDNA data and fauna data (Gardline, 2024, Gardline, 2025).

3.3.1.2 These datasets are detailed in **Table 3.1**, and are summarised in **Table 3.4** below.

Table 3.4: Data used to ground-truth and provide additional context for the heat mapping and associated outputs

Data source	Applicability to assessment
Spawning and nursery grounds of selected fish species in UK waters (Ellis <i>et al.</i> , 2012)	Provided additional regional context on the distribution of spawning and nursery grounds for commercially important fish species.
A distribution model for the lesser sandeel (<i>Ammodytes marinus</i>) (Langton <i>et al.</i> , 2021)	Used to contextualise the distribution of suitable sandeel supporting habitat and compare with the sandeel heat map outputs.
MHPGC Project-specific surveys eDNA data and fauna data (Gardline <i>et al.</i> , 2024; Gardline 2025)	Used as an additional line of evidence on species presence and distribution to support interpretation and validation of the mapping outputs.

3.4 Heat mapping of Atlantic herring spawning habitat and sandeel supporting habitat

- 3.4.1.1 Heat mapping was also undertaken to identify and map areas of spawning potential for Atlantic herring and sandeel within the Atlantic Herring and Sandeel Study Area. The approach combines multiple regional-scale datasets relating to habitat suitability, spawning activity, species distribution and fishing activity to provide relative confidence in spawning potential for Atlantic herring and sandeel. Guidance published by Kyle-Henney *et al.* (2024) and Reach *et al.* (2024) for Atlantic herring and sandeel, respectively, has been followed, which improved upon the previous MarineSpace guidance (Reach *et al.*, 2013; Latto *et al.*, 2013).
- 3.4.1.2 The 2024 guidance documents provide a method for developing a species-specific heat map showing potential Atlantic herring spawning habitat and sandeel supporting habitat at a regional, national and international level. Although developed to support marine aggregate extraction licence applications in the North Sea, the approach is also considered applicable to offshore wind farm export cables due to their potential interaction with these habitat types.
- 3.4.1.3 The guidance identifies a range of data sources which are to be used to assess the confidence in potential spawning or supporting habitat suitability, and its relevance to spawning, or supporting populations. The data sources are analysed to produce a series of base maps for interpretation of habitat suitability and spawning potential. The data sources used for Atlantic herring and sandeel, and their application within the heat mapping methodology, are provided in **Table 3.5**.
- 3.4.1.4 Where applicable, each data layer is assigned a 'confidence score' (see **Table 3.5** for the data sources and their respective confidence scores), which is combined and analysed within a Geographic Information System (GIS) to produce a heat map showing spawning potential. The confidence scores represent the total normalised value for each dataset, calculated using total weighted scores that account for the quality of evidence (considering the following factors: method, vintage, positioning, coverage, and quality standards) and the dataset's suitability as an indicator of Atlantic herring spawning or sandeel supporting habitat presence. The total normalised confidence score represents a value from zero to one.
- 3.4.1.5 These scores are multiplied together to provide a continuous combined score of zero to one, which is used to produce the resultant heat maps presented in this report. A score of one represents the lowest confidence in spawning, or the presence of no data. Due to the nature of multiplying these scores together, there is a Minimum Possible Data-layers Score from which the heat maps have been scaled to this lowest value. For Atlantic herring this is 0.028125, and for sandeel this is 0.017578.
- 3.4.1.6 The colour scales for heat mapping are continuous and represent a relative gradient of low to very high confidence, interpreted using professional judgement in accordance with the methodology provided in the 2024 assessment guidance documents.

Table 3.5: Data sources used to develop the Atlantic herring spawning habitat and sandeel heat maps and their respective confidence scores

Data source	Applicable to species heat map		Confidence score (Total normalised: 0 to 1)	
	Atlantic herring	Sandeel	Atlantic herring	Sandeel
EMODnet seabed substrate (250k) (EMODnet, 2018)	Yes	Yes	Preferred = 0.5 ² Marginal = 0.75	Preferred = 0.25 ² Marginal = 0.75
Coull <i>et al.</i> (1998)	Yes	Yes	0.75	0.75
VMS data for vessels greater than 15m (2020)	Yes	Yes	0.75	0.75
Sandeel fishing grounds; sandeel population structure and connectivity model (Wright <i>et al.</i> , 2019)	No	Yes	N/A	0.5
OneBenthic Sandeel Presence (Cefas, 2024b)	No	Yes	N/A	0.25
IHLS larval abundance (ICES, 2025)	Yes	N/A	0.1	N/A
Eastern Sea Fisheries Joint Committee (ESFJC) data ³	No	No	N/A	N/A

² There is a difference in the confidence scores for Atlantic herring and sandeel. The 'preferred' and 'marginal' habitat classes for Atlantic herring tend to overestimate the potential suitability for Atlantic herring spawning because these Folk (1954) classifications allow for higher mud proportions (<10% mud) than herring prefer (<5% mud). Therefore, the area of potential suitable habitat for Atlantic herring is considered to be highly precautionary.

In contrast, the preferred Folk (1954) classifications for sandeel are considered to accurately reflect sandeel habitat preferences. Therefore, the Folk (1954) classifications for 'preferred' sandeel habitat are deemed to align well with sandeel sediment preferences, resulting in a higher confidence score.

'Marginal' habitat is considered to provide a low confidence in Atlantic herring spawning habitat and sandeel supporting habitat.

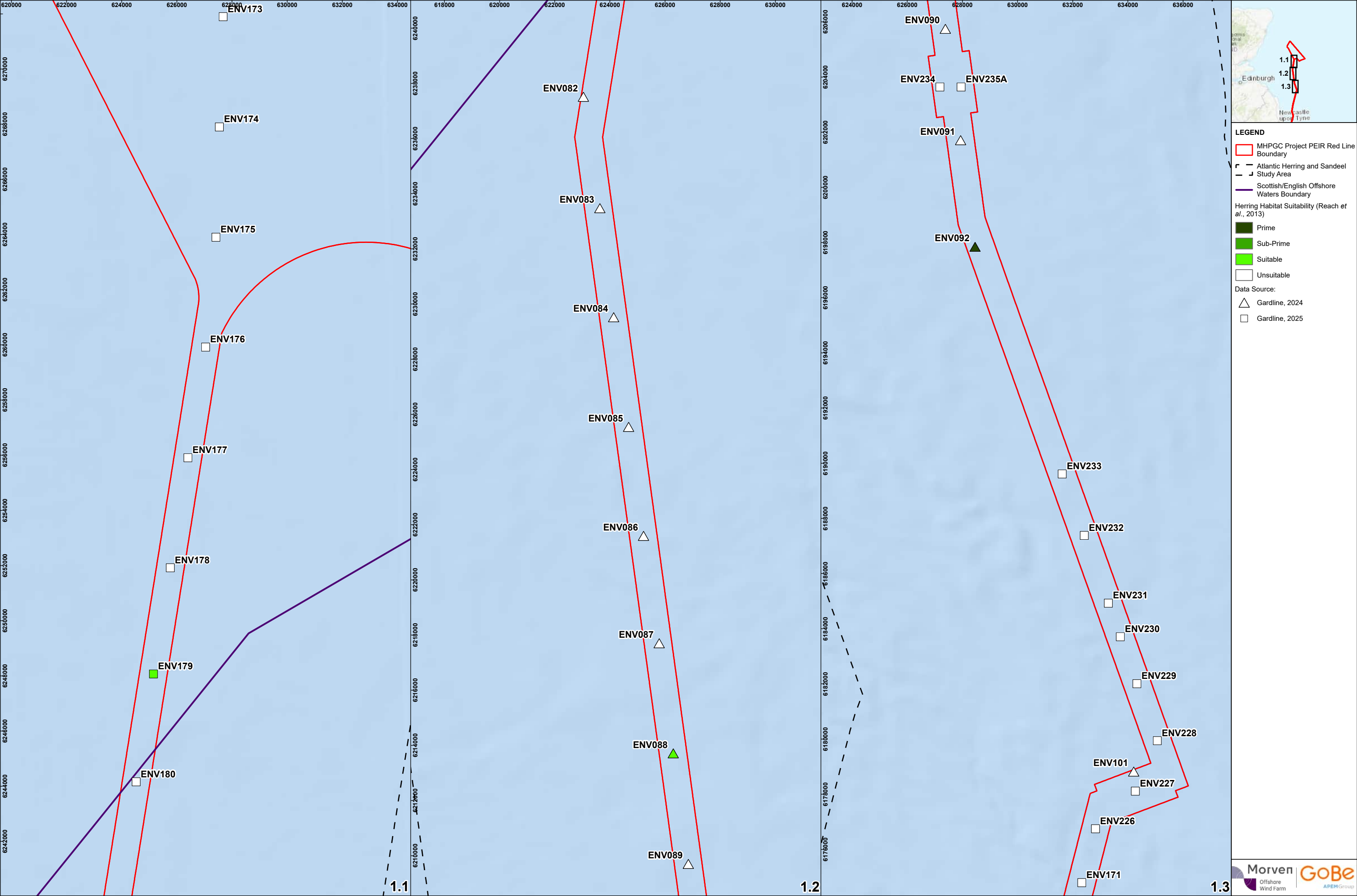
³ The ESFJC dataset was not used in this assessment as its geographical coverage is not relevant to the Atlantic Herring and Sandeel Study Area. Although included within the original heat mapping methodologies, it was excluded from the present assessment.

4 Results

4.1 Atlantic herring

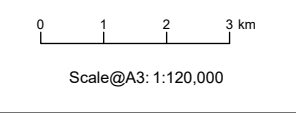
4.1.1 Habitat Suitability Assessment

- 4.1.1.1 In Scottish waters, the majority of MHPGC Project grab samples were classified as unsuitable for Atlantic herring spawning (85.7%; 6/7) (**Figure 4-1** and **Figure 4-2**). One grab sample was classified as suitable habitat within the MHPGC Project PEIR Red Line Boundary, within close proximity to English waters (near KP184). No prime or sub-prime Atlantic herring spawning substrates were identified within the MHPGC Project PEIR Red Line Boundary. Similar results were reported for the Morven North and Morven South PSA sampling, where all 100 sediment grab samples were classified as unsuitable for Atlantic herring spawning within the Morven North Boundary and Morven South Boundary, and across the wider study areas (5km to 14km buffer around the respective boundaries) (Figure 4.10 in Tetra Tech RPS Energy (2026)).
- 4.1.1.2 In English waters, the majority of MHPGC Project sediment grab samples were classified as unsuitable for Atlantic herring spawning (97.1%; 67/69) (**Figure 4-1**). One grab sample was classified as prime habitat (near KP133), and one grab sample was classified as suitable habitat (near KP149) within the MHPGC Project PEIR Red Line Boundary (**Figure 4-1** and **Figure 4-2**). Both samples were from the northern half of the MHPGC Project PEIR Red Line Boundary in English waters.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING SPAWNING HABITAT SUITABILITY BASED ON THE SITE-
SPECIFIC BENTHIC SURVEY RESULTS (GARDLINE, 2024; 2025) - SHEET 1

