FIVE ESTUARIES
OFFSHORE WIND FARM

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ENVIRONMENTAL STATEMENT

VOLUME 6, PART 5, ANNEX 6.1: FISH AND SHELLFISH ECOLOGY TECHNICAL BASELINE REPORT

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Project	Five Estuaries Offshore Wind Farm
Sub-Project or Package	Environmental Statement
Document Title	Volume 6, Part 5, Annex 6.1: Fish and Shellfish Ecology Technical Baseline Report
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FIGURES

GLOSSARY OF TERMS

Term	Definition
Array areas	The areas where the wind turbines will be located
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement.
Export cables	Cables that transfer power from the offshore substation(s) or the converter station(s) to shore.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Five Estuaries array area to the proposed substation areas, within which the export cables will be located.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial, resulting from the activities associated with the construction, operation and maintenance, or decommissioning of the project.
Maximum design scenario (MDS)	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Report to Inform Appropriate Assessment	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Subtidal	The region of shallow waters which are below the level of low tide.
Wind turbine	All of the components of a wind turbine, including the tower, nacelle, and rotor.
Wind turbine foundation	The wind turbines are attached to the seabed with a foundation structure typically fabricated from steel or concrete.

DEFINITION OF ACRONYMS

Term	Definition
BAP	Biodiversity Action Plan
BNA	Bass Nursery Area
Cefas	Centre for Environment, Fisheries and Aquaculture
CMACS	Centre for Marine and Coastal Studies Ltd
CPA	Coast Protection Act
DCO	Development Consent Order
Defra	Department for Environment, Food & Rural Affairs
EC	European Commission
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIFCA	Eastern Inshore Fisheries & Conservation Authority
EMF	Electromagnetic Fields
ES	Environmental Statement
ETG	Expert Topic Group
GGOWL	Greater Gabbard Offshore Winds Limited
ICES	International Council for the Exploration of the Sea
IHLS	International Herring Larvae Surveys
JNCC	Joint Nature Conservation Committee
KEIFCA	Kent and Essex Inshore Fisheries & Conservation Authority
LPUE	Landings per unit effort
MCZ	Marine Conservation Zone
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MSC	Marine Stewardship Council
MW	Megawatt
NPS	National Policy Statement
NSIBTS	North Sea International Bottom Trawl Surveys
O&M	Operation and Maintenance
OWF	Offshore Wind Farm
NSIP	Nationally Significant Infrastructure Project

Term	Definition
PINS	Planning Inspectorate
PSA	Particle Size Analysis
RIAA	Report to Inform Appropriate Assessment
SEL	Sound Exposure Level
SOS	Secretary of State
SSCs	Suspended Sediment Concentrations
TAC	Total Allowable Catch
VE	Five Estuaries Offshore Wind Farm
VER	Valued Ecological Receptor
ZOI	Zone of Influence

1 INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 The Five Estuaries (VE) Offshore Wind Farm (OWF) is a proposed extension to the operational Galloper Offshore Wind Farm, which is located 37 km off the coast of Suffolk, England, at its nearest point.

1.2 PURPOSE AND STRUCTURE OF THIS DOCUMENT

1.2.1 The primary purpose of this report is to provide a contemporary and comprehensive analysis of site-specific and regional fish and shellfish ecology data within the study area and potential Zones of Influence (ZOI) defined for VE.

1.2.2 This report provides the technical baseline for fish (both pelagic and demersal, including elasmobranch species) and shellfish (molluscs and crustaceans) ecology within the VE site boundary as well as the wider surrounding area.

1.2.3 The remainder of this document is structured in the following way:

- Definition of the proposed study area;
- Outline of data sources used to inform the characterisation;
- A review of the baseline (existing) conditions of the array and the offshore Export Cable Corridor (ECC);
- Discussion; and
- Conclusion.

1.2.4 It is important to note that this document will accompany Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology and should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology and the Benthic Ecology and Subtidal Characterisation Reports (Volume 6, Part 5, Annex 5.1 and Volume 6, Part 5, Annex 5.2) with regards to the Particle Size Analysis (PSA), as submitted as part of the Environmental Statement (ES).

2 SCOPE AND METHODOLOGY

2.1 OVERVIEW

2.1.1 This report provides a baseline characterisation of the existing environment as it relates to fish and shellfish ecology, collating the data sources gathered in order to provide a complete picture of the condition of the baseline environment for the purposes of carrying out an Environmental Impact Assessment (EIA). This report accompanies Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.

2.1.2 During pre-scoping consultation, the collection of fish abundance data were requested by Natural England, to provide site-specific data to inform the VE fish and shellfish baseline characterisation. VE OWFL (Offshore Wind Farm Limited) consider the data available from existing literature and relevant surveys to deliver an appropriate evidence base for fish and shellfish populations within the VE study area, which is sufficient and robust for the purposes of EIA.

2.1.3 It is considered that there is very limited value in undertaking additional surveys for the purposes of informing the baseline, or the subsequent assessment. Such surveys provide solely a temporal snapshot of species, limited to those species that have been successfully sampled by the trawl at a distinct point in time; the utility of such data principally being to confirm that the survey data aligns with the wider regional data drawn from the existing datasets. It is also worth highlighting that should species not be recorded in a site specific survey, the outcome is not then to exclude consideration of these species from the characterisation of assessment process – rather, the baseline description and EIA draws upon (or defaults to) the wider literature, as this provides a more thorough, robust, and longer time series evidence base, which therefore ensures a more comprehensive and indeed precautionary baseline to be derived for the purposes of EIA. The species list derived from such data provides a broader list of receptors for assessment with greater certainty that all species present have been captured compared with a series of snapshot surveys. Additionally, it is also notable that site-specific surveys would be highly unlikely to identify any additional receptor species that are not already recorded in the extensive (both spatially and temporally) data that is available and which will be used for the EIA of the proposed VE project. It is therefore considered that additional survey data would add limited value to the characterisation of the area and, importantly, would not materially alter the findings of the EIA.

2.1.4 Baseline characterisation data on fish and shellfish resources were gathered through a desktop study collating site-specific data collected within the VE array areas and ECC, regional datasets and industry specific monitoring undertaken for a number of regional offshore wind farms.

2.1.5 The following aspects are considered for fish and shellfish resource in the area:

- Spawning grounds;
- Nursery grounds;
- Feeding grounds;
- Overwintering areas for crustaceans; and
- Migration routes.

2.2 STUDY AREA

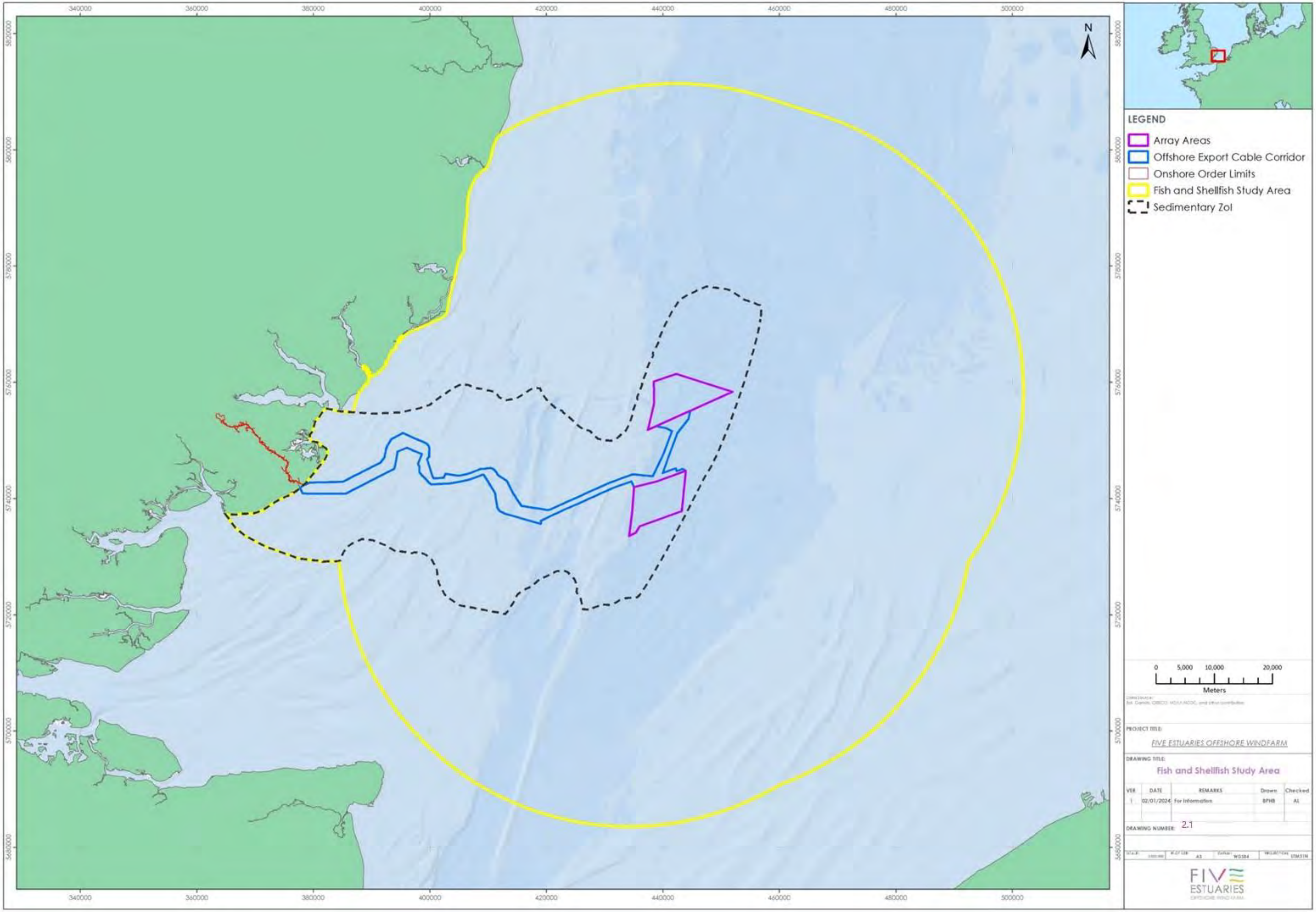
2.2.1 The fish and shellfish ecology study area is dynamic, in that it varies according to the nature of the impact being studied. The study area is therefore defined by the furthest reaching ZOI. Based on experience from recent offshore wind farm projects, the largest ZOI is anticipated to relate to underwater noise from piling in the array areas. The exact extents over which noise effect thresholds will be reached has been determined through detailed underwater noise modelling, based on the maximum design scenario (MDS) and relates to the greatest spatial, and greatest temporal effects. The maximum impact range from underwater noise will be up to 39 km from the array areas. The maximum impacts from sheet piling at landfall will be up to 160 meters from the source. To ensure a precautionary approach, the ZOI for underwater noise and therefore the study area has been informed by impact ranges for the 186 dB re 1 µPa2 s Sound Exposure Level (SEL) for recent UK offshore wind farm applications.

2.2.2 Until recently, fish were assumed to flee the noise stimulus at a rate of 1.5 m/s, however recent projects (RWE, 2022; Equinor, 2022; Ørsted, 2021; Vattenfall, 2019) have been advised to also consider stationary receptor modelling for some species groups. The maximum impact ranges for both stationary (e.g., spawning herring *Clupea harengus*) and fleeing receptors from recent OWF applications have been presented in Table 2.1 below. Taking the maximum impact ranges as informed by underwater noise modelling for recent offshore wind farm projects, a 50 km ZOI for underwater noise impacts from the array area is deemed suitably precautionary for VE. Sheet piling at landfall is anticipated to result in localised impacts ranges which will be will be encapsulated within the Order Limits.