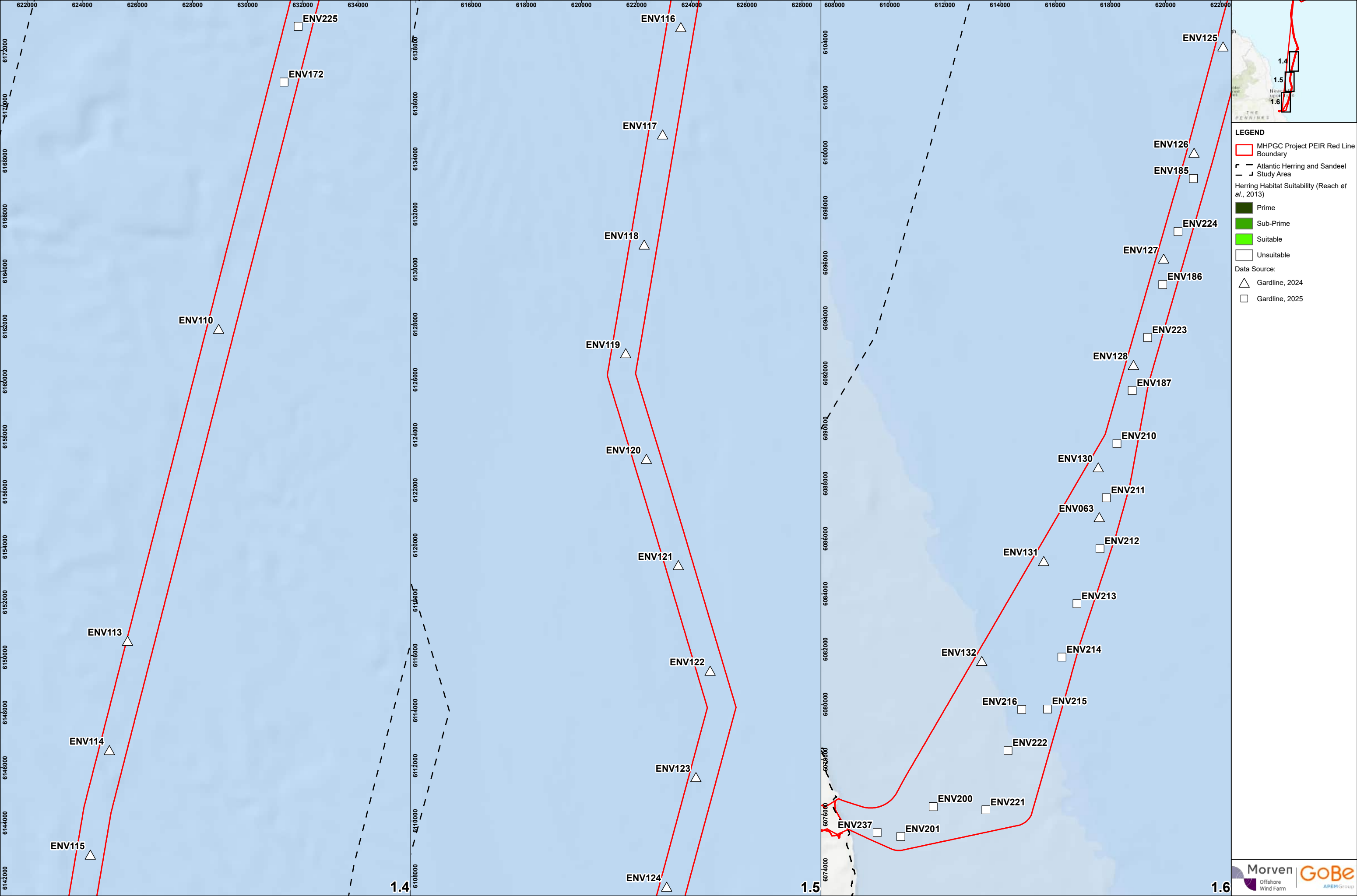


Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

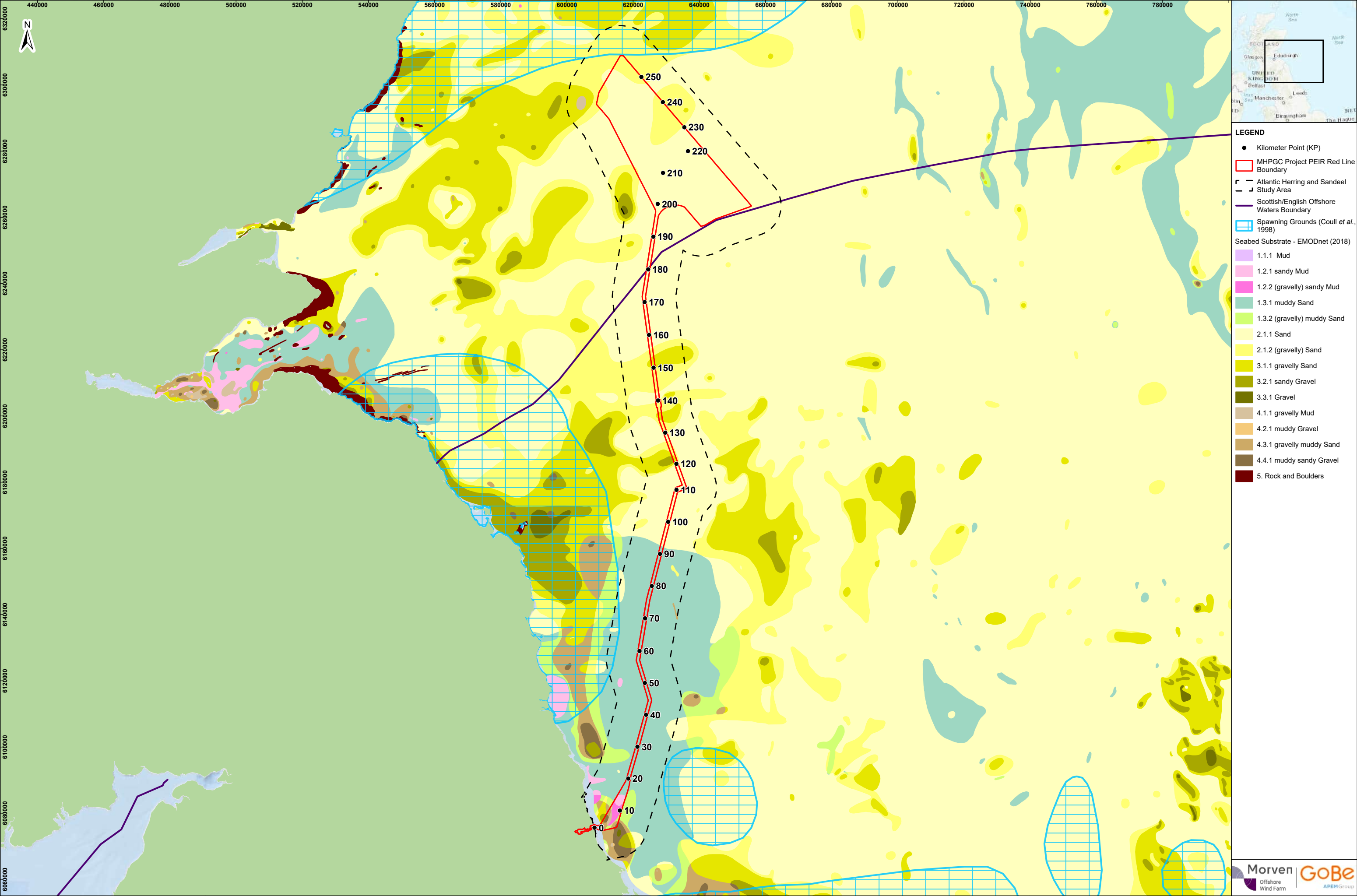
Data Sources:
BP, Ordnance Survey

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

Drawing Number: FIGURE 4-1				
VER	DATE	DETAILS	BY	CHECK
00	14/08/2025	Initial Issue	GB	AdB
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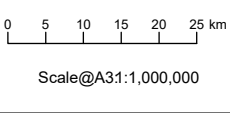


- 4.1.1.3 EMODnet broadscale habitat mapping data indicates that the Atlantic Herring and Sandeel Study Area, within Scottish waters, including the MHPGC Project PEIR Red Line Boundary, is predominantly comprised of Sand which is unsuitable for Atlantic herring spawning (**Figure 4-3** and **Figure 4-4**). There are discrete areas of gravelly Sand located to the northwest and southwest of the MHPGC Project PEIR Red Line Boundary, within the Atlantic Herring and Sandeel Study Area. These substrates are considered as marginal suitability for Atlantic herring spawning. A discrete area of sandy Gravel and Gravel is also present to the southwest of the MHPGC Project PEIR Red Line Boundary, within the Atlantic Herring and Sandeel Study Area, representing preferred Atlantic herring spawning habitat. However, no marginal or preferred Atlantic herring spawning habitat occurs within the MHPGC Project PEIR Red Line Boundary.
- 4.1.1.4 In English waters, the EMODnet broadscale habitat mapping data indicate that the northern section of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is predominantly comprised of Sand, which is unsuitable for Atlantic herring spawning (**Figure 4-3** and **Figure 4-4**). Although discrete areas of gravelly Sand, which is marginal supporting habitat, intersect the MHPGC Project PEIR Red Line Boundary at approximately three locations (near KP120, KP140 and KP150). The southern section of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line boundary comprises muddy Sand which is unsuitable spawning habitat (**Figure 4-3** and **Figure 4-4**). However, close to the landfall location, discrete areas of gravelly Sand occur on either side of the MHPGC Project PEIR Red Line Boundary within the Atlantic Herring and Sandeel Study Area, which are considered to represent marginal Atlantic herring spawning habitat.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
EUNIS CLASSIFICATION WITHIN THE ATLANTIC HERRING AND SANDEEL STUDY
AREA AND HERRING SPAWNING GROUNDS (EMODNET, 2018)



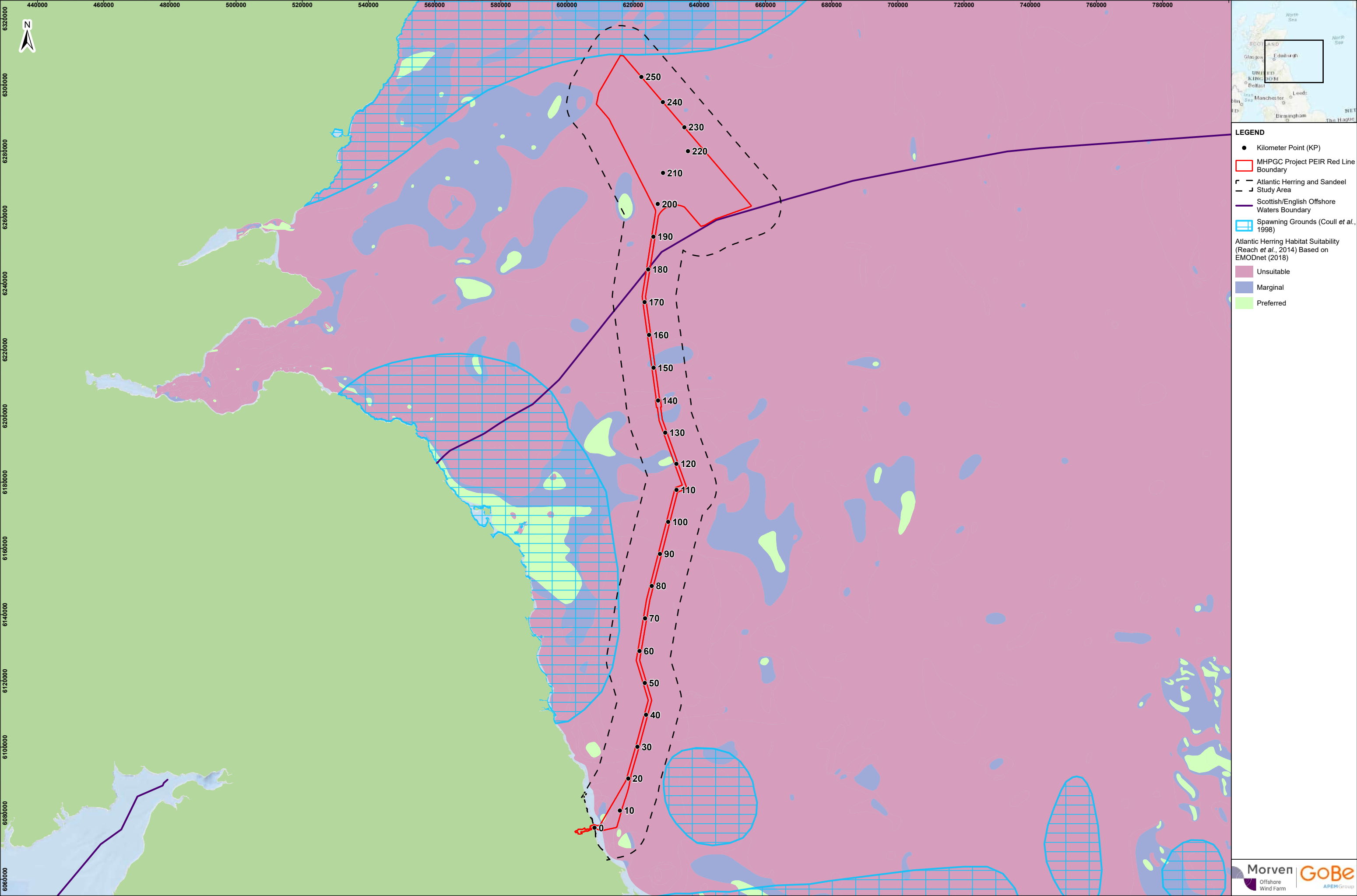
Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

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

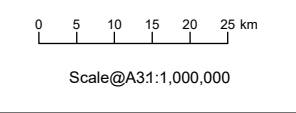
Drawing Number:
FIGURE 4-3

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00	14/08/2025	Initial Issue	GB	KD
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Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING HABITAT SUITABILITY BASED ON EMODNET, (2018)



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

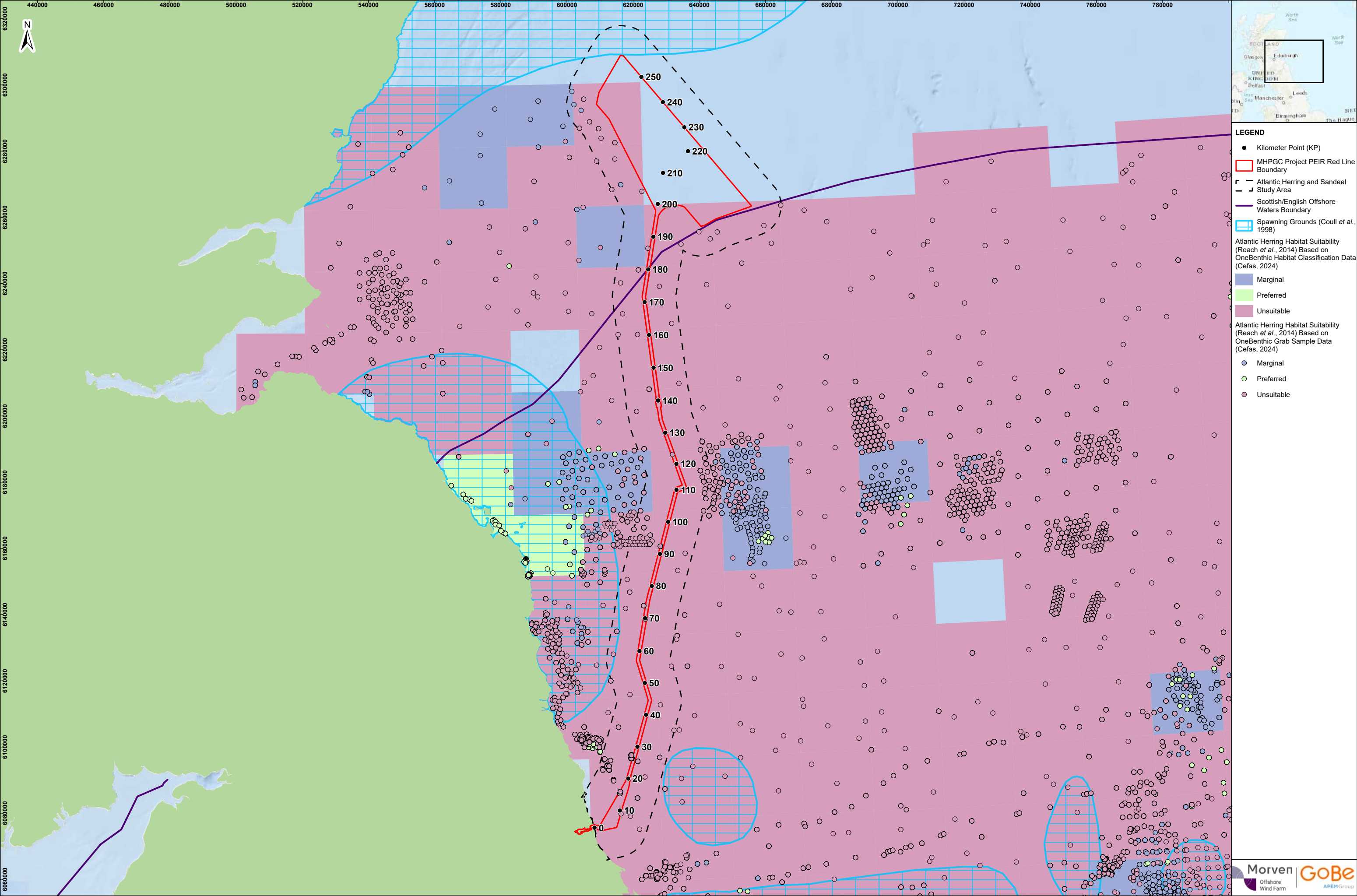
Data Sources:
BP, Ordnance Survey

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

Drawing Number:
FIGURE 4-4

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00	14/08/2025	Initial Issue	GB	KD
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- 4.1.1.5 Similar to the EMODnet broadscale habitat mapping data, the OneBenthic PSA data, categorised in accordance with the Kyle-Henney *et al.* (2024) classifications, show that the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is unsuitable spawning habitat for Atlantic herring (although data within the northeast section of the Atlantic Herring and Sandeel Study Area is lacking) (**Figure 4-5**). Areas of marginal spawning habitat generally align with the EMODnet broadscale habitat mapping data, however, no preferred spawning habitat is identified within the Atlantic Herring and Sandeel Study Area. These differences are likely due to differing data resolution (the larger ICES sub-rectangles used as for the mapping of the OneBenthic PSA data) and the mobile and dynamic nature of sediment in the Atlantic Herring and Sandeel Study Area (**Volume 2, Chapter 1: Physical Processes, of the PEIR**).
- 4.1.1.6 In Scottish waters, the EMODnet broadscale habitat mapping data and OneBenthic PSA (and associated habitat classification) data broadly align with the MHPGC Project-specific PSA data which determined that the majority of samples in Scottish waters, within the MHPGC Project PEIR Red Line Boundary, were classified as unsuitable spawning habitat, with only one sample in the south identified as suitable. Similarly, the Morven North and Morven South PSA data, within the Morven North Boundary and Morven South Boundary and wider study area (5km to 14km buffer), were classified as unsuitable habitat, aligning with the EMODnet broadscale habitat mapping data and OneBenthic PSA data.
- 4.1.1.7 In English waters, similar to the EMODnet broadscale habitat mapping data, the OneBenthic PSA data (and associated habitat classification data) show that the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is unsuitable spawning habitat. Unlike the EMODnet broadscale habitat mapping data, no marginal or preferred spawning habitat was indicated within the south of the Atlantic Herring and Sandeel Study Area. As described above, these differences are likely due to the differing spatial resolution of the datasets and the mobile and dynamic nature of sediment within the Atlantic Herring and Sandeel Study Area.
- 4.1.1.8 In English waters, the MHPGC Project PSA data broadly align with the EMODnet broadscale habitat mapping data and OneBenthic PSA data (and associated habitat classification assessments). Consistent with these datasets, the MHPGC Project-specific PSA data indicate that the majority of the MHPGC Project PEIR Red Line Boundary comprises unsuitable Atlantic herring spawning habitat, with only limited areas of suitability. These were identified in the northern section, where one sediment sample was classified as prime spawning habitat and one as suitable spawning habitat.



LEGEND

- Kilometer Point (KP)
- ▭ MHPGC Project PEIR Red Line Boundary
- ▭ Atlantic Herring and Sandeel Boundary
- ▭ Scottish/English Offshore Waters Boundary
- ▭ Spawning Grounds (Coull *et al.*, 1998)

Atlantic Herring Habitat Suitability (Reach *et al.*, 2014) Based on OneBenthic Habitat Classification Data (Cefas, 2024)

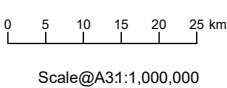
- ▭ Marginal
- ▭ Preferred
- ▭ Unsuitable

Atlantic Herring Habitat Suitability (Reach *et al.*, 2014) Based on OneBenthic Grab Sample Data (Cefas, 2024)

- Marginal
- Preferred
- Unsuitable

Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING HABITAT SUITABILITY BASED ON ONEBENTHIC DATA
(CEFAS, 2024A)



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 4-5

VER	DATE	DETAILS	BY	CHECK
00	14/08/2025	Initial Issue	GB	KD
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4.1.1.9 Collectively, the available datasets indicate that the MHPGC Project PEIR Red Line Boundary is predominantly characterised by sediments classified as unsuitable for Atlantic herring spawning. The project-specific PSA data classified the majority of sediment samples as unsuitable spawning habitat, with only one sample in Scottish waters classified as suitable spawning habitat and, in English waters, one sample classified as suitable spawning habitat and one as prime spawning habitat. Similarly, all samples from the Morven North and Morven South PSA datasets were classified as unsuitable spawning habitat. The broader-scale EMODnet and OneBenthic habitat suitability classifications support this pattern, indicating that the Atlantic Herring and Sandeel Study Area is largely dominated by sediment types corresponding to unsuitable spawning habitat, with marginal and preferred spawning habitats limited in extent and generally occurring outside, or only locally intersecting, the MHPGC Project PEIR Red Line Boundary.

4.1.2 Heat mapping of Atlantic herring spawning potential

4.1.2.1 Building on the habitat suitability characterisation derived from the site-specific PSA datasets, EMODnet broadscale habitat mapping and OneBenthic PSA data, a heat mapping exercise was undertaken to determine the confidence in Atlantic herring spawning potential within the MHPGC Project PEIR Red Line Boundary and across the wider Atlantic Herring and Sandeel Study Area. The heat mapping combined habitat suitability classifications with additional datasets that provide information on contemporary spawning activity and the potential ecological importance of areas used by Atlantic herring.

4.1.2.2 In addition to the habitat suitability datasets already described above in **Section 4.1.1**, the heat mapping also incorporated IHLS data, which provide a proxy for active spawning based on the distribution and abundance of Atlantic herring larvae, and VMS data for pelagic fishing activity, which provide a precautionary indicator of areas that may support commercially important pelagic fish populations (such as herring). These datasets are summarised in **Table 3.1**, and are described below, and were used in combination with the habitat suitability classifications (as determined in **Section 4.1.1**) to determine the confidence assigned to Atlantic herring spawning potential within and adjacent to the MHPGC Project PEIR Red Line Boundary and wider Atlantic Herring and Sandeel Study Area.

International Herring Larval Survey data

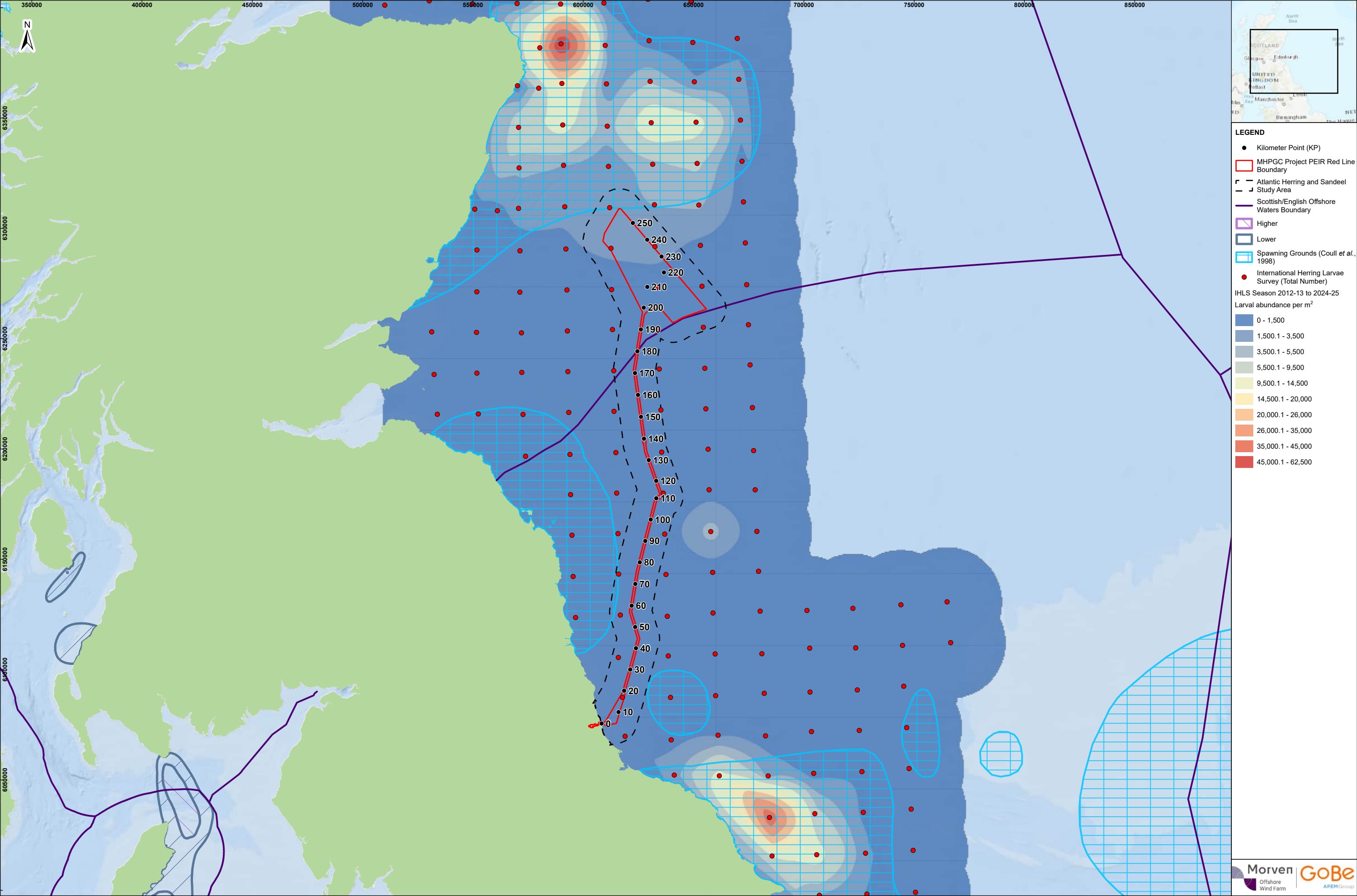
4.1.2.3 The IHLS data provide a proxy for active Atlantic herring spawning, based on the distribution and abundance of larvae within the water column. Although Atlantic herring are demersal spawners, larvae become suspended in the water column and are therefore influenced by hydrodynamic processes, meaning that larvae may be recorded outside of recognised spawning grounds and areas of suitable spawning habitat. Nevertheless, the IHLS dataset is considered the most suitable available indicator of contemporary spawning activity.

4.1.2.4 Within Scottish waters, the IHLS data indicates that there is low larval abundance (<1,500 per m²) throughout the Atlantic Herring and Sandeel Study Area, including the MHPGC Project Red Line Boundary, based on the aggregated 10-year dataset (**Figure 4-6**). Low larval abundance in these areas is also evident in the individual survey-year datasets presented in **Appendix A**. In the northern section of the Atlantic Herring and Sandeel Study Area in Scottish waters, including within the MHPGC Project PEIR Red Line Boundary, larval abundance was slightly higher (1,500-3,500 per m²) (**Figure 4-6**); however this is still considered low, in the context of wider spawning activity across the North Sea. For example, larval abundances of up to approximately 70,000 per m² have been recorded in proximity to the Muir Mhor OWF offshore export cable corridor (approximately 60km north of the MHPGC Project PEIR Red Line Boundary, offshore from Peterhead) (GoBe Consultants, 2024), around 17 to 39 times higher than those recorded within the Atlantic Herring and Sandeel Study Area.

4.1.2.5 The IHLS data supports the location of the Buchan Atlantic herring spawning ground in Scottish waters, which intersects the northern section of the Atlantic Herring and Sandeel Study Area (**Figure 4-6**). Within this spawning ground, larval abundance is higher than in surrounding areas, although it remains relatively low (3,500 per m² to 5,500 per m²) within the section overlapping the Atlantic Herring and Sandeel Study Area). Similarly, the EMODnet broadscale habitat mapping data indicate that most of the section of the Buchan Atlantic herring spawning ground that overlaps the Atlantic

Herring and Sandeel Study Area is 'unsuitable' spawning habitat, with discrete areas of 'marginal' habitat.

- 4.1.2.6 Within English waters, the IHLS data similarly indicates that there is low larval abundance (0 per m² to 1,500 per m²) throughout the Atlantic Herring and Sandeel Study Area, including the MHPGC Project Red Line Boundary, based on the aggregated 10-year dataset (**Figure 4-6**). Low larval abundance in these areas is also evident in the individual survey-year datasets presented in **Appendix A**. With regard to the Banks spawning ground identified by Coull *et al.* (1998), which lies adjacent to and southeast of the Atlantic Herring and Sandeel Study Area, the IHLS identifies low intensity spawning activity across the spawning ground (**Figure 4-6**). However, EMODnet broadscale habitat mapping data and OneBenthic PSA data indicate the presence of preferred spawning habitats for herring, although these substrates lie outside of the Atlantic Herring and Sandeel Study Area. Further afield, within a larger area of the Banks spawning ground located approximately 60km northeast of the MHPGC Project PEIR Red Line Boundary, larval densities increase substantially, reaching approximately 56,000 per m².



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
INDICATIVE ATLANTIC HERRING SPAWNING GROUND BASED ON IHLS MAPPING
DATA (ICES 2012/13 - 2024/25 SEASONS)

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

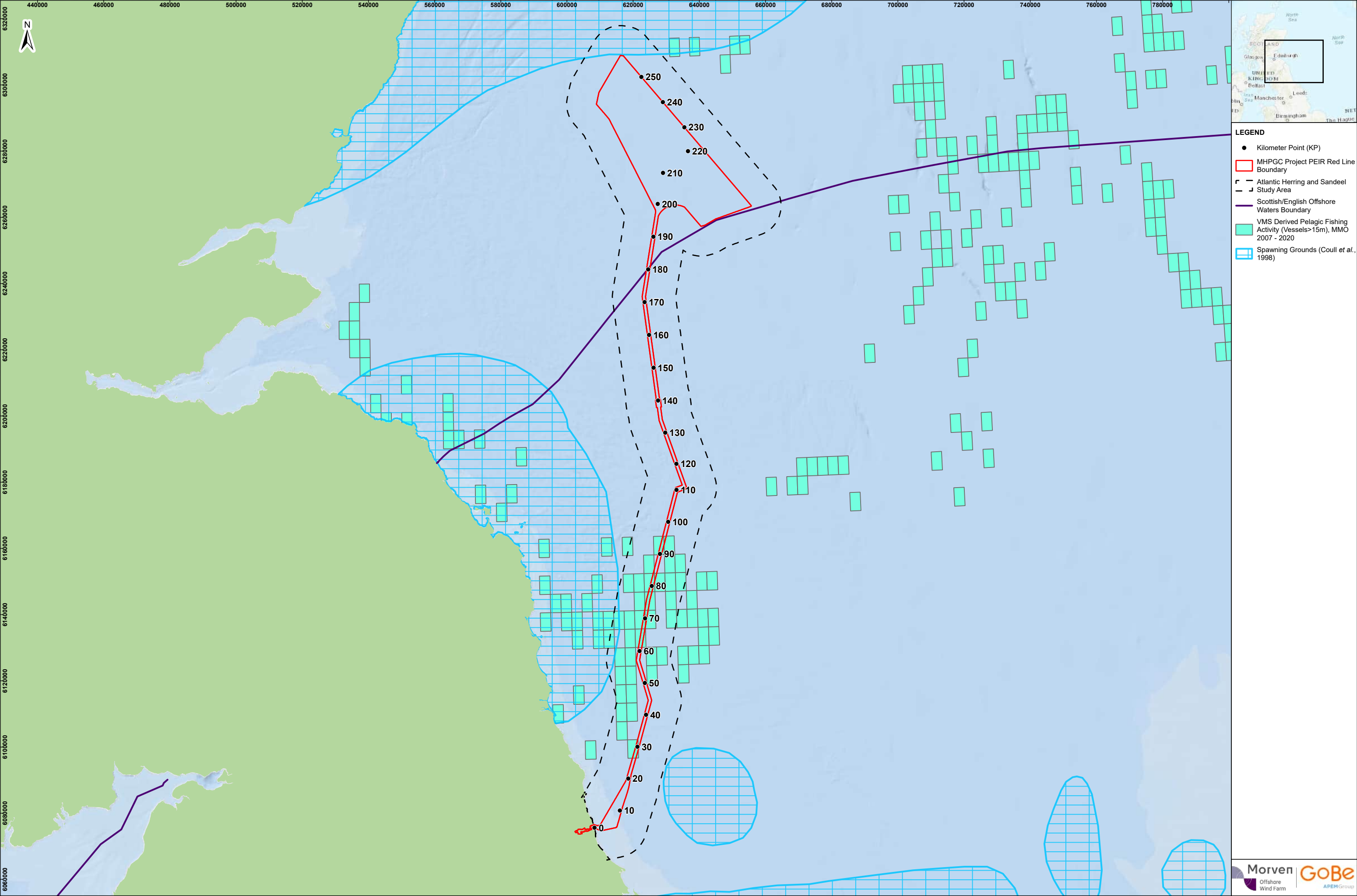
Service Layer Credits:
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number:
FIGURE 4-6

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00	18/08/2025	Initial Issue	GB	KD
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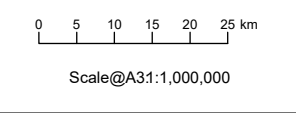
Vessel Monitoring System data

- 4.1.2.7 Pelagic fishing activity derived from VMS data is shown in **Figure 4-7**. It is important to note that the pelagic fishing gear types included in the VMS data target multiple species in addition to Atlantic herring and therefore the data cannot be considered representative of specific Atlantic herring spawning ground or suitable habitat. Consequently, the VMS data only provide a very low confidence indicator that Atlantic herring spawning may be occurring in an area where pelagic fishing gear is used.
- 4.1.2.8 In Scottish waters, there is no overlap between the MHPGC Project PEIR Red Line Boundary and wider Atlantic Herring and Sandeel Study Area with areas of pelagic fishing activity.
- 4.1.2.9 In English waters, a concentrated area of pelagic fishing activity is present within the southern section of the Atlantic Herring and Sandeel Study Area, intersecting the MHPGC Project PEIR Red Line Boundary (**Figure 4-7**). Pelagic fishing activity also occurs within the Banks spawning ground, which extends across Scottish and English waters and slightly overlaps the southern section of the Atlantic Herring and Sandeel Study Area. Similarly, areas of marginal and preferred spawning ground were identified within this location by the EMODnet broadscale habitat mapping data and OneBenthic PSA data, extending from the Banks spawning ground and intersecting a discrete area of the central western section of the Atlantic Herring and Sandeel Study Area. Elsewhere within the Atlantic Herring and Sandeel Study Area and the MHPGC Project PEIR Red Line Boundary in English waters, there is no overlap with areas of pelagic fishing activity.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
VESSEL MONITORING SYSTEMS (VMS) DATA OF PELAGIC FISHING GEAR



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

- LEGEND**
- Kilometer Point (KP)
 - ▭ MHPGC Project PEIR Red Line Boundary
 - ▭ Atlantic Herring and Sandeel Study Area
 - ▭ Scottish/English Offshore Waters Boundary
 - ▭ VMS Derived Pelagic Fishing Activity (Vessels>15m), MMO 2007 - 2020
 - ▭ Spawning Grounds (Coull *et al.*, 1998)