Table 2.1: Maximum impact ranges for fleeing and stationary receptors from recent OWF applications

Project	Maximum impact range for a fleeing receptor	Maximum impact range for a stationary receptor
Awel y Môr OWF (RWE, 2022)	17 km	36 km
Sheringham Shoal and Dudgeon OWF Extension Projects (Equinor, 2022)	10 km	19 km
Hornsea Four OWF (Ørsted, 2021)	26 km	38 km
Norfolk Boreas (Vattenfall, 2019)	6.5 km	18 km

2.2.3 The largest ZOI from activities within the ECC would result from increased suspended sediment concentrations (SSCs) and associated sediment deposition and smothering from foundation and cable installation works and seabed preparation works. The 'Sedimentary ZOI' is based on the mean spring tidal excursion buffer of the site, which represents the expected maximum distance that suspended sediments may be transported on a mean spring tide in a flood and/or ebb direction (although the majority of suspended sediment are expected to be deposited much closer to the disturbance activity). It should be noted that the underwater noise ZOI largely subsumes the Sedimentary ZOI, therefore for the purposes of the baseline characterisation of the existing environment the two ZOIs have been merged to create a study area representing the largest potential ZOI. The study area is shown in Figure 2.1 below.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Onshore Order Limits
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Meters
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FIVE ESTUARIES OFFSHORE WINDFARM
DRAWING TITLE:
Fish and Shellfish Study Area
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1 02/01/2024 For Information BPHB AL
DRAWING NUMBER: 2.1
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2.3 DATA SOURCES

2.3.1 A detailed desktop review was carried out to establish the baseline information available on fish and shellfish populations in the study area for VE. Information was collated to identify fish and shellfish ecology in general and on spawning and nursery activity. The baseline characterisation utilises a broad combination of datasets and provides a robust temporal analysis and validation of the site-specific monitoring datasets and regional monitoring datasets.

2.3.2 Data to support the baseline characterization of the VE study area was utilised from the sources listed in Table 2.2 below.

Table 2.2: Data sources used to inform the VE baseline characterisation.

Data Source	Data Summary	Spatial Coverage	Temporal Coverage
Environmental Statements, and pre- and post-construction monitoring reports from other Offshore Wind Farm (OWF) developments within the defined study area: > Gunfleet Sands OWF > Galloper OWF > Greater Gabbard OWF > London Array OWF > North Falls OWF.	Site specific fish and shellfish surveys for OWF Projects in the area. Used to provide a fish and shellfish ecology characterisation taken from previous OWF project surveys of the area.	Specific to OWF project locations.	2007-2014
British Geological Survey (BGS) Seabed Sediment datasets (BGS, 2015)	PSA data presented to provide an indication on the location of suitable habitat and spawning grounds for sandeel Ammodytidae and herring.	Coverage across UK waters, full coverage of the study area.	2015
EUSea Map broadscale marine habitat data (2021)	Broadscale marine habitat data presented to provide an indication on the location of suitable habitat and spawning grounds for sandeel and herring.	Coverage across UK waters, full coverage of the study area.	2021

Data Source	Data Summary	Spatial Coverage	Temporal Coverage
Marine Management Organisation (MMO) UK Sea Fisheries Monthly Reports and Annual Statistics Reports.	Commercial fisheries specific data (national and regional coverage). Used to provide data related to fisheries landings and fishing effort within the area.	Coverage across UK waters, full coverage of the study area.	2020-2022
Department of Environment Food and Rural Affairs (Defra) spawning and nursery maps for mobile species considered to be of conservation importance (Ellis *et al.*, 2012).	Spawning and nursery ground maps for fish and shellfish species in the area. Used to assess the presence of spawning and nursery ground located within the area.	Coverage across UK waters, full coverage of the study area.	2012
Fisheries Sensitivity Maps in British Waters (Coull *et al.*, 1998)			1998
Screening spatial interactions between marine aggregate application areas and sandeel habitat (Latto *et al.*, 2013)	Methodologies used to identify preferred spawning habitats of herring and sandeel within the VE study area (methodologies detailed by MarineSpace (2013a,b) are adapted from Reach *et al*. (2013) and Latto *et al*. (2013).		
Screening Spatial Interactions between Marine Aggregate Application Areas and Atlantic Herring Potential Spawning Areas (Reach *et al.*, 2013)			
Environmental Effect Pathways between Marine Aggregate Application Areas and Atlantic Herring Potential Spawning Habitat (MarineSpace, 2013a)			

Data Source	Data Summary	Spatial Coverage	Temporal Coverage
Environmental Effect Pathways between Marine Aggregate Application Areas and Sandeel Habitat: Regional Cumulative Impact Assessments (MarineSpace, 2013b)			
The International Herring Larval Survey (IHLS) data (International Council for the Exploration of the Sea (ICES), 2007-2020).	Time-series acoustic data on herring distribution used to characterise the herring populations throughout European seas.	Coverage across the UK, full coverage of the study area.	2007-2020
ICES Beam Trawl Survey data (2020-2020) (ICES Database on Trawl Surveys (DATRAS), 2023a)	Time-series beam trawl survey data collected throughout the North Sea, used to characterise the fish assemblages.	Coverage across the UK, within VE study area.	2010-2020
ICES North Sea International Bottom Trawl Survey (NSIBTS) data (ICES, 1965-2022) (ICES DATRAS, 2023b)	Time-series groundfish survey data collected throughout European seas used to characterise the fish assemblages.	Coverage across the UK, within VE study area annual trawls undertaken south of the VE array areas.	2010-2020
Centre for Environment, Fisheries and Aquaculture (Cefas) Young Fish Survey data (Burt *et al.*, 2019)	Time-series beam trawl survey data in inshore areas around the British Isles.	Trawls undertaken within inshore locations of VE study area.	1981 to 2010
Cefas Blackwater Herring Surveys (Cefas, 1989-2009)	Trawls undertaken across the Thames estuary to assess the status of the Blackwater herring stocks.	Coverage of the Thames Estuary. Partial coverage of the inshore waters of the southwestern extent of the study area.	1989 to 2009
Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) Thames Estuary Cockle Survey Report (Haupt, 2022).	Used to assess the status of commercially important fish stocks within the area.	Coverage of the Thames Estuary. Partial coverage of the inshore waters of the southwestern extent of the study area.	2022

Data Source	Data Summary	Spatial Coverage	Temporal Coverage
KEIFCA Oyster Survey Report (Dyer, 2019)		Coverage of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ). Coverage of discrete area in western extent of study area, to the south of the ECC.	2019
Eastern Inshore Fisheries and Conservation Authority (EIFCA) Whelk Technical Summary Report – Review of whelk permit Conditions (EIFCA, 2020).		Coverage of the eastern IFCA. Partial coverage of inshore waters within northern extent of the study area.	2020
The Outer Thames Estuary Regional Environmental Characterisation (The Marine Aggregate Levy Sustainability Fund (MALSF), 2009).	Used to characterise fisheries activity in the Outer Thames Estuary.	Coverage of inshore areas of the study area, partial nearshore coverage of the VE ECC.	2007-2008
Information on species of conservation interest (Joint Nature Conservation Committee (JNCC), 2007).	Used to characterise specific native species of conservation interest within the area.	Coverage across UK waters, full coverage of the study area.	2007
ICES Fish Map (ICES, 2006).	Used to characterise the species located within and around the study area.	Coverage across UK waters, full coverage of the study area.	2006
Thames bass trawl survey (Walmsley, 2006)	Regional survey data for sea bass *Dicentrarchus labrax*.	Coverage of the Thames Estuary. Partial coverage of the inshore waters of the southwestern extent of the study area.	2006
Thames Herring Survey (Walmsley, 2007)	Regional survey data for herring.		2007

Data Source	Data Summary	Spatial Coverage	Temporal Coverage
Regional Seabed Monitoring Programme (RSMP) (Cooper and Barry, 2017) (data obtained from the One Benthic baseline tool[1])	The dataset comprises of 33,198 macrofaunal samples (83% with associated data on sediment particle size composition) covering large parts of the UK continental shelf.	Good coverage across the study area and wider region.	2017
Additional Data Sources			
VE site specific benthic survey data collected in 2021, used to determine spawning habitat suitability (Fugro, 2022a,b).			
VE site specific geophysical survey data collected in 2021, used to determine spawning habitat suitability (Fugro, 2022c,d).			
Benthic habitats data from the Benthic Ecology and Subtidal Characterisation Reports (Volume 6, Part 5, Annex 5.1 and Volume 6, Part 5, Annex 5.2)			
Commercial Fisheries baseline characterisation (Volume 6, Part 5, Annex 8.1)			

2.4 DATA LIMITATIONS

2.4.1 Mobile species, exhibit varying spatial and temporal patterns. All regional survey data used to characterise the baseline (as detailed in Table 2.2, noting that no site-specific fish surveys have been undertaken for VE), provide a semi-seasonal description of the fish and shellfish assemblages within the fish and shellfish study area. It should be noted, however, that the data collected during fish surveys represent snapshots of the fish and shellfish assemblage within the study area at the time of sampling, and the fish and shellfish assemblages may vary considerably both seasonally and annually. However, should species be absent from the regional surveys, the outcome is not then to exclude consideration of these species from the baseline characterisation. Rather, the baseline description draws upon (or defaults to) wider scientific literature, as this provides a more thorough, robust, and longer time series evidence base, which therefore ensures a more comprehensive and precautionary baseline, identifying all species that are likely to be present within the study area.

[1] https://rconnect.cefas.co.uk/content/25/

2.4.2 It should also be noted that the methods of surveying fish and shellfish (regarding the regional fish surveys as detailed in Table 2.2) vary in their efficiency at capturing different species. For example, otter and beam trawl surveys are ineffective at capturing information on pelagic fish species (such as herring and sprat *Sprattus sprattus*). This limits the data utility in capturing relative abundances of species within the area. To minimise this limitation caused by trawl methodology of the surveys, sensitive receptors have been chosen based on their presence or absence in surveys, rather than whether that species contributes more significantly to the fish assemblage in the survey data.

2.4.3 The description of spawning and nursery grounds provided in this report are primarily based on the information presented in Coull *et al*. (1998) and Ellis *et al*. (2012), data sources widely accepted across the offshore wind industry. The limitations of these sources of information should, however, be recognised. These publications provide an indication of the general location of spawning and nursery grounds, and the spawning periods of commercial fish species. It should, however, be acknowledged that spawning times presented in the publications represent the maximum duration of spawning on a species/ stock basis. In some cases, the duration of spawning may be much more contracted, on a site-specific basis, than reported in Coull *et al*. (1998) and Ellis *et al*. (2012). Therefore, where available, additional research publications have also been reviewed to provide site-specific information.

2.4.4 Additionally, Coull *et al*. (1998) and Ellis *et al*. (2012) do not define precise boundaries of spawning and nursery grounds. However, when considering demersal spawners which display substrate dependency (e.g., herring and sandeel), site-specific PSA and geophysical data (collected along the VE ECC and in the array areas) are used to ground truth the Coull *et al*. (1998) and Ellis *et al*. (2012) datasets.

2.4.5 When discussing herring spawning grounds within the vicinity of VE in paragraph 3.1.29, reference is made to the Brown and May Ltd (2009) Thames herring spawning survey undertaken for Gunfleet Sands OWF; it should be noted, however that care should be taken when interpreting the findings, as the surveys did not include any further investigation into physiological damage to herring or their eggs and larvae that may have resulted from piling. Furthermore, the survey was carried out for one spawning season only, so there are insufficient data to infer the duration of the spawning period.

2.4.6 Due consideration is also given to the IHLS data in paragraph 3.1.25, when discussing herring spawning activity in the vicinity of VE. It should be noted however, that the southern North Sea and eastern English Channel IHLS surveys from the Downs herring population were conducted as three separate sampling event surveys. However, one survey was discontinued in 2017 so this should be kept in mind when interpreting the IHLS data.

2.4.7 The EUSeaMap (2021) broadscale marine habitat data is used as one of the data sets to identify preferred sandeel and herring spawning habitats. It should be acknowledged however that this dataset is limited by the broadscale nature of the data, since it does not account for small scale, localised differences in seabed sediments, unlike the data obtained from site-specific grab sampling. In this case it is important to review all of the datasets presented, to develop a clear overview of preferred sandeel and herring habitat.

2.4.8 Site-specific PSA data has therefore been collected along the VE ECC and in the array areas, to confirm and validate broadscale marine habitat data (Coull *et al*., 1998; Ellis *et al*., 2012; EUSeaMap, 2021). These data have been classified in accordance with the Latto *et al*. (2013) and Reach *et al*. (2013) classifications to identify areas of preferred spawning habitat for sandeel and herring, respectively. The use of PSA data and broadscale habitat mapping provides a proxy for the presence of sandeel and herring spawning habitat in these locations (based on suitability of habitats, i.e., the potential for spawning rather than actual contemporary spawning activity). In addition, whilst grab samples provide detailed information on the sediment types, they cannot cover wide swaths of the seabed and consequently only represent point samples. The PSA data is therefore interpreted in combination with additional PSA data across the site, sourced from the BGS (2015), to provide comprehensive cover of the fish and shellfish study area. It is important to note, that although the data used in the characterisation of the fish and shellfish baseline conditions (as detailed in Table 2.2) span a long time period, with some sources published over a decade ago, the information presented represents a long-term dataset. Accordingly, this allows for a detailed overview of the characteristic fish and shellfish species in the study area. The diversity and abundance of many species, particularly demersal fish species, is linked to habitat types, which have remained relatively constant in the study area, indicating no major shift in the fish and shellfish communities over the time period of the data used in this report.

2.4.9 Despite the data limitations detailed within this section of the report, the data as detailed in Table 2.2 provides a robust and sufficient evidence base to inform the fish and shellfish baseline characterisation and underpin the assessment.

3 BASELINE CONDITIONS

3.1 OVERVIEW

3.1.1 The sections below describe the broadscale spawning and nursery habitats, followed by a more focused description of the baseline within the array areas and offshore ECC.

3.1.2 This section characterises the baseline in the following sub-sections. It should be noted that due to the demersal spawning nature of herring and sandeel, and therefore their increased sensitivity to potential impacts from the development, herring and sandeel have been addressed in separate sub-sections:

- Fish and Shellfish Assemblage;
- Spawning and Nursery Grounds:
  - General spawning grounds;
  - Herring and sandeel spawning grounds and habitats; and
  - Sandeel spawning grounds and habitats.
- Species of commercial importance;
- Migratory species;
- Elasmobranchs;
- Designated sites; and
- Species of Conservation Importance.

FISH AND SHELLFISH ASSEMBLAGE

3.1.3 The following section describes the fish and shellfish communities present within the VE study area. The baseline description of the study area draws on site-specific data collected within the VE array areas and ECC, regional datasets and industry specific monitoring undertaken for a number of regional offshore wind farms.

3.1.4 The data represents both snapshots of the current species composition across the southern North Sea, alongside long-term time series data (e.g., bottom trawl surveys), which show the species composition to have remained consistent, subject to natural variation, overtime. Therefore, the data presented is considered both spatially, and temporally appropriate for the purposes of undertaking an EIA.

REGIONAL SURVEYS

3.1.5 Long-term time series data that cover the greater North Sea and the study area include ICES NSIBTS. These data have a significant spatio-temporal coverage and have been carried out in quarters 1 and 3 of each year for the last 40 years. Surveys have been conducted using beam trawls across the wider North Sea. For the purpose of this study, the ICES squares closest to VE have been focused on (32F1, 32F2 and 33F1 and 33F2). The spatial extents of these surveys are shown in Figure 3.1 below.

3.1.6 NSIBTS data collected from 2018 to 2022, within the VE study area were dominated by Norway pout *Trisopterus esmarkii*, haddock *Melanogrammus aeglefinus* and whiting *Merlangius merlangus*. Trawls undertaken in 2020 were also dominated by American plaice *Hippoglossoides platessoides* and Nephrops *Nephrops norvegicus*, and silvery pout *Gadiculus argenteus* were recorded in 2021 (ICES, 2018-2022). Across the study area the presence of various species considered to be sensitive to potential impacts from the construction, O&M and decommissioning of VE were recorded. These include species of increased sensitivity to underwater noise such as cod *Gadus morhua* and species that exhibit substrate dependant demersal spawning behaviours such as herring and sandeel. In addition, several electrosensitive species were recorded such as lesser spotted dogfish *Scyliorhinus canicula*, starry smoothhound *Mustelus asterias*, spotted ray *Raja montagui*, cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata* and velvet belly lanternshark *Etmopterus spinax*. Migratory species of conservation importance were also present, including European eel *Anguilla anguilla* and twaite shad *Alosa fallax*, and species of commercial importance to the site such as common whelk *Buccinum undatum*, brown crab *Cancer pagurus* and European lobster *Homarus gammarus*.

3.1.7 Cefas Young Fish Surveys were undertaken between 1981 and 2010, surveying juvenile fish around the British Isles, predominantly along the south and east coasts. Annual beam trawls were undertaken across the nearshore ECC and recorded a species composition consisting of goby species *Pomatoschistus* spp., dab *Limanda limanda*, common sole *Solea solea*, plaice *Pleuronectes platessa*, hooknose *Agonus cataphractus*, and common dragonet *Callionymus lyra* from 2000 to 2010 (Burt *et al.*, 2019). Across the study area the presence of various species considered potentially sensitive to the construction, O&M and decommissioning of VE were recorded. These include species of increased sensitivity to underwater noise such as cod and herring and species that exhibit substrate dependant demersal spawning behaviours such as herring and sandeel. In addition, several electrosensitive species were recorded such as lesser spotted dogfish, starry smoothhound, thornback ray, blonde ray Raja *brachyura* and small eyed ray *Raja microocellata*. Migratory species of conservation importance were also present, including European eel and European smelt *Osmerus eperlanus*. Offshore Wind Development Surveys.

3.1.8 A number of surveys have been conducted as part of other studies that sampled stations within the VE study area and were designed to obtain baseline information regarding diversity and abundance of fish and shellfish. The spatial extents of these surveys are shown in Figure 3.1 below.

3.1.9 Pre-construction fish surveys were conducted for Greater Gabbard Offshore Wind Limited (GGOWL) in 2008/2009 (Brown and May Ltd., 2009a,b). Surveys were carried out using beam and otter trawls and sites were located within the planned Greater Gabbard OWF array areas, offshore ECC as well as a control location. The results of otter trawl surveys indicated a species assemblage consisting of whiting, cod and whiting-pout *Trisopterus luscus*. Dab, plaice, poor cod *Trisopterus minutus*, tub gurnard *Chelidonichthys lucerna* and thornback ray were also recorded across the GGOWL site. Beam trawl surveys across the site recorded presence of many species including sand goby *Pomatoschistus minutus*, sole, northern rockling *Ciliata septentrionalis*, gobies *Gobiidae*, common dragonet, whiting-pout, poor cod, lesser sandeel *Ammodytes marinus*, painted goby *Pomatoschistus pictus*, five beard rockling *Ciliata mustela* and sprat. The beam trawls also recorded presence of various shellfish species, namely pink shrimp *Pandalus montagui*, common hermit crab *Pagarus bernhardus*, flying crab *Liocarcinus holsatus*, night shrimp *Processa* spp., harbour crab *Liocarcinus depurator*, velvet swimming crab *Necora puber*, brown shrimp *Crangon crangon* and marbled swimming crab *Liocarcinus marmoreus* (Brown and May Ltd., 2009a,b). Species of potential sensitivity to VE include species that exhibit substrate dependant spawning behaviours such as sandeel and herring, and the electrosensitive species lesser spotted dogfish. In addition, the commercially important brown crab were also recorded within the study area.

3.1.10 Post-construction elasmobranch monitoring surveys were undertaken for GGOWL in 2014 (Brown and May Ltd., 2014). Long line surveys were carried out within and adjacent to the Greater Gabbard OWF and the cable route. The surveys recorded five species of elasmobranch, lesser spotted dogfish, thornback ray, spurdog *Squalus acanthias*, smoothhound species *Mustelus* spp. and tope *Galeorhinus galeus*.

3.1.11 Beam trawl fish surveys were conducted along the Galloper OWF ECC route in 2010 to support the Galloper OWF EIA. Overall, the trawls revealed species assemblages consisting of commercially exploited species, including sprat, sole, cod and common whelk (Centre for Marine and Coastal Studies Ltd (CMACS), 2010).

3.1.12 Pre- and post-construction fish surveys consisting of both otter and beam trawls were undertaken for London Array OWF in 2009/2010 and 2013/2014 respectively. Pre-construction otter trawls undertaken in the spring were dominated by thornback ray, whiting and cod. The trawls also recorded the presence of the electrosensitive thornback ray, lesser spotted dogfish, starry smoothhound and spotted ray. The commercially important European lobster and brown crab were also recorded within the study area, and presence of herring a species that exhibits substrate dependant spawning. Autumn otter trawl surveys recorded assemblages consisting of cod, whiting, lesser spotted dogfish, and whiting-pout. Pre-construction beam trawls consisted of solenette *Buglossidium luteum* and sole in the spring. The presence of sandeel was also recorded, a species considered potentially sensitive to the development due to its substrate dependant nature. Autumn beam trawls consisted of sole and sand goby (Brown and MayLtd., 2010). Post-construction otter trawls recorded assemblages consisted of thornback ray, whiting and lesser spotted dogfish in autumn and spring trawls, cod and sole were also recorded. While beam trawls consisted of Lozano's goby *Pomatoschistus lozanoi*, pogge *Agonus cataphractu)* and solenette in autumn trawls, and sole, sand goby and pogge in spring trawls (Marine Space, 2015). The results of the post-construction surveys show little change in species numbers since the 2009/2010 pre-construction survey. Whilst some fluctuations were observed in the presence, abundance and location of particular species, the changes noted were attributed to natural fluctuation (Marine Space, 2015).

3.1.13 Pre-construction seasonal otter trawl fisheries surveys were undertaken for Gunfleet Sands OWF in August and October 2007 and April 2008 (RPS, 2007a,b; RPS, 2008). Species present across all three seasonal surveys included thornback ray, cod, whiting- pout, dab, plaice and sole. Species recorded in the August survey only were smoothhound and turbot *Scophthalmus maximus*. Species recorded in the October survey only were lesser spotted dogfish, tub gurnard, sea snails, lesser weaver *Echiichthys vipera* and goby spp. Species recorded in the April survey only were John dory *Zeus faber* and sea bass. Post-construction fish surveys consisting of otter and beam trawls were undertaken in September 2010 and August 2011 (Brown and May Ltd., 2011). Whiting, dab, sole, unidentified goby, plaice, pogge and sprat were present in pre- and post-construction surveys.

350000
400000
450000
500000
5800000
5750000
5700000
N
33F1
33F2
32F1
32F2
31F1
31F2

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- ICES Rectangles
- Cefas Young Fish Survey Trawls
- North Sea International Bottom Trawl Surveys (NSIBTS)
- London Array OWF Otter Trawl Survey
- London Array OWF Beam Trawl Survey
- Gunfleet Sands OWF Otter Trawl Survey
- Gunfleet Sands Pre-Construction Otter Trawls (Oct 2007)
- Galloper OWF Beam Trawl Survey
- Greater Gabbard OWF Beam and Otter Trawl Surveys
- Greater Gabbard OWF Long Line Elasmobranch Survey

0 5 10 20
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Fish and Shellfish Surveys within the Region

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:550,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM

SPAWNING AND NURSERY GROUNDS

3.1.14 This section describes fish species which have spawning and nursery areas that overlap, or are in close proximity to, the VE array areas or ECC.