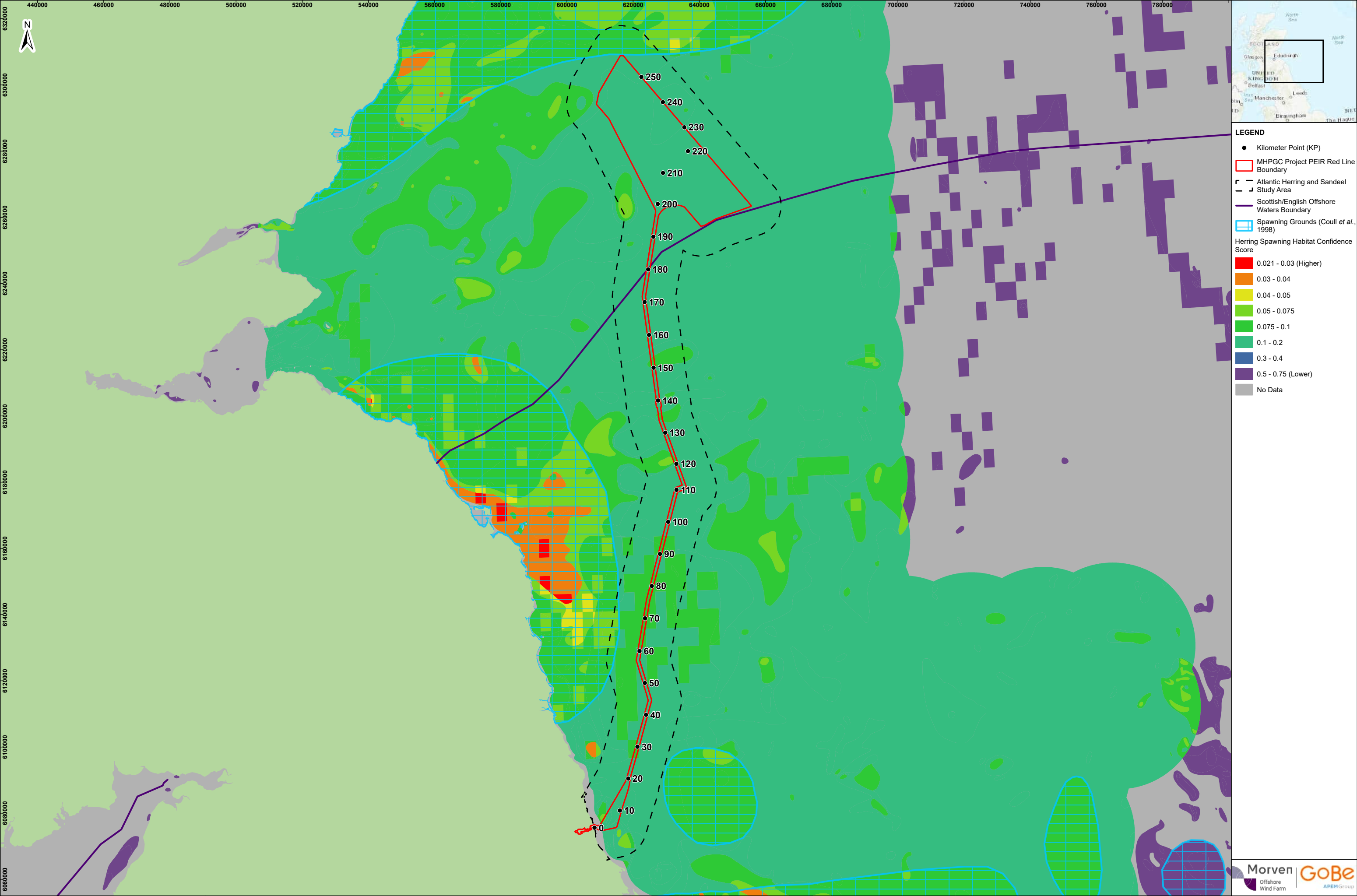


Drawing Number:
FIGURE 4-7

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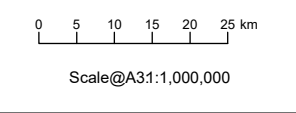
Atlantic herring spawning confidence assessment

- 4.1.2.10 The Atlantic herring spawning confidence heat map is presented in **Figure 4-8**. The heat map was developed following the methodology described by Kyle-Henney *et al.* (2024), which combines multiple datasets to provide a relative measure of confidence in Atlantic herring spawning potential. The assessment draws on habitat suitability classifications derived from the EMODnet seabed substrate dataset together with historical spawning ground records (Coull *et al.*, 1998), IHLS larval abundance data, and VMS-derived pelagic fishing activity. Each dataset was assigned a confidence score based on both the quality of the evidence and its suitability as an indicator of Atlantic herring spawning. The confidence scores assigned to each dataset are provided in **Table 3.5**. The resulting heat map therefore reflects the combined contribution of habitat suitability, historical spawning ground information, larval abundance data and pelagic fishing activity.
- 4.1.2.11 In Scottish waters, the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, was dominated by sandy substrates that are unsuitable for Atlantic herring spawning and exhibited consistently low densities of Atlantic herring larvae. Consequently, this area was therefore assigned a lower confidence score ranging from 0.1 to 0.2 (shown in green) (**Figure 4-8**). Discrete areas of more gravelly and therefore more suitable substrate lie outside of the MHPGC Project PEIR Red Line Boundary but within the Atlantic Herring and Sandeel Study Area, to the north, northwest and west. Confidence is therefore higher in these locations, ranging from 0.05 to 0.1 (shown as brighter green). Additional discrete areas of suitable gravelly substrate occur outside the Atlantic Herring and Sandeel Study Area, approximately 30km to the northwest and 40km to the southwest. These areas were assigned higher confidence scores of 0.021 to 0.04 (shown as orange and red), and overlap with spawning grounds identified by Coull *et al.* (1998).
- 4.1.2.12 In English waters, the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, was similarly assigned a lower confidence score ranging from 0.05 to 0.2 (shown in green), reflecting the predominance of sandy substrates that are unsuitable for Atlantic herring spawning and the consistently low densities of Atlantic herring larvae (**Figure 4-8**). Discrete areas of more gravelly, and therefore more suitable, substrate lie within the northern section of the Atlantic Herring and Sandeel Study Area and overlap with the MHPGC Project PEIR Red Line Boundary. Confidence is higher in these locations compared to the rest of the Atlantic Herring and Sandeel Study Area, ranging from 0.05 to 0.1 (shown in brighter green). This same confidence range has been assigned to a larger, more continuous area in the southern section of the Atlantic Herring and Sandeel Study Area, including parts of the MHPGC Project PEIR Red Line Boundary, reflecting the presence of demersal fishing activity. The highest confidence scores, (shown in yellow, orange and red), occur outside the Atlantic Herring and Sandeel Study Area, where suitable gravelly substrate coincides with spawning grounds identified by Coull *et al.* (1998) to the west, including a discrete area in proximity to the section approaching landfall.
- 4.1.2.13 Overall, the heat mapping outputs are consistent with outputs of the habitat suitability assessment (see **Section 4.1.1**). While isolated areas of potentially suitable spawning habitat occur within the Atlantic Herring and Sandeel Study Area, the predominance of unsuitable substrate together with generally low larval abundances indicates a relatively low likelihood of extensive contemporary Atlantic herring spawning activity within the MHPGC Project PEIR Red Line Boundary and wider Atlantic Herring and Sandeel Study Area. The highest-confidence spawning habitat is located outside the Atlantic Herring and Sandeel Study Area, principally within areas of the Banks spawning ground where suitable spawning substrate coincides with historical spawning records.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
ATLANTIC HERRING SPAWNING CONFIDENCE HEATMAP



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

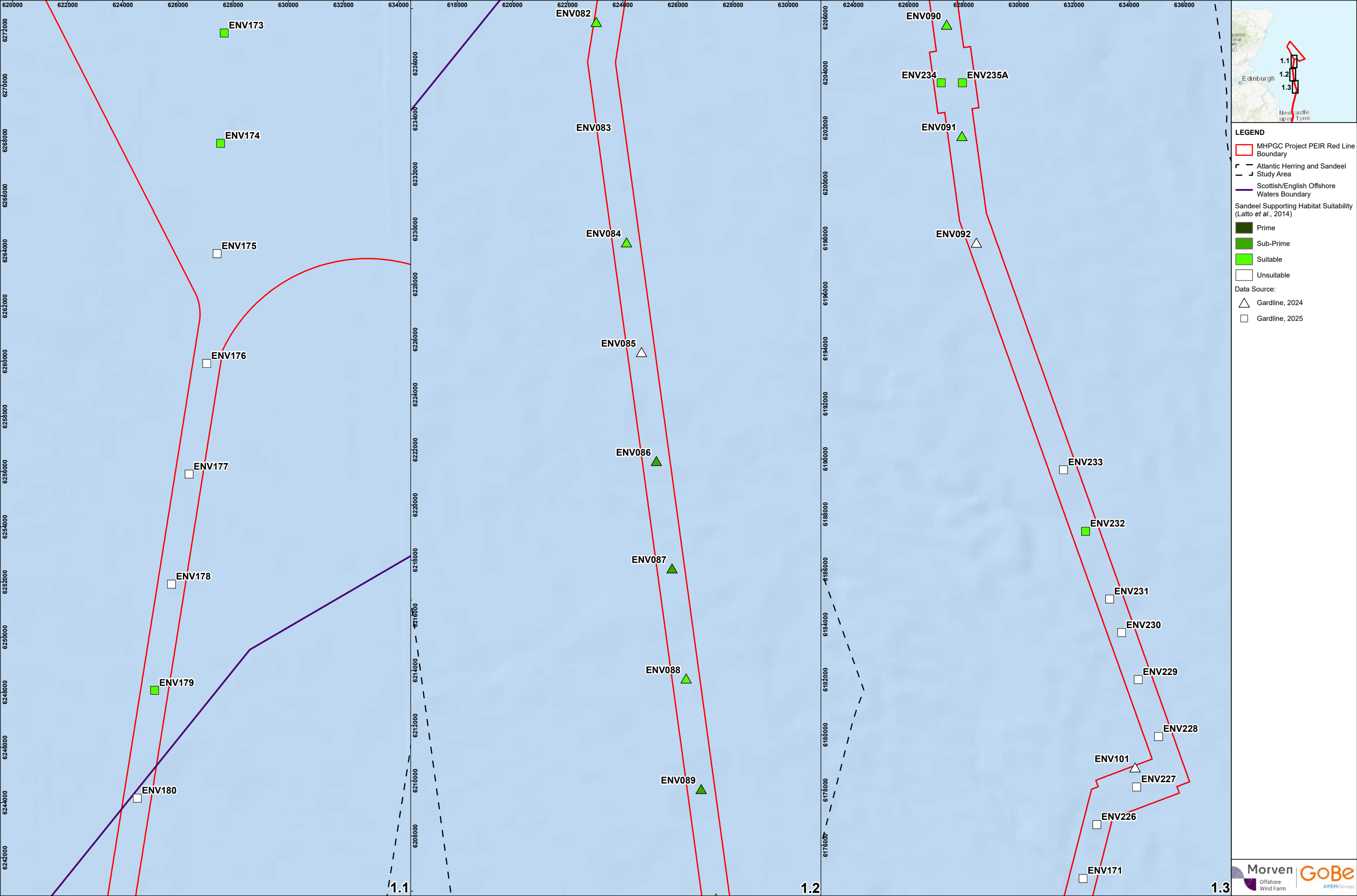
Drawing Number:
FIGURE 4-8

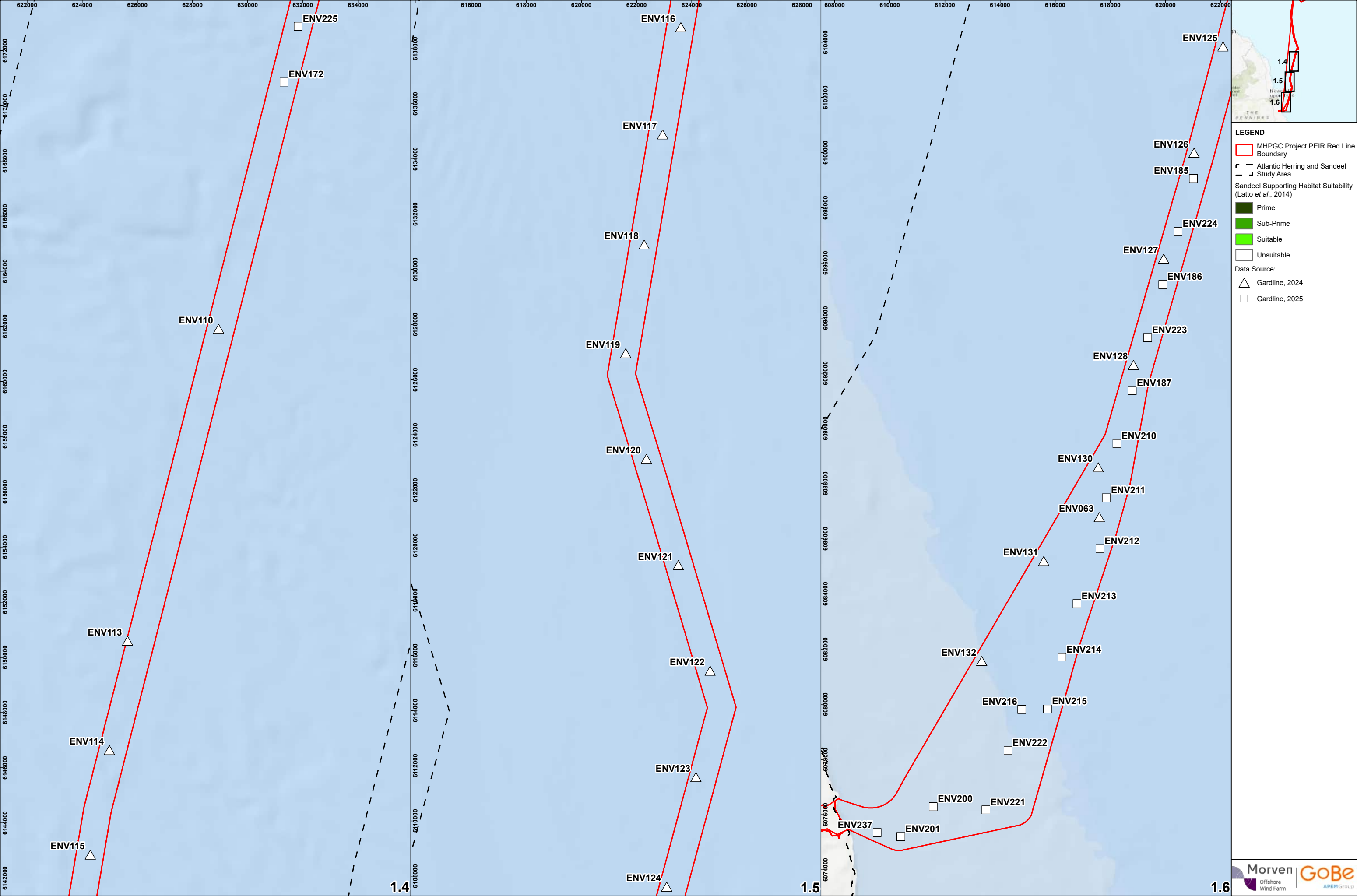
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4.2 Sandeel

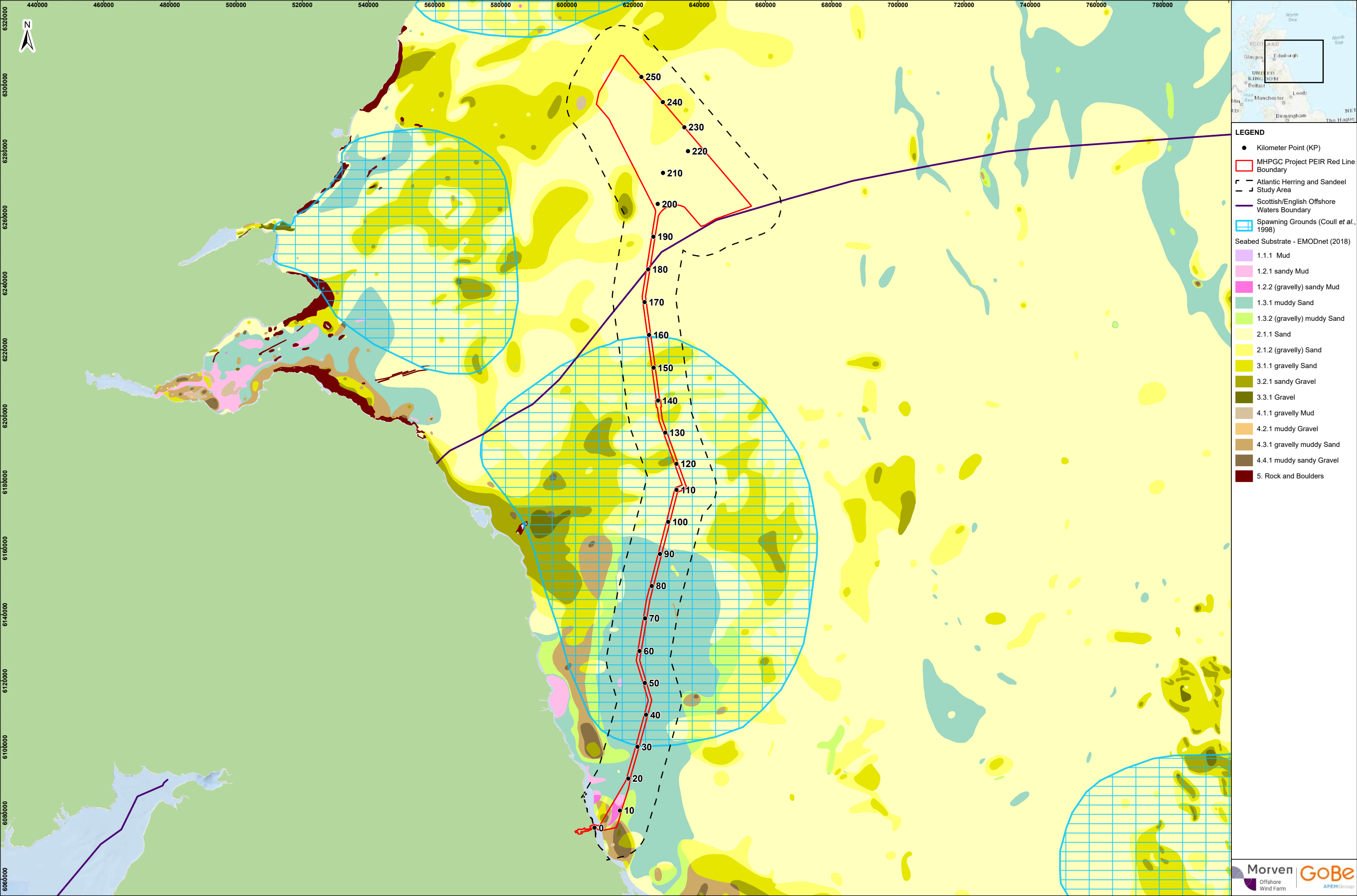
4.2.1 Habitat Suitability Assessment

- 4.2.1.1 In Scottish waters, three of the MHPGC Project grab samples were classified as suitable supporting habitat within the MHPGC Project PEIR Red Line Boundary (42.99%; 3/7), with the remaining samples classified as unsuitable (**Figure 4-9** and **Figure 4-10**). There was no prime or sub-prime habitat identified within the MHPGC Project PEIR Red Line Boundary.
- 4.2.1.2 In contrast, the majority of grab samples collected within both the Morven North Boundary and Morven South Boundary, and wider study area as defined for the respective projects (5km to 14km from both boundaries), were classified as marginal sandeel supporting habitat (81/100; 81%) (Figure 4.13 in Tetra Tech RPS Energy (2026)).
- 4.2.1.3 Within the Morven North Boundary, all grab samples were classified as marginal supporting habitat, with the exception of one sample in the north-east, which was classified as unsuitable (1/48; 2.1%) (Tetra Tech RPS Energy, 2026). Within the Morven South Boundary, all grab samples were classified as marginal supporting habitat, with the exception of nine samples classified as unsuitable (9/33; 27.3%), which were distributed relatively evenly throughout the site, and one sample near the centre of the area within the boundary that was classified as preferred habitat (1/33; 3.0%) (Tetra Tech RPS Energy, 2026). Within the wider study area defined for the Morven South project (5km to 14km buffer), seven samples were classified as marginal habitat (7/19; 36.8%) and 11 as unsuitable habitat (11/19; 57.9%), dispersed relatively evenly throughout the area (Tetra Tech RPS Energy, 2026). One sample in the north-west of the wider study area was classified as preferred habitat (1/19; 5.3%) and lies within the Atlantic Herring and Sandeel Study Area (Tetra Tech RPS Energy, 2026).
- 4.2.1.4 In English waters, three grab samples were classified as sub-prime (4.9%; 3/62), and eight grab samples were classified as suitable supporting habitat (12.9%; 8/62), within the MHPGC Project PEIR Red Line Boundary (**Figure 4-9** and **Figure 4-10**). These sub-prime and suitable supporting habitat samples were in the northern half of the MHPGC Project PEIR Red Line Boundary in English waters. The remaining samples (82.3%; 51/62) were classified as unsuitable sandeel supporting habitat (**Figure 4-9** and **Figure 4-10**). There was no prime habitat identified within the MHPGC Project PEIR Red Line Boundary.



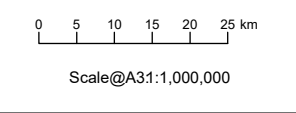


-
- 4.2.1.5 EMODnet broadscale habitat mapping data indicates that the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is predominantly comprised of Sand which is preferred sandeel supporting habitat (**Figure 4-11** and **Figure 4-12**).
- 4.2.1.6 Within Scottish waters, there are two discrete areas of Mud and Gravel located to the northwest and southwest of the MHPGC Project PEIR Red Line Boundary, respectively, within the Atlantic Herring and Sandeel Study Area (**Figure 4-11** and **Figure 4-12**). These substrates are considered unsuitable sandeel supporting habitat, although a limited area of marginal supporting habitat surrounds the unsuitable habitat in the northwest, where sandy gravel occurs (**Figure 4-11** and **Figure 4-12**).
- 4.2.1.7 Conversely, the southern section of the Atlantic Herring and Sandeel Study Area, located in English waters, including the MHPGC Project PEIR Red Line Boundary comprises muddy Sand which is considered unsuitable supporting habitat (**Figure 4-11** and **Figure 4-12**). However, there are two discrete areas of marginal and preferred habitat within close proximity to the MHPGC PEIR Red Line Boundary, in the southern section, respectively close to landfall (approximately 3.2km from the nearest point).



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
EUNIS CLASSIFICATION WITHIN THE ATLANTIC HERRING AND SANDEEL STUDY
AREA AND SANDEEL SPAWNING GROUNDS (EMODNET, 2018)



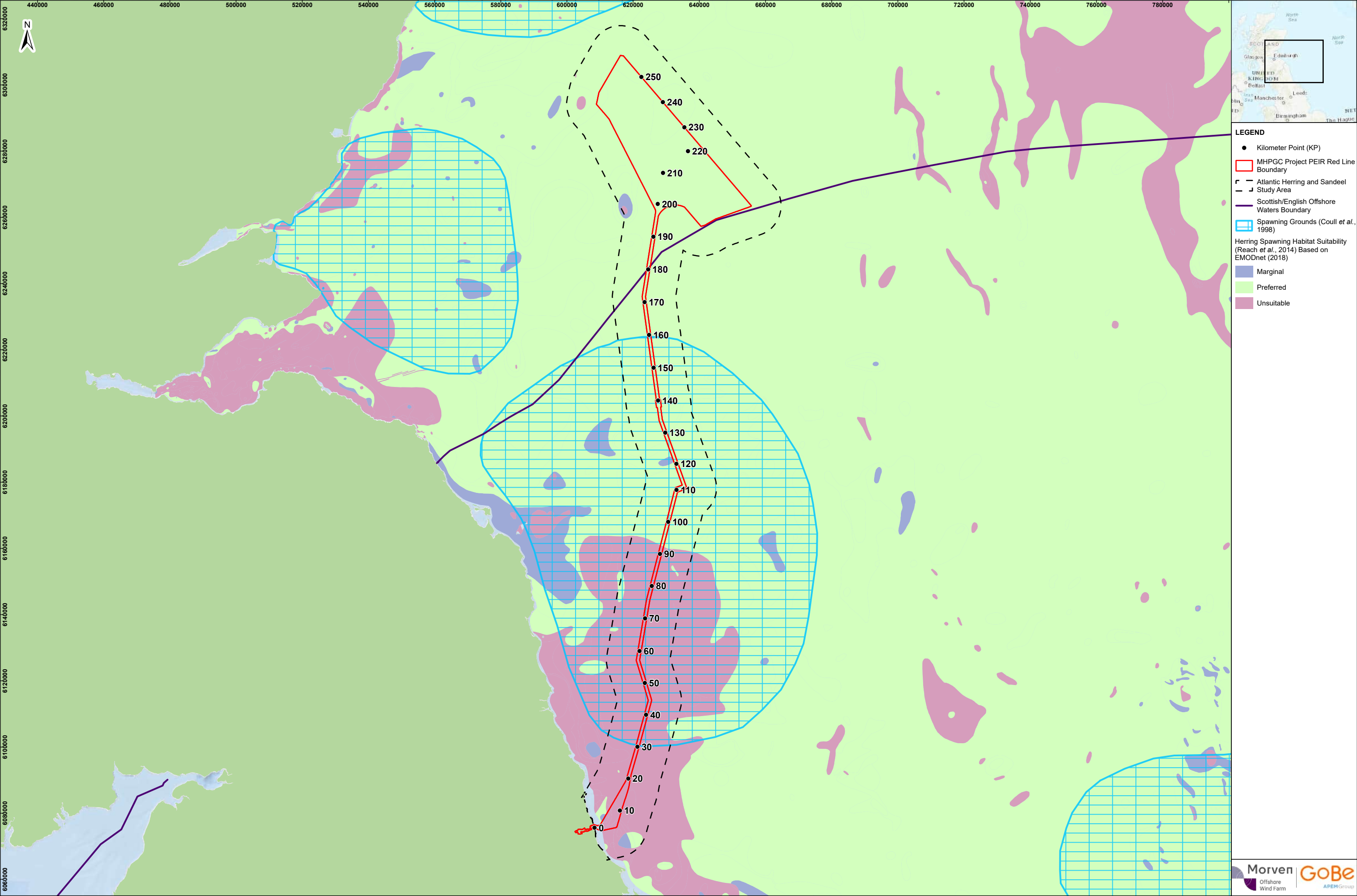
Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

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

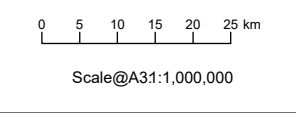
Drawing Number:
FIGURE 4-11

VER	DATE	DETAILS	BY	CHECK
00	14/08/2025	Initial Issue	GB	KD
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Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL SPAWNING HABITAT SUITABILITY BASED ON EMODNET, (2018)



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

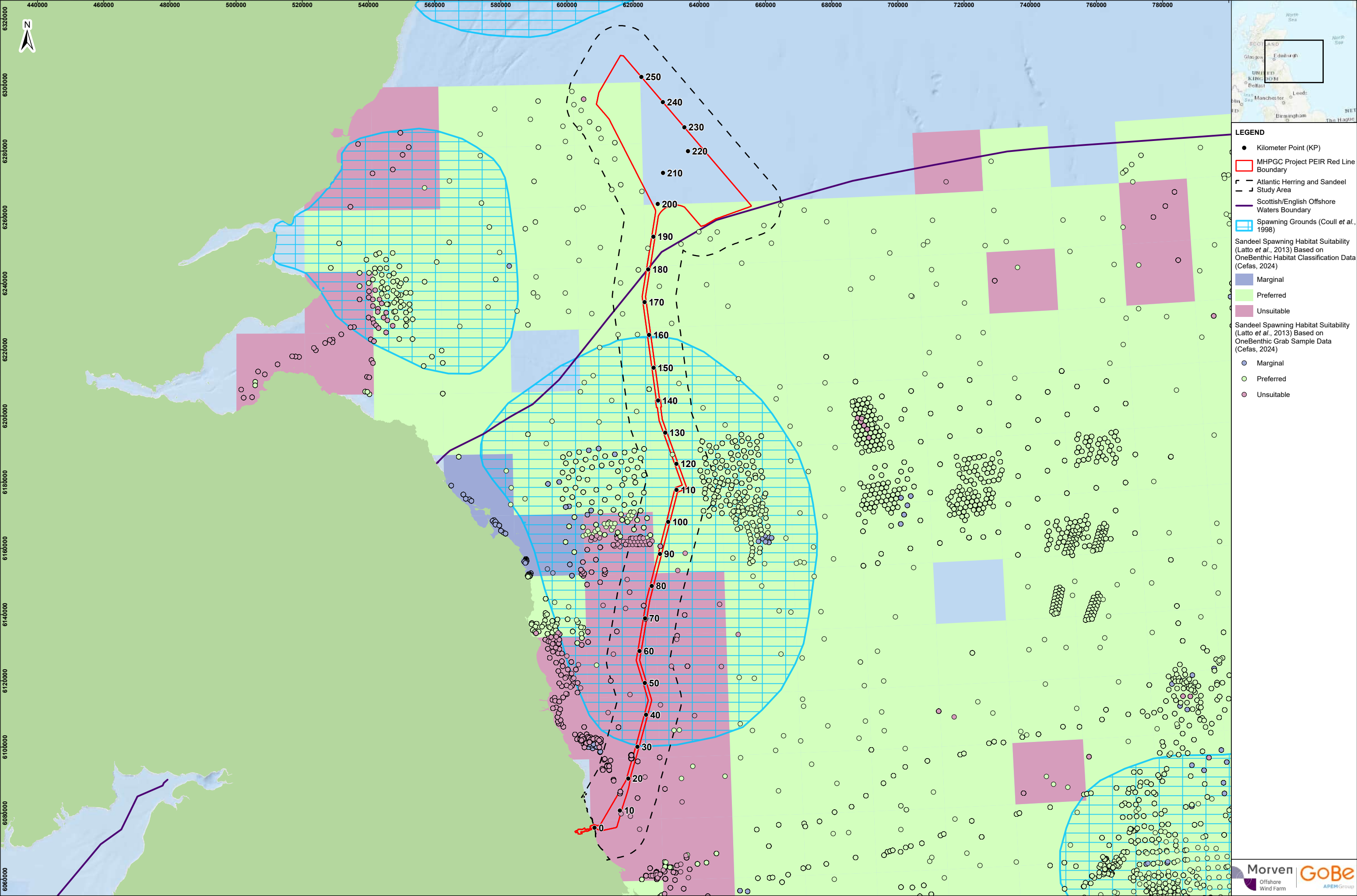
Data Sources:
BP, Ordnance Survey

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

Drawing Number:
FIGURE 4-12

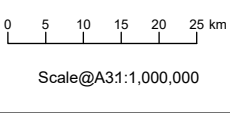
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- 4.2.1.8 Similar to the EMODnet broadscale habitat mapping data, the OneBenthic PSA data (and the associated habitat classification data), show that the majority of the Atlantic Herring and Sandeel Study Area in Scottish waters, including the MHPGC Project PEIR Red Line Boundary, is preferred supporting habitat for sandeel (although data within the northeast section of the Atlantic Herring and Sandeel Study Area is lacking) (**Figure 4-13**). In contrast to the EMODnet broadscale habitat mapping data, no discrete areas of marginal or unsuitable supporting habitat were identified within the MHPGC Project PEIR Red Line Boundary in Scottish waters. These differences are likely attributable to the differing methodologies and spatial resolutions of the datasets, with the OneBenthic habitat classifications derived from PSA data aggregated to larger ICES sub-rectangles, and the mobile and dynamic nature of sediment within the Atlantic Herring and Sandeel Study Area (**Volume 2, Chapter 1: Physical Processes, of the PEIR**).
- 4.2.1.9 Within English waters, similar to the EMODnet broadscale habitat mapping data, the OneBenthic PSA data (and associated habitat classification data), show that the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is suitable supporting habitat in the northern section and unsuitable supporting habitat in the southern section (**Figure 4-13**). Unlike the EMODnet data, no discrete areas of marginal or preferred supporting habitat were indicated within the southern section of the Atlantic Herring and Sandeel Study Area, with the exception of a single datapoint indicating preferred habitat on the southern boundary of the Coull et al. (1998) spawning ground, which overlaps a larger area of preferred habitat identified by the EMODnet data. These differences are likely attributable to the factors described for Scottish waters above.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL SUPPORTING HABITAT SUITABILITY BASED ON ONEBENTHIC DATA
(CEFAS, 2024)