3.1.15 Spawning and nursery areas are categorised by Ellis *et al*. (2012) as either 'high' or 'low intensity' dependent on the level of spawning activity or abundance of juveniles recorded in these habitats. Coull *et al*. (1998) does not always provide this level of detail. The spatial extent of the spawning grounds and the duration of spawning periods indicated in these studies are therefore considered likely to represent the maximum theoretical extent of the areas and periods within which spawning will occur.

3.1.16 Due to the demersal spawning nature of herring and sandeel, and therefore their increased sensitivity to potential impacts from the development, herring and sandeel have been addressed separately below. The spawning and nursery grounds (Coull *et al.*, 1998 and Ellis *et al.*, 2012) discussed and illustrated below are considered robust sources of information, as the physical drivers such as sediment type remain the same (EUSeaMap, 2021) and are supplemented by project specific PSA (Fugro, 2022a,b) and geophysical survey data (Fugro, 2022c,d).

SPAWNING GROUNDS

3.1.17 Species of fish and shellfish that are known to spawn in relatively close proximity to, or potentially overlapping with the VE study area (Coull *et al*., 1998, Ellis *et al*., 2012 are presented in Figure 3.2 to Figure 3.3. There are ‘high intensity’ plaice and sole spawning grounds that overlap the study area (Ellis *et al*., 2012) (see Figure 3.2and Figure 3.3 respectively). North Sea plaice spawning grounds are significant in size with high intensity areas in the eastern channel and Southern Bight (ICES Fishmap, 2019).

3.1.18 North Sea sole spawning grounds occur all along the southern coasts with distinguished high intensity spawning grounds in the southern regions including the Thames Estuary (ICES Fishmap, 2019). The spawning sites for sole are significant in size, and therefore the interaction between the sites and the study area is small.

3.1.19 'Low intensity' spawning grounds are also present across the study area for cod. Cod spawning grounds are extensive across the North Sea and eastern channel (Ellis *et al*, 2012). This is evidenced by the relative frequency of the presence of aggregations in International Bottom Trawl Surveys (ICES DATRAS, 2023b) from 2010 to 2020, showing aggregations of ‘running’ adults throughout the eastern channel, Southern Bight, and North Sea.

3.1.20 A herring spawning ground intersects with the eastern side of the study area (Coull *et al*., 1998) (see Figure 3.4, Figure 3.5 and Figure 3.6). Furthermore, there is a herring spawning ground located in the Blackwater estuary, approximately 10 km from the nearshore section of the offshore ECC (Figure 3.6).

3.1.21 A whiting spawning ground interacts with the study area (Coull *et al*, 1998). Whiting spawning grounds are significant in size, spanning large areas across the southern North Sea and the Channel. This is evidenced by the relative frequency of the presence of aggregations in International Bottom Trawl Surveys (ICES DATRAS, 2023b) from 2010 to 2020, showing aggregations of ‘running’ adults throughout the eastern channel, Southern Bight, and North Sea.

3.1.22 There are also spawning grounds present across the study area for mackerel *Scomber scombrus*, sprat, lemon sole *Microstomus kitt,* horse mackerel *Trachurus trachurus* and sandeel (Coull *et al.*, 1998; Ellis *et al*., 2012) (Figure 3.2 and Figure 3.3). These spawning grounds are significant in size, spanning large areas across the southern North Sea and the Channel. As these species' spawning sites are significant in size, the interaction between the sites and the study area is small.

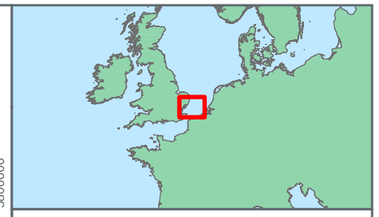
Mackerel

Plaice

N

Whiting

Sandeel



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI

Spawning Grounds (Coull, 1998)

- Higher Intensity
- Lower Intensity
- Undetermined Intensity

Spawning Grounds (Ellis, 2012)

- Higher Intensity
- Lower Intensity

0 10 20 40

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

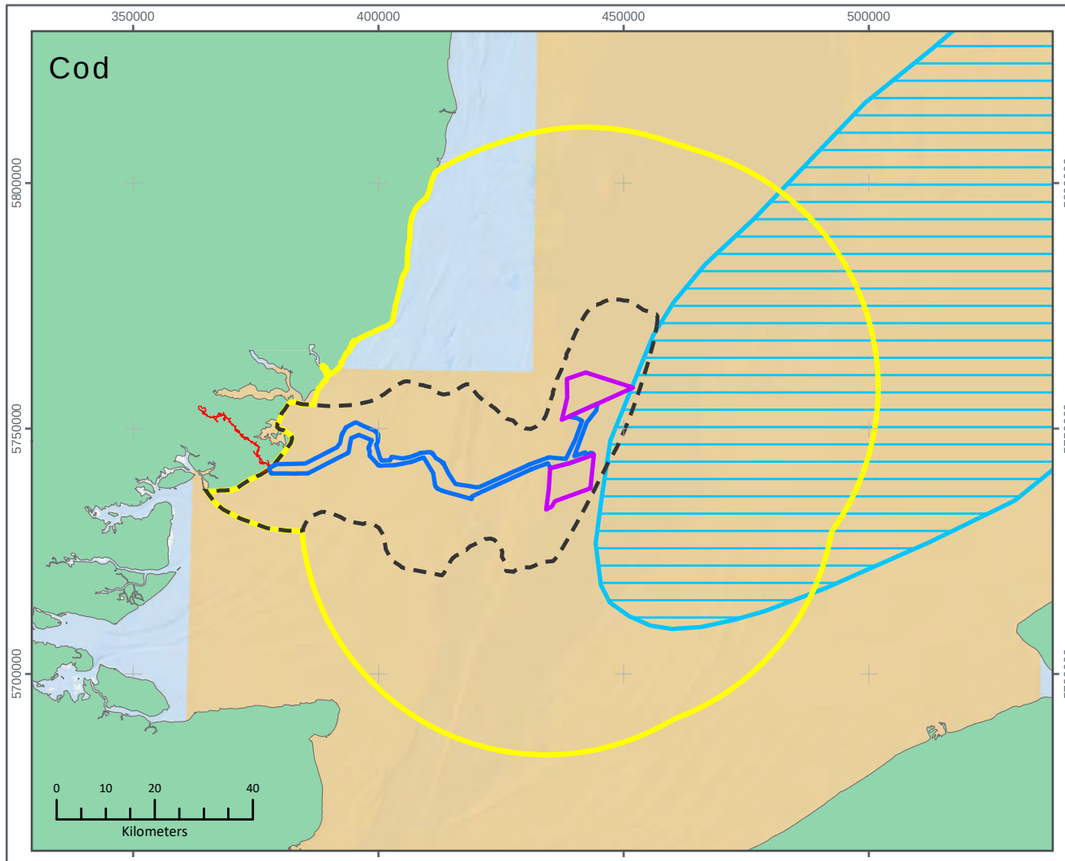
Mackerel, Plaice, Whiting and Sandeel Spawning Grounds relative to the Project

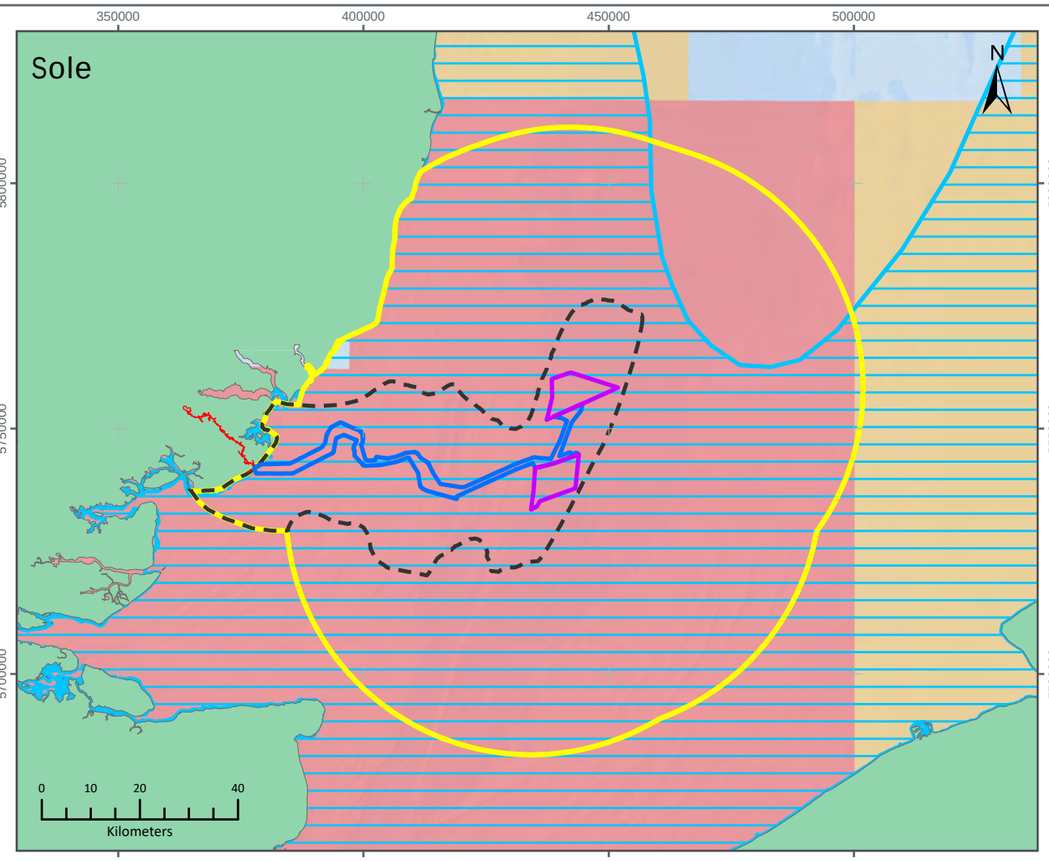
VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

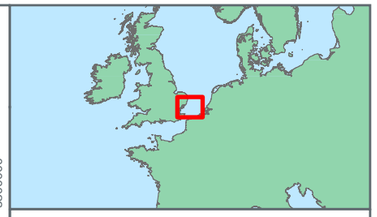
DRAWING NUMBER: 3.2

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM







LEGEND

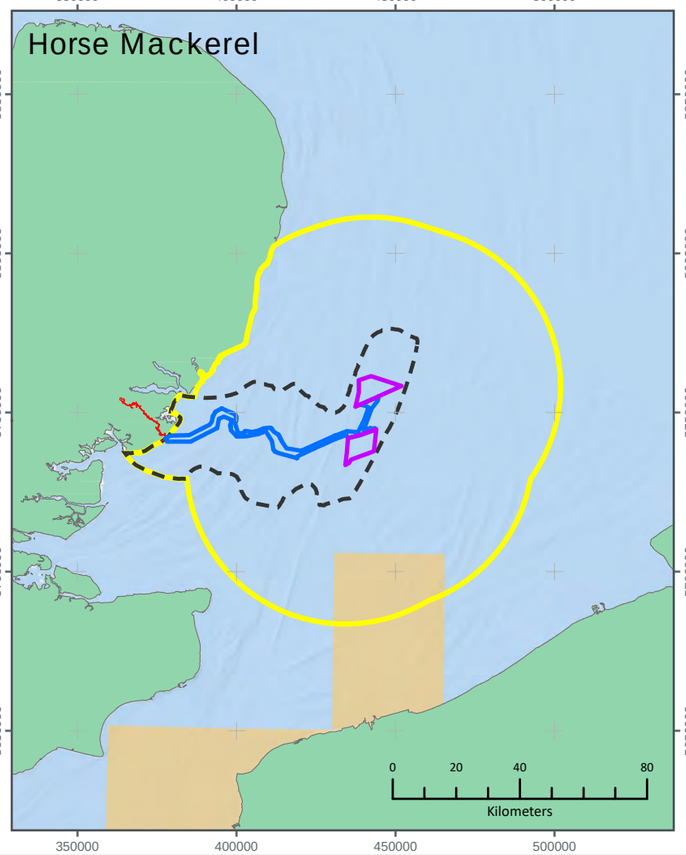
- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI

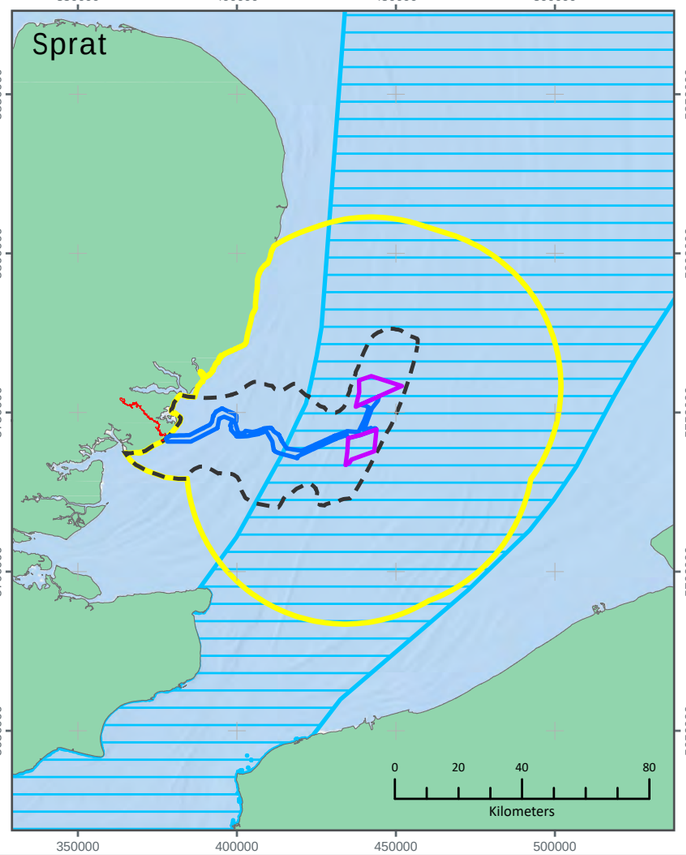
Spawning Grounds (Coull, 1998)

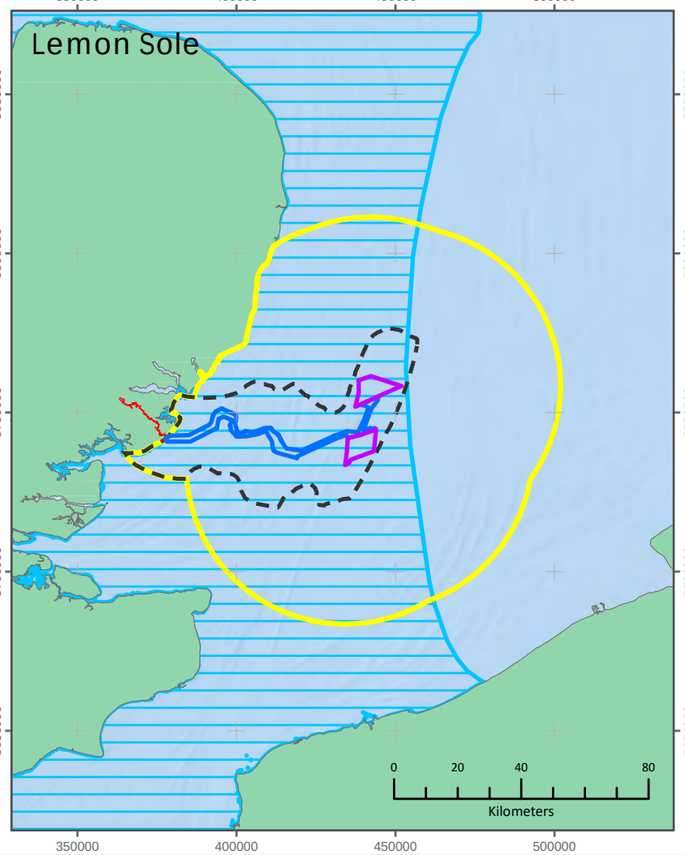
- Higher Intensity
- Lower Intensity
- Undetermined Intensity

Spawning Grounds (Ellis, 2012)

- Higher Intensity
- Lower Intensity







Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Sole, Sprat, Cod, Horse Mackerel and Lemon Sole Spawning Grounds relative to the Project

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.3

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

HERRING AND SANDEEL SPAWNING GROUNDS AND HABITATS

3.1.23 Herring and sandeel are of particular relevance when considering impacts to spawning areas as they are demersal spawners. As such, they have specific requirements in terms of spawning grounds, with seabed sediment being the primary determinant (Maravelias *et al*., 2000). Due to their reliance on specific substrates, sandeel and herring are more susceptible to seabed disturbance impacts, inclusive of impacts from increased SSC and sediment deposition.

3.1.24 Sandeel, as their name suggests, spawn in coarse sands to gravelly sands, whilst herring prefer to spawn in coarser sediments comprising sandy gravels to gravel. Data from Coull *et al*. (1998) and Ellis *et al*. (2012) suggests that the VE fish and shellfish study area lies within or interacts with, sandeel and herring spawning grounds.

HERRING

3.1.25 The preferred sediment habitat for herring spawning is gravel, with some tolerance of more sandy sediments, although these are primarily on the edge of any spawning grounds (Stratoudakis *et al*., 1998). Herring spawning grounds are typically discrete, localised features. Actual spawning habitat, or habitat that could be used for spawning activity, likely comprises relatively small seabed features, with discrete spatial extents, although these may be spread across wide areas of suitable seabed spawning habitat at a regional scale (e.g., spawning grounds). Eggs are laid on the seabed, usually in water 10-80 m deep, in areas of gravel, or similar coarse habitats (e.g., coarse sand, shell and maerl), with well oxygenated waters (Ellis *et al.*., 2012; Bowers, 1980; Groot, 1980; Rakine, 1986, Aneer, 1989; Stratoudakis *et al*., 1998).

3.1.26 The North Sea consists of discrete stocks of spring and autumn spawning herring (Plate 1), with the Autumn spawning stocks representing the bulk of the North Sea spawning stock (Daan *et al*, 1990). The spawning grounds relative to the VE fish and shellfish study area are shown in Figure 3.5 and are addressed separately below.

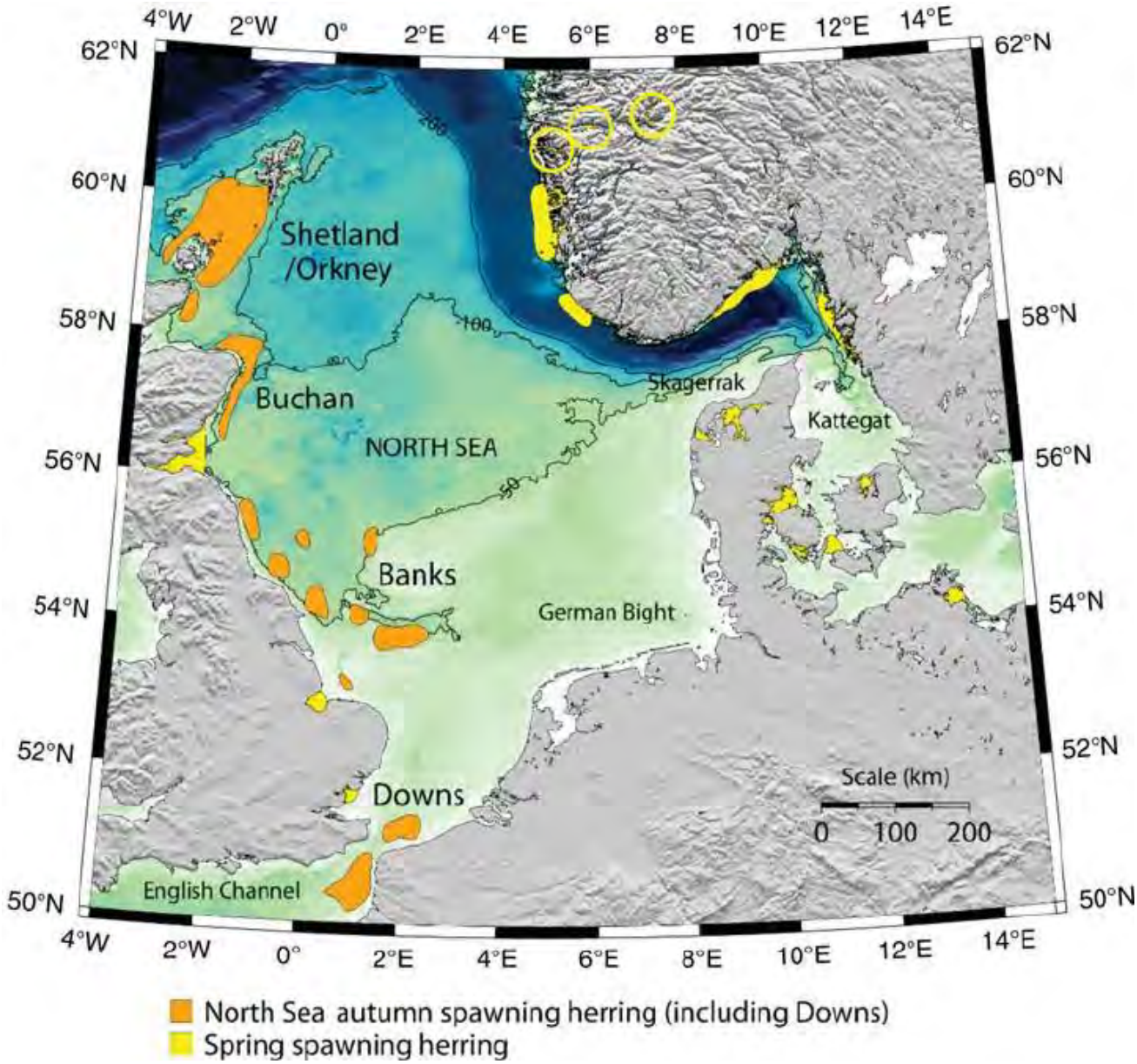


Plate 1: Atlantic herring spawning sub-populations in the North Sea (taken from Dickey-Collas *et al*, 2010)