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 4-13				
VER	DATE	DETAILS	BY	CHECK
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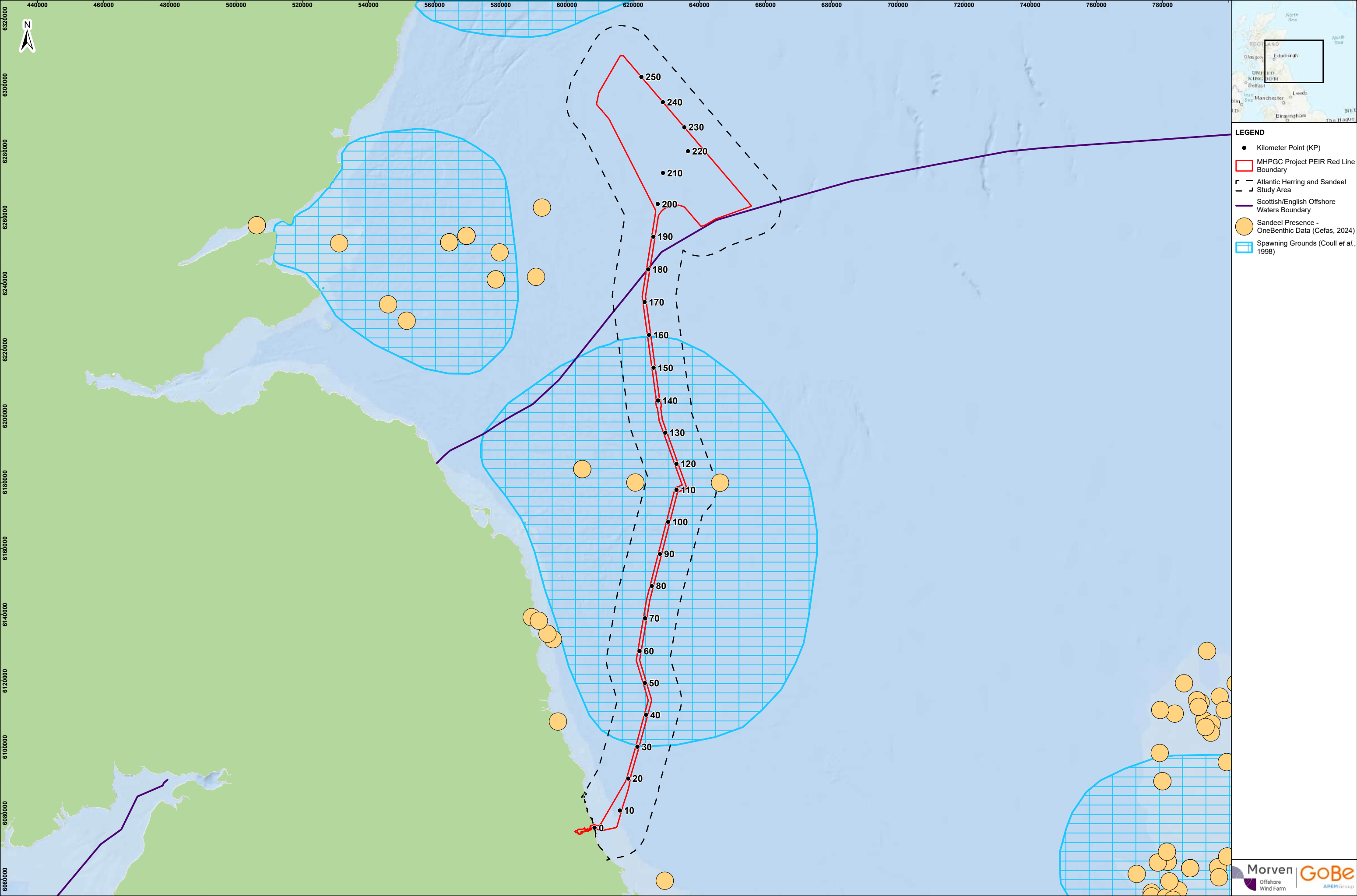
- 4.2.1.10 Taken together, the available evidence suggests that the MHPGC Project PEIR Red Line Boundary is not characterised by extensive areas of high-quality sandeel supporting habitat. Project-specific PSA data indicate that most sediments within the project area are unsuitable for supporting sandeel, with only limited occurrences of suitable or sub-prime habitat identified, primarily within the northern part of the English and Scottish waters of the MHPGC Project PEIR Red Line Boundary, and no prime habitat recorded. Results from the Morven North and Morven South surveys similarly indicate that sediments are predominantly classified as marginal sandeel supporting habitat, with only isolated records of preferred habitat.
- 4.2.1.11 At a broader spatial scale, EMODnet and OneBenthic habitat suitability datasets indicate that large parts of the Atlantic Herring and Sandeel Study Area are associated with sandy sediments that may provide suitable or preferred habitat for sandeel. However, the EMODnet data are broadscale in nature and are intended to characterise regional patterns in seabed sediment distribution, while the OneBenthic habitat classifications are derived from PSA data aggregated to larger ICES sub-rectangles. Consequently, these datasets are not designed to resolve the fine-scale heterogeneity in sediment composition and habitat suitability captured by project-specific surveys. These differences are likely further influenced by the mobile and dynamic nature of sediments within the Atlantic Herring and Sandeel Study Area (**Volume 2, Chapter 1: Physical Processes, of the PEIR**).
- 4.2.1.12 Contrastingly, project-specific PSA data indicates that most sediments within the project area itself are unsuitable for supporting sandeel, with only limited occurrences of suitable or sub-prime habitat identified, primarily within the northern part of the English and Scottish waters, and no prime habitat recorded. Results from the Morven North and Morven South surveys similarly indicate that sediments are predominantly classified as marginal sandeel supporting habitat, with only isolated records of preferred habitat.
- 4.2.1.13 Taken together, the available evidence suggests that the MHPGC Project PEIR Red Line Boundary is not characterised by extensive areas of high-quality sandeel supporting habitat, although areas of supporting habitat may be present within the region.

4.2.2 Ground-truthing of the habitat suitability assessment

- 4.2.2.1 While sediment composition can be used to identify areas that are potentially suitable for sandeel, habitat suitability assessments based on substrate characteristics alone are not a direct indicator of sandeel presence. Consequently, habitat suitability classifications should be considered alongside sandeel occurrence and distribution datasets to provide a more robust understanding of likely habitat use, including sandeel presence records contained within the OneBenthic dataset and the modelled distribution of buried sandeel presented by Langton *et al.* (2021). Together, these datasets provide complementary lines of evidence on both the suitability of habitat and the evidence of sandeel occurrence within the study area.
- 4.2.2.2 In Scottish waters, OneBenthic survey data showing sandeel presence (with no distinction between life stages) showed no records of sandeel within the Atlantic Herring and Sandeel Study Area (**Figure 4-14**). Recorded sandeel occurrences were instead concentrated within the spawning ground (defined by Coull *et al.* (1998)) located southwest of the Atlantic Herring and Sandeel Study Area. Similarly, Langton *et al.* (2021) did not predict sandeel presence within the Atlantic Herring and Sandeel Study Area in Scottish waters. Only low probability (<0.5) of sandeel presence was predicted in the southwest of the Atlantic Herring and Sandeel Study Area, outside of the MHPGC Project PEIR Red Line Boundary (**Figure 4-15**). Areas of high buried sandeel density (up to 120 individuals per m²) and a high probability of buried sandeel presence (>0.5) were largely confined to the spawning ground (defined by Coull *et al.*, (1998)) located southwest of the Atlantic Herring and Sandeel Study Area.
- 4.2.2.3 In English waters, the OneBenthic sandeel presence data showed no sandeel presence points within the Atlantic Herring and Sandeel Study Area (**Figure 4-14**). Three presence records were located within sandeel spawning ground, nearest to KP110, but outside of the Atlantic Herring and Sandeel Study Area, to the east and west. Similarly, Langton *et al.* (2021) did not predict sandeel presence within the Atlantic Herring and Sandeel Study Area. Only a low probability (<0.5) of sandeel presence was predicted within the northern section of the Atlantic Herring and Sandeel Study Area, including within the MHPGC Project PEIR Red Line Boundary (**Figure 4-15**). A further discrete area of low predicted presence probability also occurred within the Atlantic Herring and Sandeel Study Area,

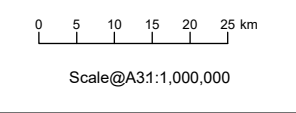
outside the MHPGC Project PEIR Red Line Boundary and relatively close to the landfall location (**Figure 4-15**).

- 4.2.2.4 The sandeel presence datasets broadly support the habitat suitability assessments derived from the EMODnet and OneBenthic datasets. In the southern section of the Atlantic Herring and Sandeel Study Area, in English waters, both habitat datasets identified predominantly unsuitable supporting habitat, consistent with the absence of sandeel presence records. In the northern section, the habitat datasets identified areas of preferred supporting habitat associated with a mapped spawning ground, and the three sandeel presence records occurred within this area. However, these records were restricted to a small part of the spawning ground and were not distributed throughout the wider area of preferred habitat identified by the EMODnet and OneBenthic datasets. This likely reflects the fact that the EMODnet and OneBenthic habitat assessments describe the physical suitability of the seabed based on sediment characteristics alone and do not account for other factors influencing sandeel distribution. In addition, both datasets provide broadscale habitat characterisations and may not capture local-scale variability in sediment characteristics and habitat use.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL PRESENCE (CEFAS, 2024)



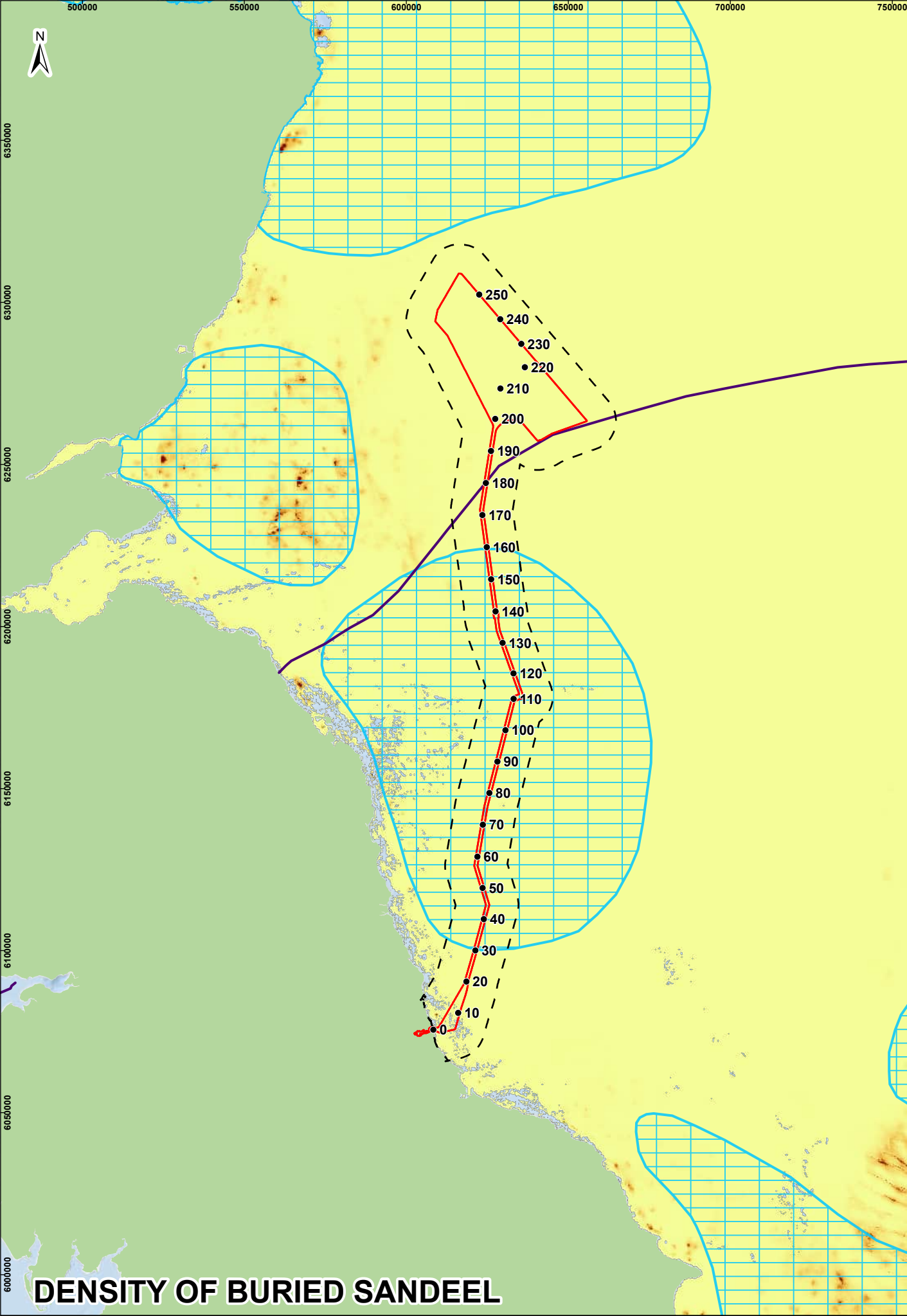
Geodetic Information:
Datum: European 1950
Projection: ED 1950 UTM Zone 30N

Data Sources:
BP, Ordnance Survey

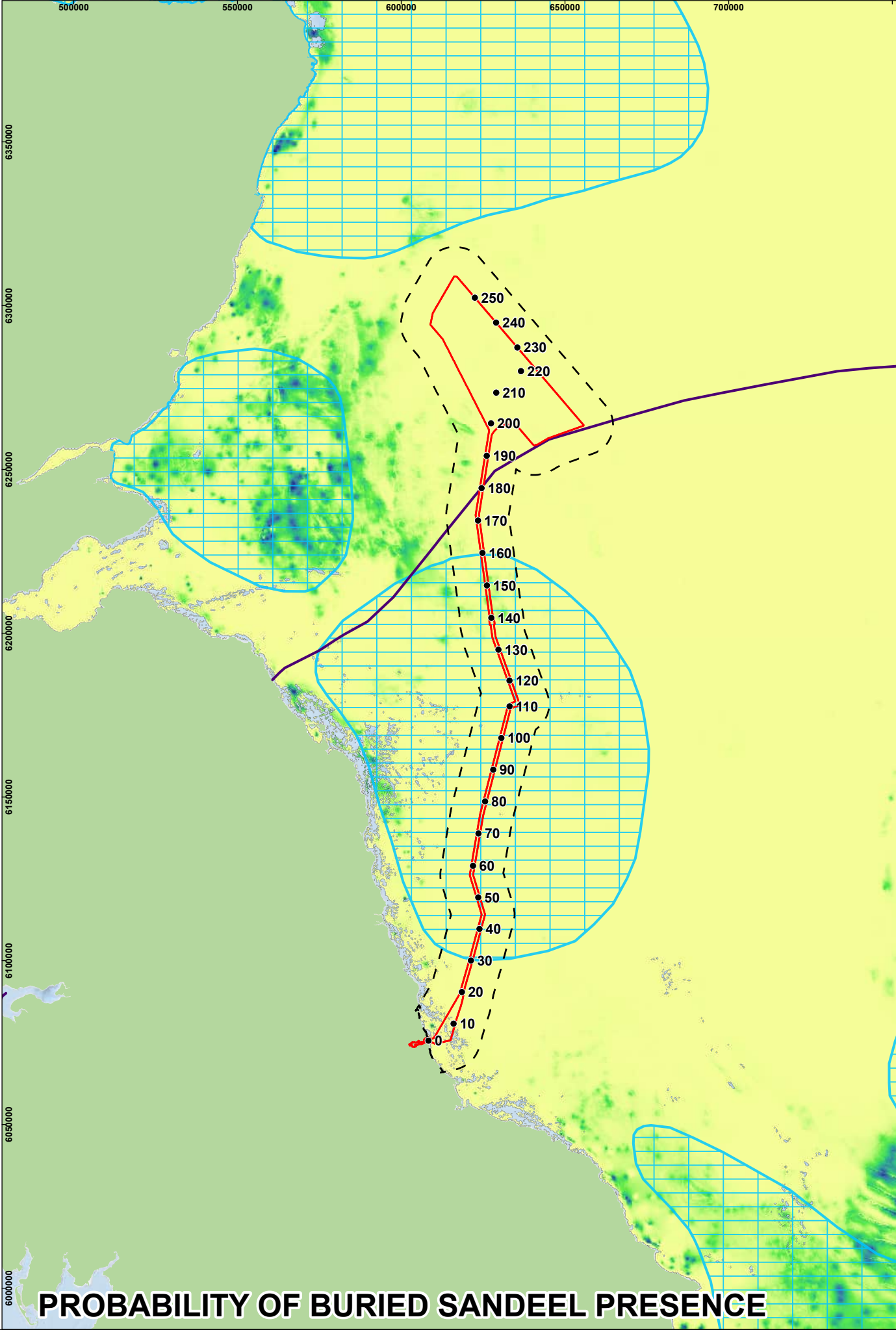
Service Layer Credits:
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number:
FIGURE 4-14

VER	DATE	DETAILS	BY	CHECK
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DENSITY OF BURIED SANDEEL



PROBABILITY OF BURIED SANDEEL PRESENCE



LEGEND

- Kilometer Point (KP)
- MHPGC Project PEIR Red Line Boundary
- ▭ Atlantic Herring and Sandeel Study Area
- ▬ Scottish/English Offshore Waters Boundary
- ▭ Spawning Grounds (Coull et al., 1998)

Density of Buried Sandeel

0 per sq m

120 per sq m or greater

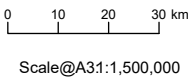
Probability of Buried Sandeel Presence

0 (Less Probable)

1 (More Probable)

Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
DENSITY AND PROBABILITY OF PRESENCE OF BURIED SANDEEL IN THE
ATLANTIC HERRING AND SANDEEL ECOLOGY STUDY AREA (LANGTON *ET AL.*,
2021)



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 4-15				
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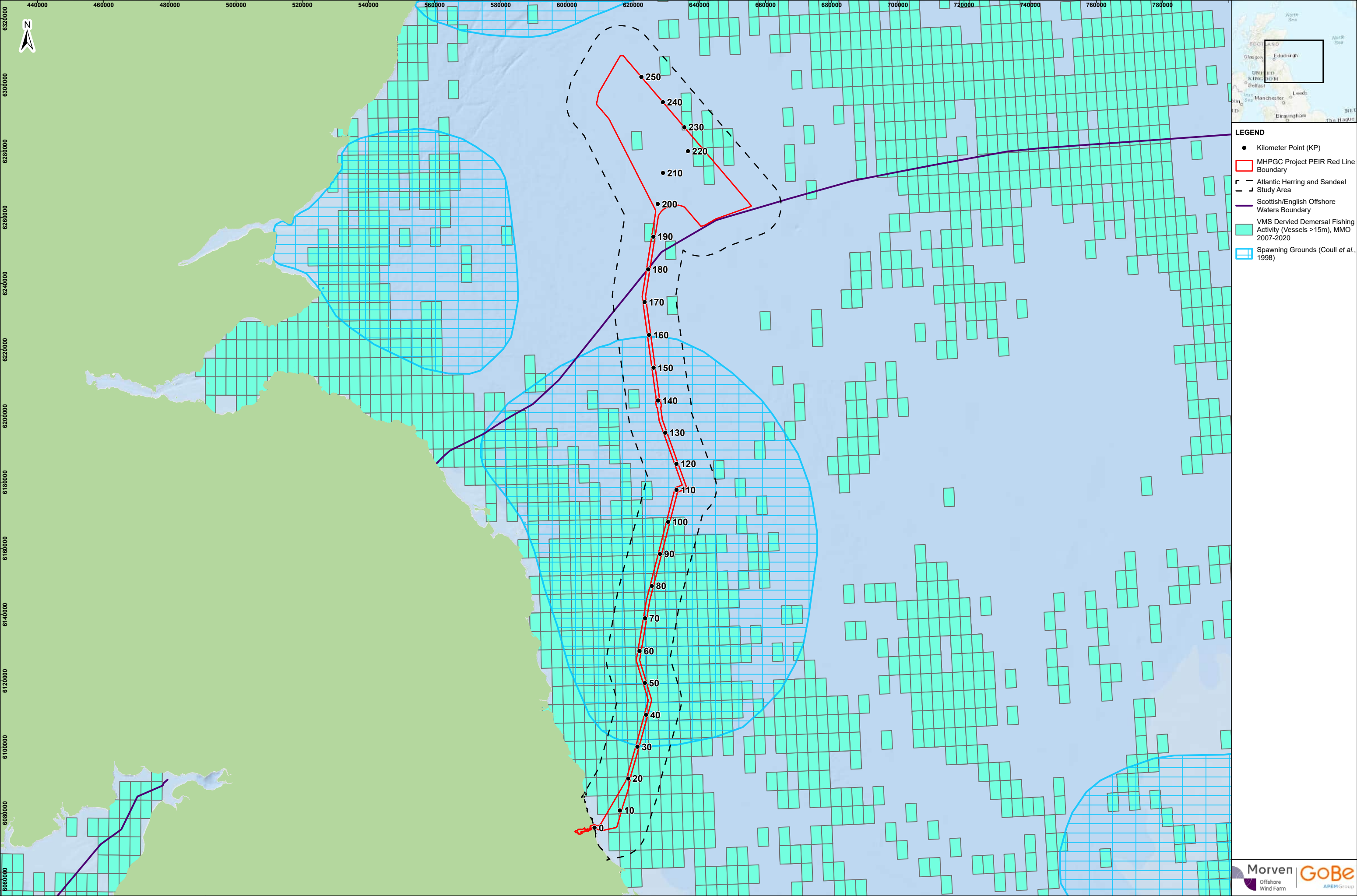
4.2.3 Heat mapping of sandeel spawning potential

- 4.2.3.1 Building on the habitat suitability characterisation derived from the site-specific PSA datasets, EMODnet broadscale habitat mapping and OneBenthic PSA, a heat mapping exercise was undertaken to determine the confidence in sandeel spawning potential across the Atlantic Herring and Sandeel Study Area. The heat mapping combined habitat suitability classifications with additional datasets that provide information on contemporary spawning activity and the potential ecological importance of areas used by sandeel.
- 4.2.3.2 In addition to the habitat suitability datasets described above, the heat mapping incorporates sandeel fishing grounds identified by Wright *et al.* (2019). These fishing grounds are based on ICES-collated information on sandeel fisheries and were refined using habitat information from Jensen *et al.* (2011), which identifies areas with potentially high densities of non-buried sandeel. As such, the mapped fishing grounds are considered representative of important sandeel foraging habitat and provide an additional line of evidence for the presence and persistence of sandeel populations. The heat mapping also incorporates VMS data for demersal fishing activity, which provide a precautionary indicator of areas that may support commercially important demersal fish populations (such as sandeel). These datasets are described below and were used in combination with the habitat suitability classification exercise to determine the overall confidence assigned to sandeel spawning potential within and adjacent to the MHPGC Project PEIR Red Line Boundary, and wider Atlantic Herring and Sandeel Study Area.

Vessel Monitoring System data

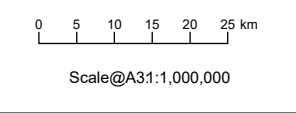
- 4.2.3.3 Demersal fishing activity derived from VMS data is shown in **Figure 4-16**. It is important to note that the demersal fishing gear types included in the VMS data target a range of species and are not specific to sandeel fisheries. Consequently, VMS data cannot be considered a direct indicator of sandeel spawning activity or sandeel presence. Instead, they provide only a very low-confidence and indirect indication that sandeel may be present in areas where demersal fishing activity is taking place. As detailed in **Table 3.1**, the interpretation of VMS data as an indicator of potential sandeel-supporting habitat is further limited by fisheries management measures that have applied to sandeel fisheries throughout much of the dataset period.
- 4.2.3.4 In Scottish waters, the VMS data show that demersal fishing gears are used within the eastern part of the Atlantic Herring and Sandeel Study Area in Scottish waters, including the MHPGC Project PEIR Red Line Boundary (**Figure 4-16**). Smaller concentrations of demersal fishing activity are also evident within the western part of the MHPGC Project PEIR Red Line Boundary and within the southern extent of both the Atlantic Herring and Sandeel Study Area and the MHPGC Project PEIR Red Line Boundary.
- 4.2.3.5 These data are only partially aligned with the other datasets discussed previously for sandeel. In contrast to the VMS data, the EMODnet habitat assessment identified the eastern section of the Atlantic Herring and Sandeel Study Area as comprising habitat that is unsuitable for supporting sandeel. Furthermore, neither the OneBenthic sandeel presence records nor Langton *et al.* (2021) indicated the presence of sandeel within this section of the study area in Scottish waters. However, a discrete area of habitat classified as marginal and preferred for supporting sandeel was identified in the southern part of the Atlantic Herring and Sandeel Study Area in Scottish waters, based on the EMODnet assessment. This area also corresponded with a low predicted probability of sandeel presence (<0.5), which broadly aligns with the pattern of demersal fishing activity indicated by the VMS data.
- 4.2.3.6 In English waters, the majority of the southern extent of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, overlaps with a large, concentrated area of demersal fishing activity. The remainder of the MHPGC Project PEIR Red Line Boundary and Atlantic Herring and Sandeel Study Area within English waters has limited overlap with demersal fishing grounds, with sparsely distributed and discrete areas of demersal gear use present in the northern section of the study area.
- 4.2.3.7 These data do not align with the other datasets discussed previously for sandeel. EMODnet and OneBenthic grab sample and associated habitat assessment data identify the southern section of the Atlantic Herring and Sandeel Study Area as comprising habitat that is unsuitable for supporting sandeel, while OneBenthic sandeel presence data and Langton *et al.* (2021) do not indicate the

presence of sandeel within this area. This discrepancy is likely because VMS data indicate the use of demersal fishing gears in general rather than targeted sandeel fishing.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
VESSEL MONITORING SYSTEMS (VMS) DATA OF DEMERSAL FISHING GEAR



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

Data Sources:
BP, Ordnance Survey

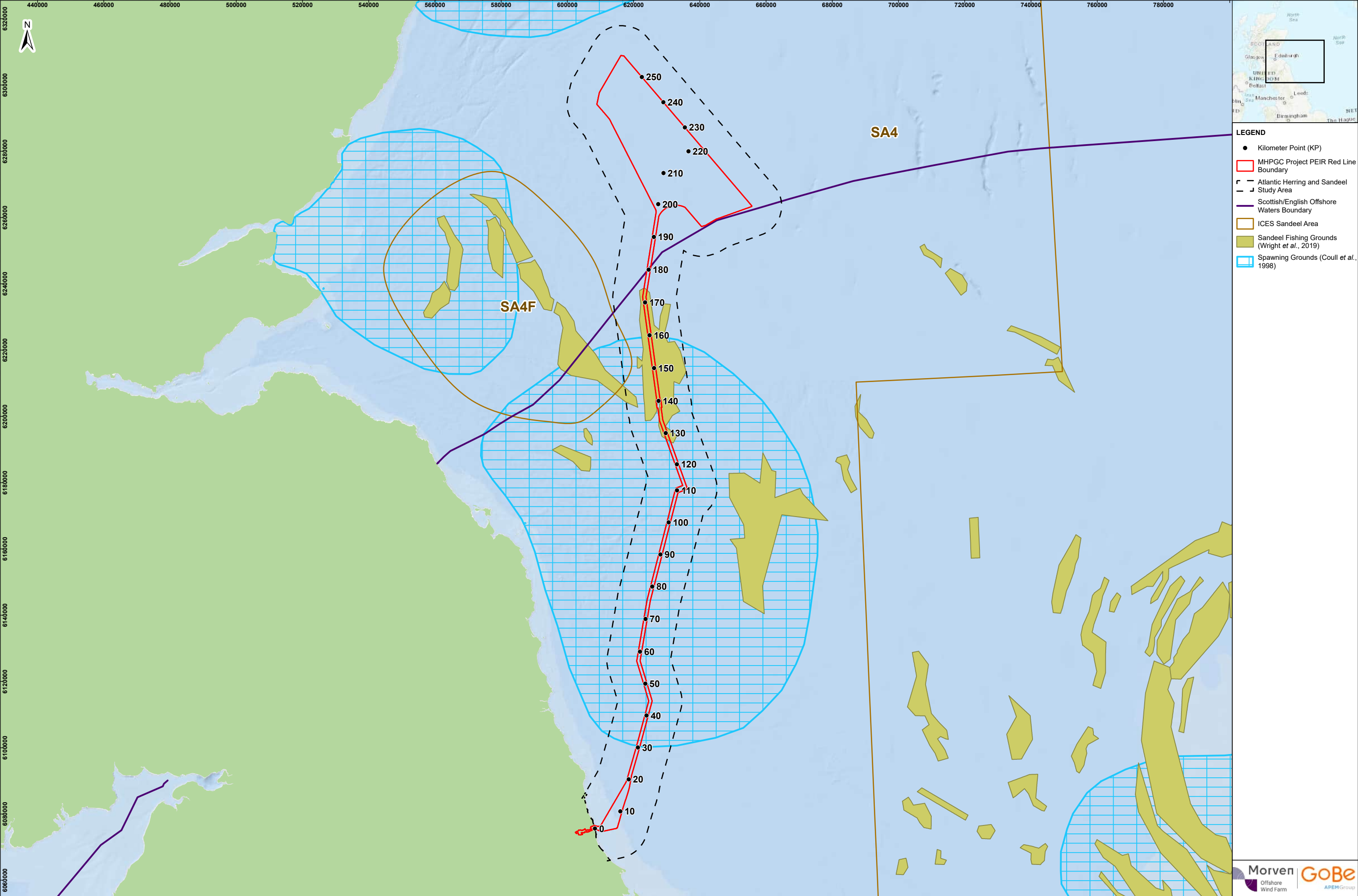
Service Layer Credits:
World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
World Ocean Base: OceanWise, Esri, GEBCO, Garmin, NaturalVue

Drawing Number:
FIGURE 4-16

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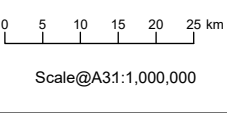
Fishing grounds (Wright et al., 2019)