AUTUMN SPAWNING STOCK

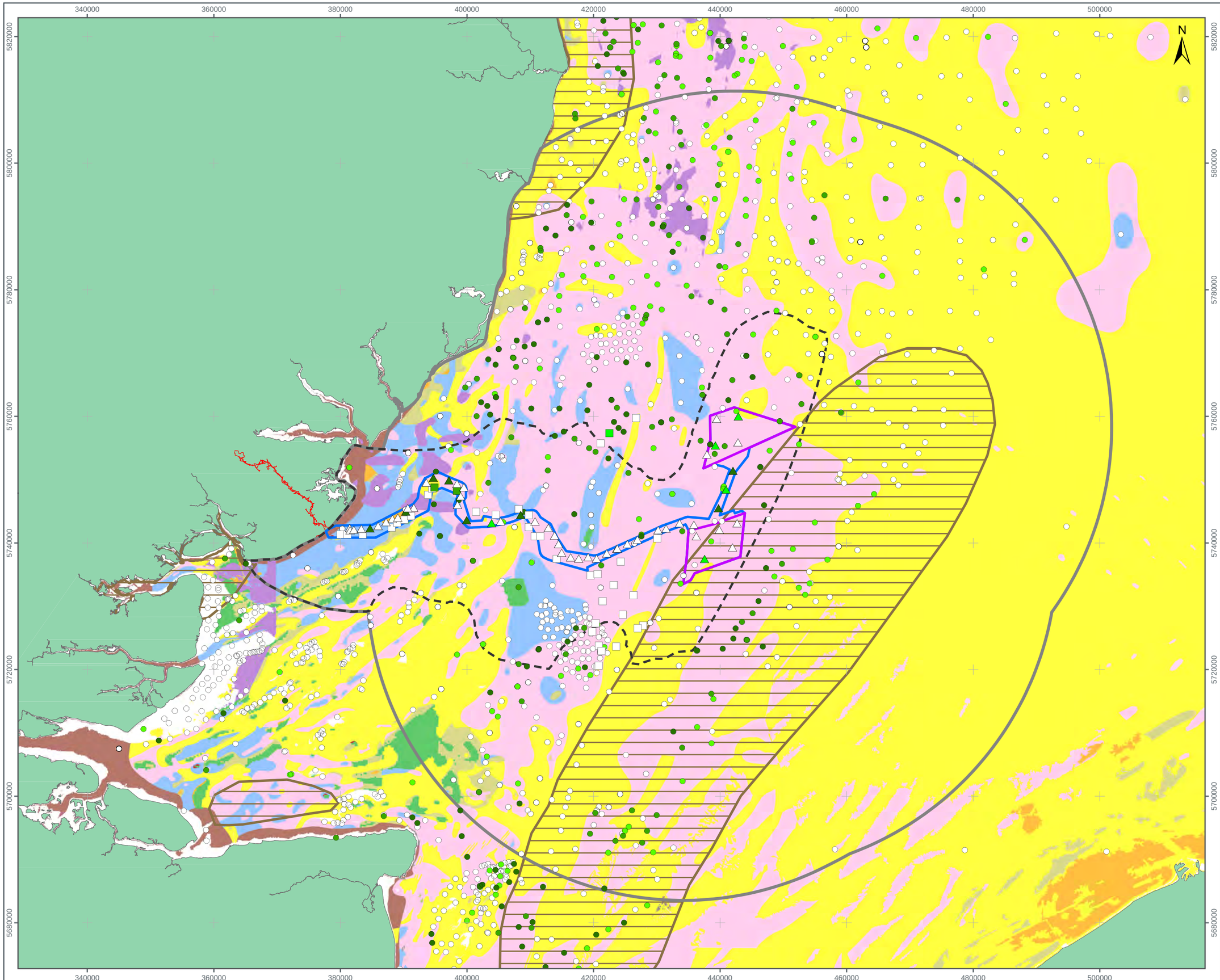
3.1.27 As presented in Figure 3.4 and Figure 3.5 the southern VE array area overlaps with a spawning ground known as the Downs spawning ground which is predominately active from November through to January (Coull *et al.*, 1998).

SPRING SPAWNING STOCKS

3.1.28 As presented in Figure 3.5 and Figure 3.6, a herring spawning ground lies within the Blackwater Estuary (Coull *et al.*, 1998), located to the south of the nearshore section of the ECC. The Thames-Blackwater herring are a small, discrete coastal stock which spawn in the spring (from late February to early May (KEIFCA, 2022; Cefas, 2008). Since the 1800's Thames-Blackwater herring have been recognised as a separate stock from the North Sea herring stock (ICES, 2004). It should be noted however, that the Blackwater herring spawning ground is not considered a spawning ground of key importance to herring stocks (Daan *et al*, 1990), with the main spring spawning contributors to herring populations being the Western Baltic spring spawners, as evidenced by the reliance on these spawners for annual stock assessments undertaken by the Herring Assessment Working Group (HAWG) for the Area South of 62° N[2.] Furthermore, the Blackwater herring stock has seen a collapse due to vacating its spawning grounds in recent years. Evidence from the herring habitat suitability heat map shows that the Blackwater Estuary consists of low suitability spawning habitat, whereas Herne Bay, to the southwest offers a higher quality habitat (Figure 3.7). Herring stocks appear to be actively using the preferable habitat in the Herne Bay area instead of Blackwater estuary. This is supported by site specific survey work completed to gather data on this stock in relation to the Thanet and Gunfleet Sands offshore wind farm developments which identified that spawning appeared to be confined to a small shallow inshore area to the north of Herne Bay, in proximity to Studhill.

3.1.29 A herring spawning survey, commissioned by Gunfleet Sands Limited (Brown and May Ltd., 2009), was conducted between February and April 2009, with the aim to determine the extent of the spawning grounds and the spawning period of the Thames-Blackwater herring. The main spawning period was determined to start between 24 February and 6 March and finish between 24 and 31 March 2009. The Eagle Bank and Colne Bar were found to be the main spawning areas during the survey, which broadly aligned with Wood (1981) who stated that the major spawning site for Thames-Blackwater herring was the Eagle Bank at the entrance to the Blackwater estuary. Piling on the Gunfleet Sands OWF commenced well before the beginning of the survey and continued until 21 March. The presence of spawning herring on their known spawning grounds indicated that spawning was not disrupted by the piling activities. The findings of the survey also indicated that the period of spawning was significantly shorter than previously thought and over a much smaller, shallower, and closer inshore, area (Brown and May Ltd., 2009). This is supported by additional studies undertaken in support of the nearby Thanet project (Brown and May Marine, 2007 and 2008), which demonstrated that the actual spawning ground is much smaller than that previously identified in the maps produced by Coull *et al*., 1998 and actual spawning habitat likely comprises relatively small seabed features, with discrete spatial extents.

3.1.30 A herring spawning ground also lies to the north of the proposed development, off of the Suffolk coast, within the northern extent of the VE fish and shellfish study area, which clips the spawning ground in the nearshore. This spawning ground also constitutes part of the spring spawning stock and is therefore recognised as separate from the North Sea herring stock (ICES, 2004), and it also not considered a spawning ground of key importance to herring stocks (Daan *et al*, 1990)



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Herring Spawning Grounds (Coull *et al.*, 1998)

Herring Habitat Suitability (Reach *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Fine mud
- Muddy sand
- Seabed
- Coarse substrate
- Sediment
- Mixed sediment
- Worm reefs
- Sabellaria spinulosa reefs
- Rock or other hard substrata

0 5 10 20
Kilometers

Data Source:

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

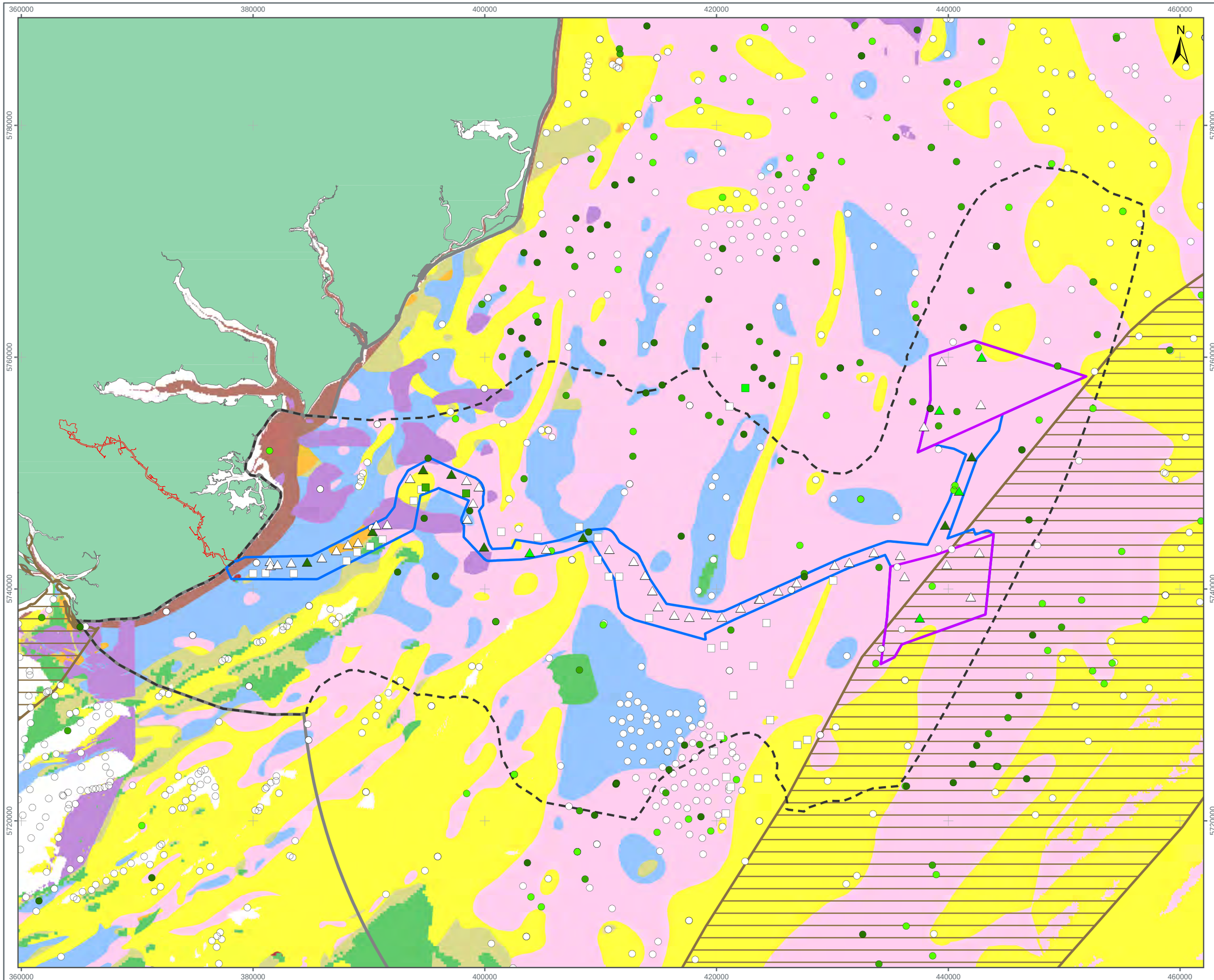
DRAWING TITLE:
Herring Spawning Grounds relative to the Fish and Shellfish Study Area

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.4

SCALE: 1:550,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Herring Spawning Grounds (Coull *et al.*, 1998)

Herring Habitat Suitability (Reach *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Fine mud
- Muddy sand
- Seabed
- Coarse substrate
- Mixed sediment
- Worm reefs
- Sabellaria spinulosa reefs

0 2.5 5 10
Kilometers

Data Source:

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

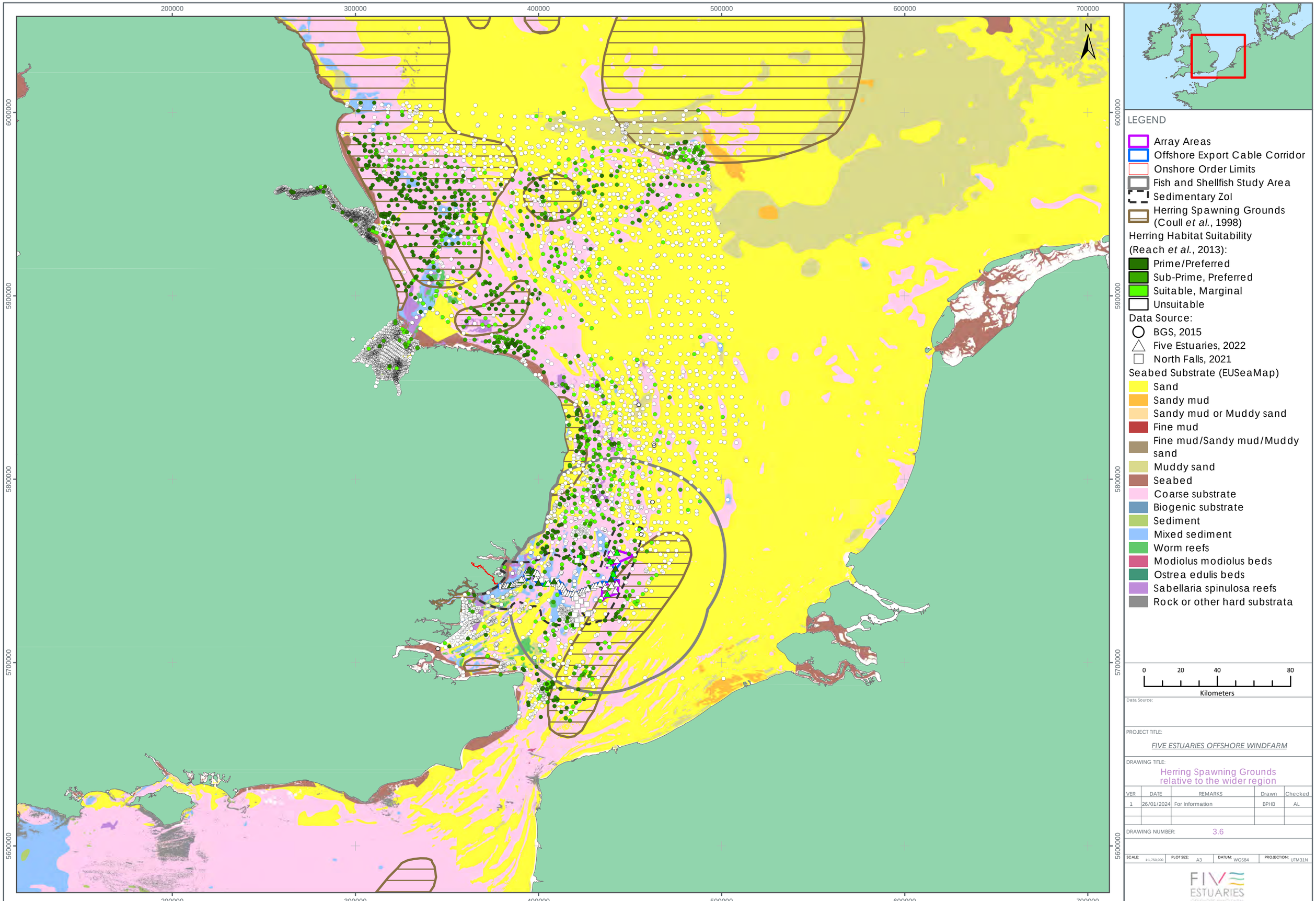
Herring Spawning Grounds relative to Five Estuaries OWF

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.5

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:300,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Herring Spawning Grounds (Coull *et al.*, 1998)

Herring Habitat Suitability (Reach *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Sandy mud or Muddy sand
- Fine mud
- Fine mud/Sandy mud/Muddy sand
- Muddy sand
- Seabed
- Coarse substrate
- Biogenic substrate
- Sediment
- Mixed sediment
- Worm reefs
- Modiolus modiolus beds
- Ostrea edulis beds
- Sabellaria spinulosa reefs
- Rock or other hard substrata

0 20 40 80
Kilometers

Data Source:

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Herring Spawning Grounds relative to the wider region

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.6

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,750,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM

HERRING MIGRATION

3.1.31 Herring spend their first few years in coastal nurseries, before moving offshore to deeper waters, where they join the adult populations (MacKenzie,1985). These populations undertake feeding and spawning migrations, to the western areas of the North Sea, with migrations following a clockwise circuit (Cushing, 2001) (Plate 2). The North Sea migration patterns, despite environmental variation, are considered to remain relatively constant over periods of several years (Corten, 2001). The Downs herring stock migrate in a clockwise circuit, from the northeast to the Downs spawning ground, and then continuing in a northerly direction (Cushing, 2001).

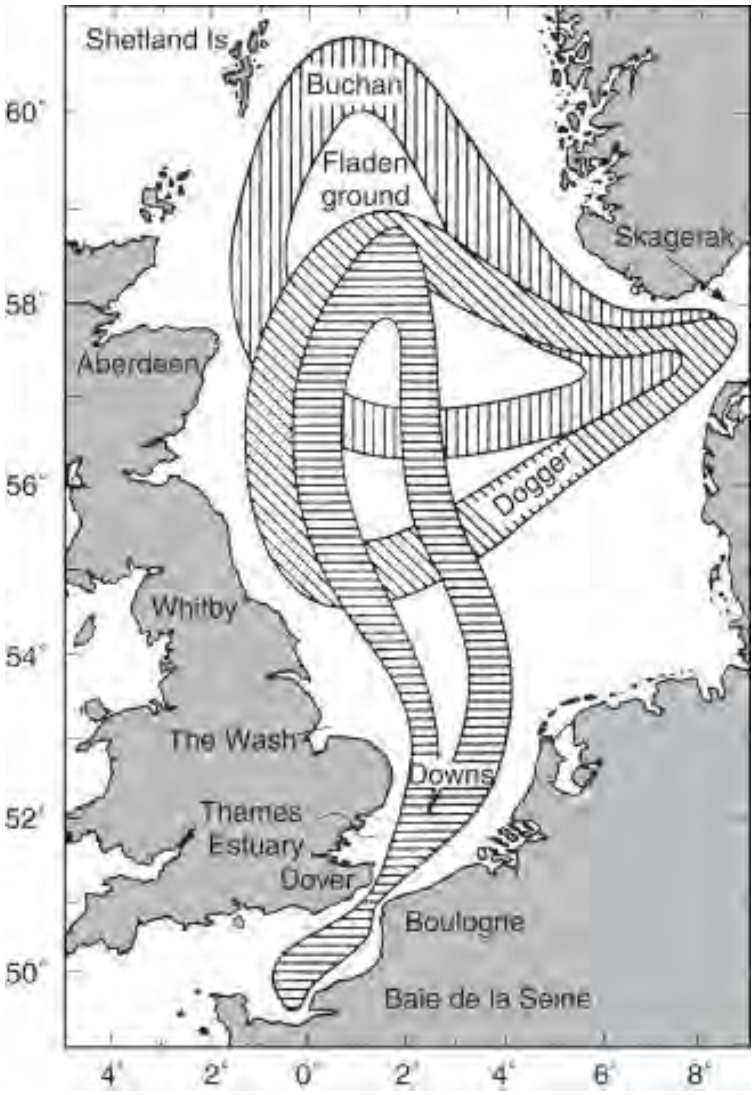


Plate 2: The migration circuits of the three groups of spawners in the North Sea: Buchan, Dogger and Downs (taken from Cushing, 2001)

HERRING SPAWNING HABITAT SUITABILITY ASSESSMENT

3.1.32 Areas of potential herring spawning habitat have been identified using site specific PSA data collected as part of benthic characterisation surveys (Fugro, 2022a,b). These data have been classified in accordance with the MarineSpace *et al*. (2013a) (adapted from Reach *et al*. (2013)) classifications as summarised in Table 3.1, for their suitability as herring spawning habitat based on the distribution of sediment particle sizes, to further refine the understanding of areas of potential herring spawning habitat within the proposed development site.

Table 3.1: Herring potential spawning habitat sediment classifications (Sources adapted from Reach *et al*. 2013).

Folk Class (Folk 1954)	Fractional composition	Habitat sediment preference	Habitat sediment classification
Gravel and part sandy gravel	<5% muds, >50% gravel	Prime	Preferred
Part sandy gravel and part gravelly sand	<5% muds, >25% gravel	Sub-prime	Preferred
Part gravelly sand	<5% muds, >10% gravel	Suitable	Marginal
Everything excluding gravel, part sandy gravel and part gravelly sand	>5% muds, <10% gravel	Unsuitable	Unsuitable

3.1.33 Site specific PSA data (Fugro, 2022a,b) collected within the northern array area were primarily characterised by coarse sediments, with gravelly sediments located in the northern array area, which are characterised as ‘sub-prime, preferred’ and ‘suitable, marginal’ herring spawning habitats. Site-specific PSA samples collected within the southern array area were classified as ‘suitable, marginal’ and ‘unsuitable’ herring spawning habitats (Fugro, 2022a,b). Site-specific PSA data (Fugro, 2022a,b) shows the ECC is largely dominated by ‘unsuitable’ herring spawning habitats (See Figure 3.7 and Figure 3.8).

3.1.34 Two methods have been used to map the distribution of potential herring spawning habitat in the areas between the site-specific PSA sampling locations:

METHOD 1

3.1.35 Site specific geophysical survey data were collected by Fugro across the VE array areas and ECC in 2021 (Fugro, 2022c,d). Seafloor sediment classes were delineated from acoustic variations in the low frequency side scan sonar acoustic reflectivity and changes in morphology derived from the bathymetry. The seafloor sediments were also crosschecked against sub-bottom profiler interpretation to ensure consistency between sensors. Sediment classifications were defined using a combination of the site-specific PSA data from grab sampling, and BGS data.

3.1.36 The seabed within the array areas are found to be dominated by coarse grained sediments, with sands and gravelly sands accounting for circa 75% of the footprint of the array areas. The remaining areas are characterised by the presence of muddy sand, which is found in the west of the northern array area and in localised northeast-to southwest-trending bands in the southern array area. The distribution of seabed sediments along the ECC is highly complex, with coarse grained (sands and gravels) and fine grained (muddy) sediments widespread (Fugro, 2022b). In many nearshore areas (<20 km from the coast), rock is found at or very near to the surface, alongside extensive areas of gravelly mud.

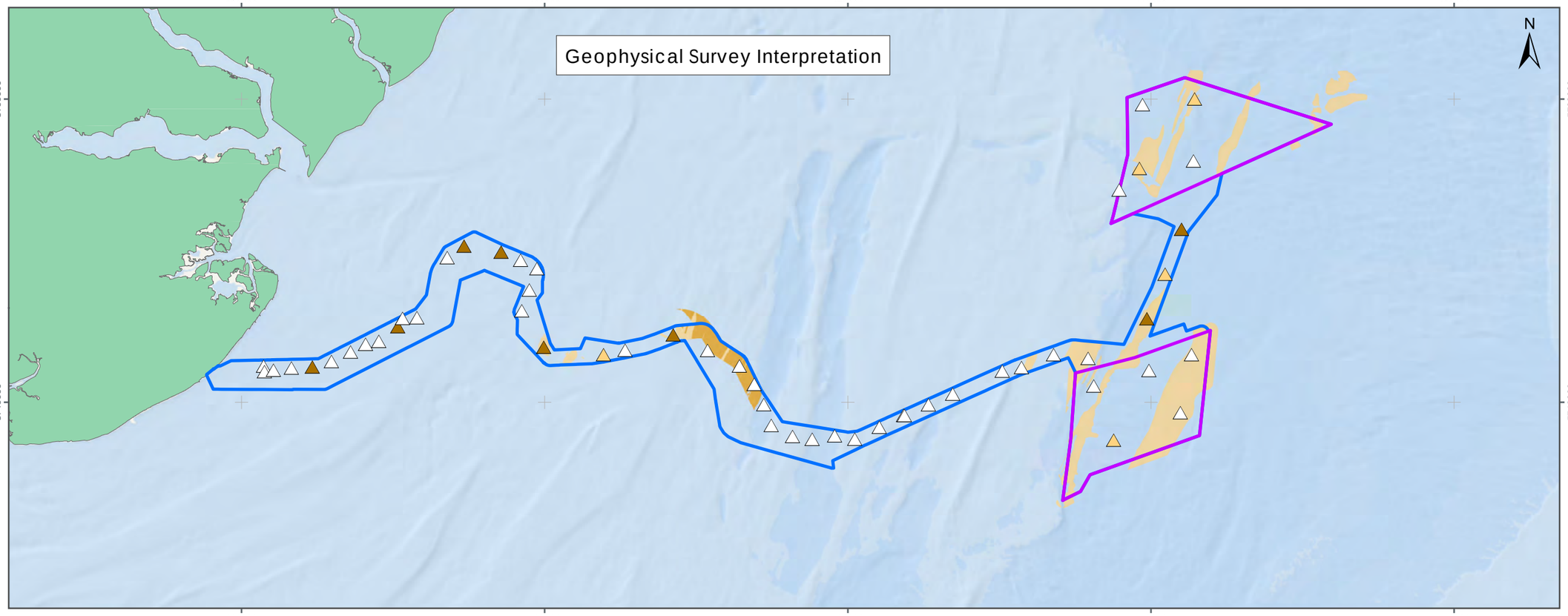
3.1.37 These have been classified using the Reach *et al*. (2013) sediment classifications to identify substrates suitable for herring spawning. This method has identified discrete areas of 'Marginal' herring spawning habitat within the northern and southern array areas, and 'Preferred' herring spawning substrates across the mid-section of the Offshore ECC. All other areas are classified as 'unsuitable' for spawning (Figure 3.7).