- 4.2.3.8 Since 2011, sandeel stocks in the North Sea have been split into separate management areas for assessment purposes (Marine Scotland, 2020). The MHPGC Project falls within the ICES Sandeel Area 4, which is the largest of the sandeel stocks in Scottish waters.
- 4.2.3.9 Since early 2024, sandeel fishing in all Scottish and English waters of the North Sea, including within ICES Sandeel Area 4, has been prohibited to allow the sandeel population to replenish following over-exploitation (ICES, 2026).
- 4.2.3.10 Prior to the introduction of this ban, several recognised sandeel fishing grounds were present throughout the North Sea, including within ICES Sandeel Area 4. The ICES sandeel areas and fisheries information are collated and refined by Wright *et al.* (2019). These data provide a spatially resolved representation of sandeel habitat and fishing grounds in the North Sea and are supported by evidence on sandeel habitat preferences presented by Jensen *et al.* (2011).
- 4.2.3.11 In Scottish waters, no sandeel fishing grounds identified by Wright *et al.* (2019) occur within the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary (**Figure 4-17**). This broadly aligns with the limited evidence of sandeel-supporting habitat and sandeel presence within Scottish waters identified by all other datasets discussed previously. The lack of alignment with the VMS data is likely because the VMS dataset reflects the use of demersal fishing gears more generally and does not specifically represent fishing activity targeting sandeel.
- 4.2.3.12 In English waters, sandeel fishing grounds are present within the northern section of the Atlantic Herring and Sandeel Study Area, including within the MHPGC Project PEIR Red Line Boundary, but are absent from the southern section (**Figure 4-17**). The location of these fishing grounds broadly corresponds with the identified distribution of sandeel spawning grounds, areas classified as preferred habitat by the EMODnet and OneBenthic grab sample and associated habitat classification datasets, and areas of low predicted probability of buried sandeel presence identified by Langton *et al.* (2021). While overlap with the VMS data is limited, evidence of discrete areas of demersal gear use was identified in close proximity to these fishing grounds.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL FISHING GROUNDS AND ICES SANDEEL AREAS (WRIGHT *ET AL.*, 2019)



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

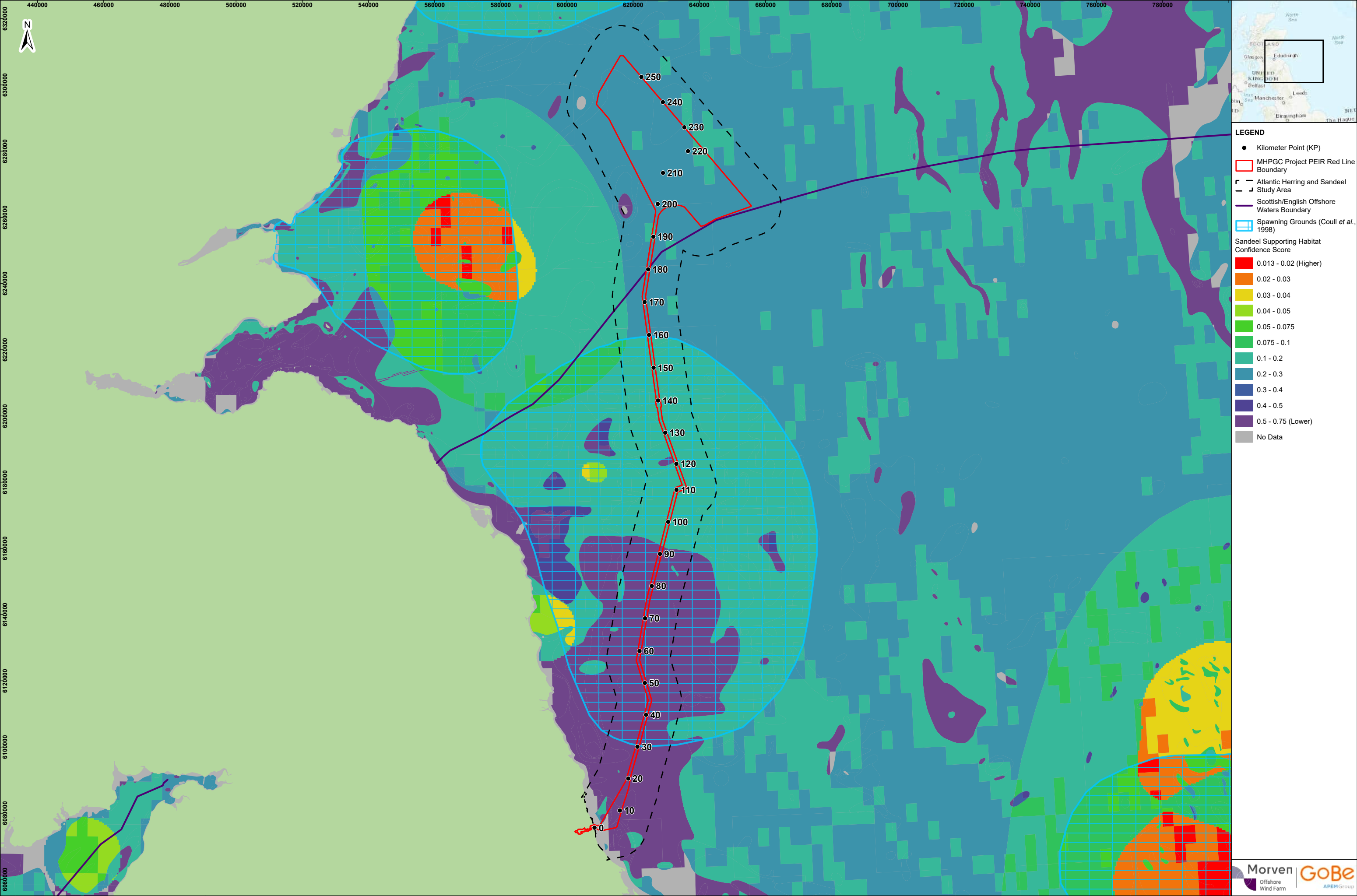
Data Sources:
BP, Ordnance Survey

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

Drawing Number:				
FIGURE 4-17				
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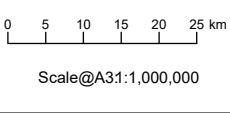
Sandeel spawning potential confidence assessment

- 4.2.3.13 The sandeel supporting habitat confidence heat map is presented in **Figure 4-18**. The heat map was developed following the methodology described by Reach *et al.* (2024), which combines multiple habitat suitability classifications derived from the EMODnet seabed substrate dataset with additional datasets that provide evidence of known sandeel distribution and habitat use. These included historical sandeel spawning grounds identified by Coull *et al.* (1998), sandeel fishing grounds defined by Wright *et al.* (2019), OneBenthic sandeel presence records (Cefas, 2024b) and VMS-derived fishing activity data for vessels greater than 15m. Each dataset was assigned a confidence score based on the quality of the evidence and its relevance as an indicator of sandeel habitat use. The confidence scores assigned to each dataset are provided in **Table 3.5**. The resulting heat map therefore reflects the combined contribution of habitat suitability, historical spawning ground information, sandeel occurrence records, recognised sandeel fishing grounds and fishing activity data.
- 4.2.3.14 In Scottish waters, there was limited evidence that the Atlantic Herring and Sandeel Study Area provides suitable supporting habitat for sandeel beyond the presence of suitable sandy substrate. Consequently, the majority of the area was assigned confidence scores ranging from 0.2 to 0.3 (shown in blue) (**Figure 4-18**). Higher confidence scores of 0.1 to 0.2 (shown in green) were assigned to discrete areas in the northeast and south of the Atlantic Herring and Sandeel Study Area that overlap the MHPGC Project PEIR Red Line Boundary, as well as an area within the west section of the MHPHC Project PEIR Red Line Boundary, where evidence of demersal fishing activity was present (**Figure 4-18**). The highest confidence scores, ranging from 0.13 to 0.4, were assigned to an area approximately 25km northwest of the Atlantic Herring and Sandeel Study Area, within spawning grounds identified by Coull *et al.* (1998).
- 4.2.3.15 In English waters, the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, was dominated by sandy substrates that provide suitable supporting habitat for sandeel. However, the other datasets informing the heatmap collectively provided limited evidence of sandeel presence, and consequently, the area was assigned confidence scores ranging from 0.1 to 0.75 (shown as purple, blue and green areas) (**Figure 4-18**). Higher confidence scores within this range were assigned to parts of the Atlantic Herring and Sandeel Study Area that overlaps with the spawning grounds identified by Coull *et al.* (1998). Overall, the highest confidence scores occurred outside of the Atlantic Herring and Sandeel Study Area, ranging from 0.03 to 0.04 (shown in yellow) in two discrete areas to the west, where suitable sediment was similarly identified within spawning grounds identified by Coull *et al.* (1998). Particularly high confidence scores of 0.013 to 0.03 were also assigned to an area of spawning ground approximately 125km to the southeast of the Atlantic Herring and Sandeel Study Area.
- 4.2.3.16 Overall, the heat mapping outputs indicate that the majority of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is characterised by lower-confidence sandeel supporting habitat, reflecting limited evidence of sandeel presence. Areas of higher-confidence supporting habitat within the Atlantic Herring and Sandeel Study Area are largely restricted to locations where there is overlap with spawning grounds identified by Coull *et al.* (1998) and where evidence of demersal fishing exists. However, the highest-confidence supporting habitat is generally associated with areas outside of the Atlantic Herring and Sandeel Study Area, where suitable substrate overlaps with historical spawning grounds.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
SANDEEL SUPPORTING HABITAT CONFIDENCE HEATMAP



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 4-18				
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5 Summary

- 5.1.1.1 This section summarises the findings of the Atlantic herring and sandeel assessments undertaken for the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary. The conclusions are based on the collective evidence from habitat suitability assessments, species occurrence and distribution datasets, historical spawning ground records, larval abundance data and habitat confidence mapping, as applicable to each receptor.

5.2 Atlantic herring

5.2.1 Scottish waters

- 5.2.1.1 The assessed datasets indicate that the Scottish section of the Atlantic Herring and Sandeel Study Area, including the MHPGC Project PEIR Red Line Boundary, is of limited importance for Atlantic herring spawning. The predominance of unsuitable spawning habitat and generally low larval abundances recorded within the study area indicate limited evidence of active spawning within the Atlantic Herring and Sandeel Study Area.

5.2.2 English waters

- 5.2.2.1 Small areas of potentially suitable Atlantic herring spawning habitat occur within the English section of the Atlantic Herring and Sandeel Study Area; however, available evidence indicates that spawning activity is limited and that more important spawning areas occur elsewhere in the region. Taken together, the available evidence indicates that the Atlantic Herring and Sandeel Study Area is not likely to represent a regionally important Atlantic herring spawning area, with the highest confidence spawning habitats occurring outside of the Atlantic Herring and Sandeel Study Area.

5.3 Sandeel

5.3.1 Scottish waters

- 5.3.1.1 While some datasets indicate the presence of potentially suitable sandeel-supporting habitat within Scottish waters, evidence of sandeel occurrence and use of the Atlantic Herring and Sandeel Study Area is limited. An area of suitable sandeel-supporting habitat has been identified southwest of the MHPGC Project PEIR Red Line Boundary in Scottish Waters, located over 25km outside of the Atlantic Herring and Sandeel Study Area at the nearest point. Overall, the assessed datasets indicate that the Atlantic Herring and Sandeel Study Area is unlikely to represent an area of key importance for sandeel.

5.3.2 English waters

- 5.3.2.1 Within English waters, the northern section of the Atlantic Herring and Sandeel Study Area contains the greatest potential to support sandeel, whereas the southern section is generally unsuitable. Although evidence suggests that parts of the northern section may provide supporting habitat, the Atlantic Herring and Sandeel Study Area forms part of a much larger area of similar habitat within the North Sea and is unlikely to comprise particularly important sandeel-supporting habitat within the wider northern and central North Sea region. Overall, the combined habitat suitability, occurrence and heat mapping assessments indicate that the Atlantic Herring and Sandeel Study Area is of relatively limited importance for sandeel, with only localised areas of potential supporting habitat identified and little evidence of contemporary sandeel presence across the wider study area.

6 References

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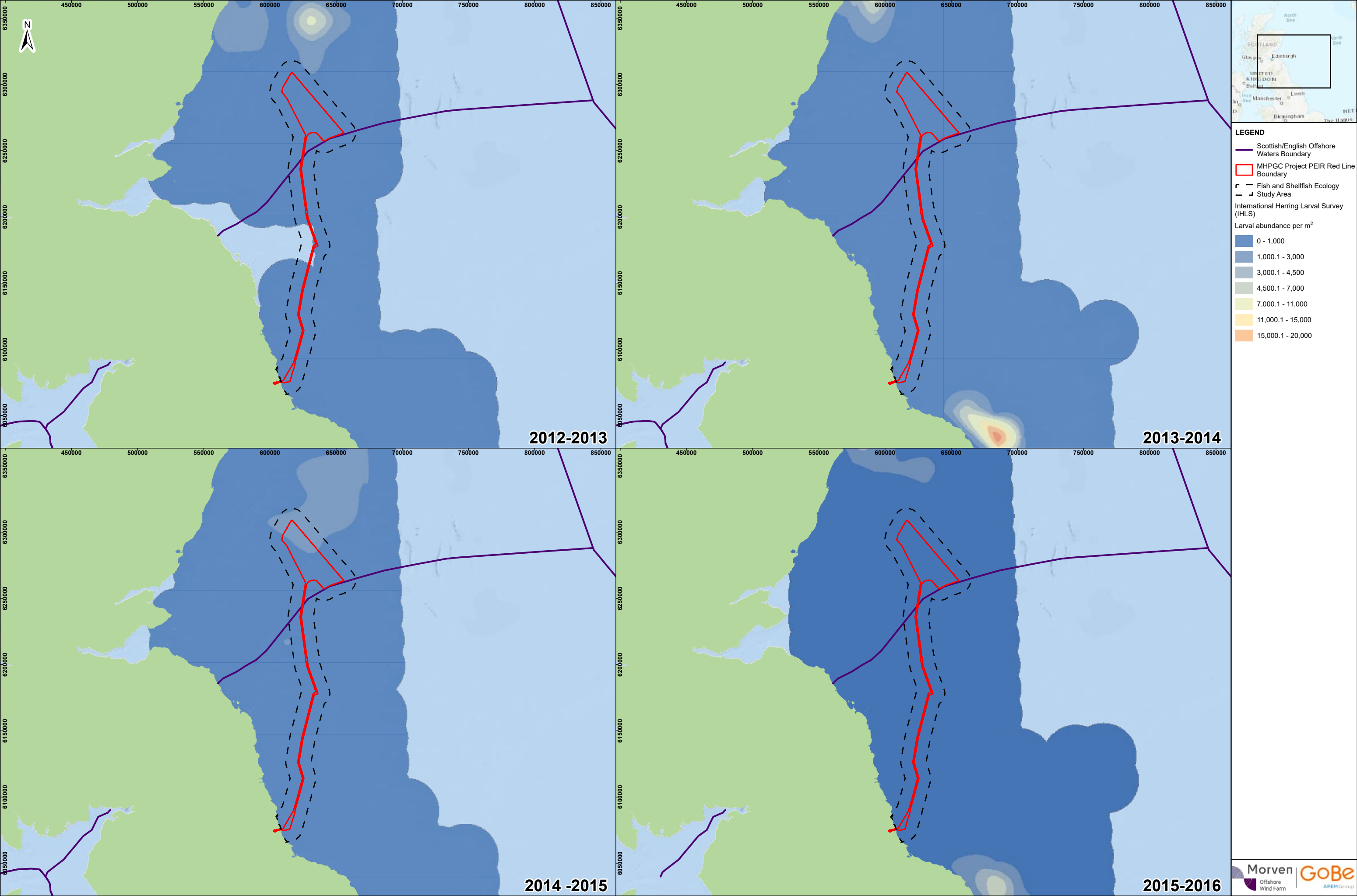
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Appendix A Indicative Atlantic Herring Spawning Data

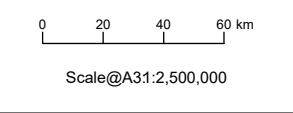
A.1 Indicative Atlantic Herring Spawning Data

To complement the cumulative larval density figures presented for the 10-year period in this Herring and Sandeel Assessment report (see **Figure 4-6**) and in Volume 2, Chapter 4, Fish and Shellfish Ecology (see **Figure 4-12**), the IHLS data have also been presented by individual survey year (**Figure A-1** to **Figure A-3**). These figures are provided for completeness and to support interpretation of interannual variability in larval density and distribution patterns.



Project Name:
MORVEN HAWTHORN PIT GRID
CONNECTION PROJECT

Drawing Title:
INDICATIVE ATLANTIC HERRING SPAWNING GROUND BASED ON IHLS MAPPING
DATA (ICES 2012/13 TO 2015/16)



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 A-1				
VER	DATE	DETAILS	BY	CHECK
00	26/08/2025	Initial Issue	GB	KD
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