METHOD 2

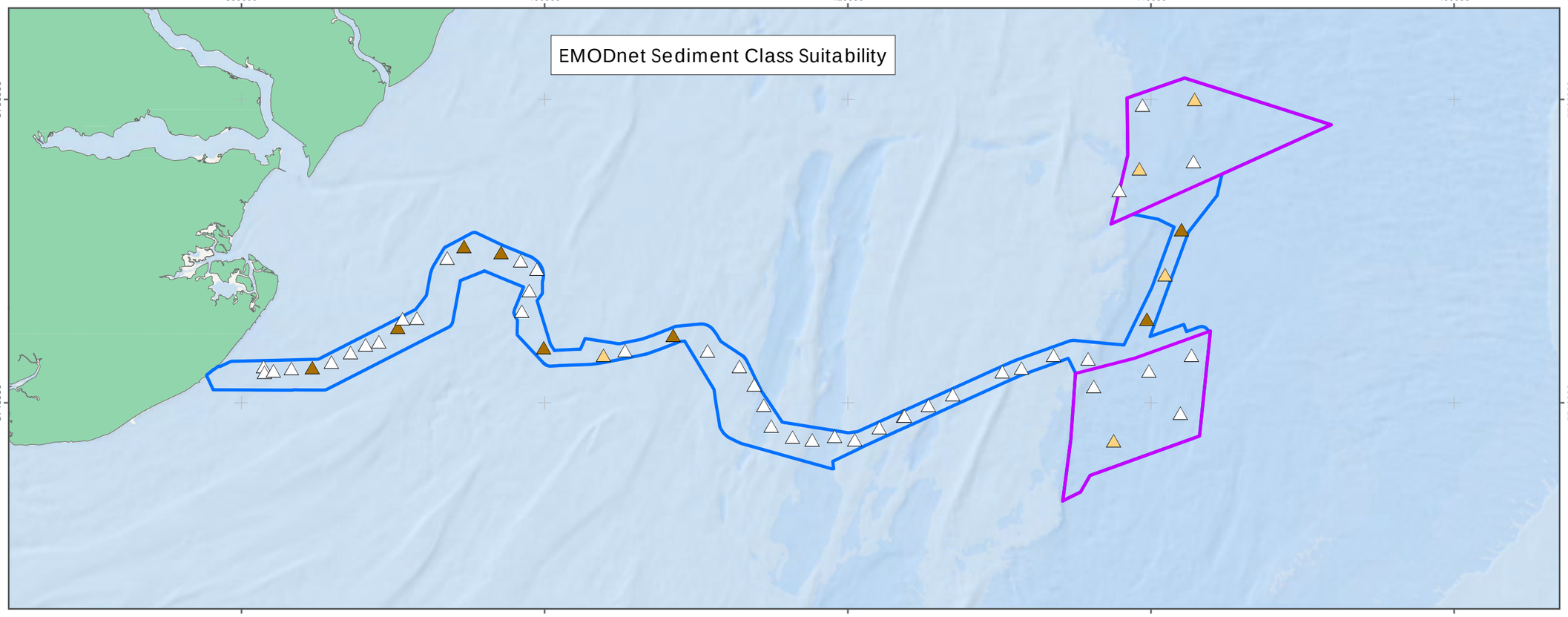
3.1.38 This approach follows the methodology as detailed in MarineSpace Ltd *et al*., (2013a) and classifies existing EMODnet 1:250,000 sediment maps, which show the distribution of sediment classes, according to the herring spawning substrate preference categories as described in Table 3.1. The results show 'Preferred' herring spawning habitat extending across the majority of the offshore ECC, with 'Marginal', 'Preferred' and unsuitable substrates located to the south. The north array area lies within an area of 'Preferred' and 'Marginal' spawning substrates, and the south array area is predominantly classified as 'Marginal' spawning substrate (Figure 3.8). On a wider scale, it is apparent that the northern portion of the historic herring spawning ground as defined by Coull *et al*. (1998), inclusive of the portion of the southern array area which overlaps the spawning ground, is dominated in substrates that are 'Marginal' and unsuitable for spawning (Figure 3.8). Whereas, the southern portion of the historic spawning ground, the Strait of Dover and the eastern English Channel is dominated in 'Preferred' spawning substrates (Figure 3.8).

3.1.39 It should be noted, that MarineSpace *et al*. (2013) acknowledge that habitat sediment classification is not the only parameter that indicates potential spawning habitat. There are other environmental (physical, chemical and biotic) parameters such as: oxygenation, siltation, overlap with range of spawning populations, micro-scale seabed morphological features e.g. ripples and ridges; which all contribute to the suitability of seabed habitat to be used as spawning beds by herring. As such the habitat sediment classes alone will always over-represent the range of habitat with the potential to support spawning events (MarineSpace *et al*. 2013).

Geophysical Survey Interpretation



EMODnet Sediment Class Suitability



LEGEND

- Array Areas
- Offshore Export Cable Corridor

Grab Samples - Herring Habitat Suitability (Reach *et al.*, 2013):

- Prime, Preferred
- Suitable, Marginal
- Unsuitable

Habitat Area
Herring Suitability

- Marginal
- Preferred

0 2.5 5 10
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

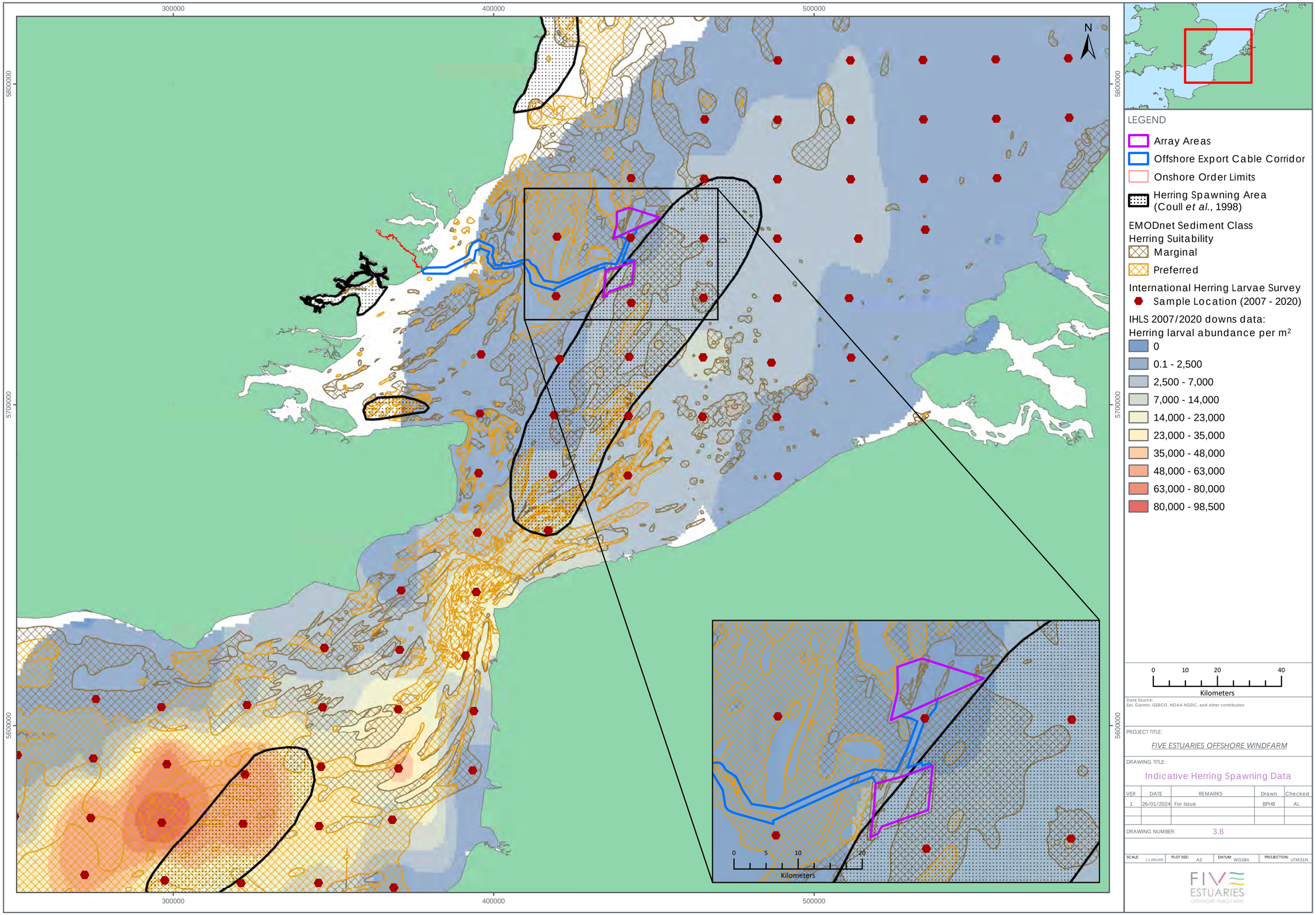
DRAWING TITLE:
Herring Habitat Suitability

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:300,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Herring Spawning Area (Coull *et al.*, 1998)

EMODnet Sediment Class
Herring Suitability

- Marginal
- Preferred

International Herring Larvae Survey

- Sample Location (2007 - 2020)

IHLS 2007/2020 downs data:
Herring larval abundance per m²

- 0
- 0.1 - 2,500
- 2,500 - 7,000
- 7,000 - 14,000
- 14,000 - 23,000
- 23,000 - 35,000
- 35,000 - 48,000
- 48,000 - 63,000
- 63,000 - 80,000
- 80,000 - 98,500

0 10 20 40
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Indicative Herring Spawning Data

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.8

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,000,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

3.1.40 As stated above, the presence of suitable spawning substrates for herring spawning does not necessarily mean that the area is actively used for herring spawning. A large portion of the southern array area overlaps a historic herring spawning ground as defined by Coull *et al*. (1998). The confidence of these data is however lower than the annual IHLS survey data (ICES, 2007-2020) (MarineSpace Ltd *et al*., 2013a). Surveys conducted from 2007-2020 indicate that areas of active herring spawning are located across the eastern extent of the wider study area. High relative abundances of herring larvae, indicative of high intensity spawning are consistently present within the eastern English Channel, whilst low to moderate spawning intensity is apparent to the east of the VE array areas (Figure 3.8). This aligns with the sediment analysis, with large areas of 'Preferred' spawning substrates occurring south of the array areas, within the eastern English Channel, and Dover Strait.

3.1.41 Following the MarineSpace *et al*., (2013) methodology, potential herring spawning substrates and active spawning areas have been further assessed through the overlap of data layers deemed to be indicative of herring spawning habitats and activity. These data have been presented spatially in Figure 3.7; where a greater number of data sources overlap, a higher 'heat' has been applied, which represents a higher confidence that the seabed may be suitable for spawning. These data utilised to construct the heat map are summarised in Table 3.2 alongside their representative confidence scores (based on a confidence assessment of the data).

Table 3.2: Confidence assessment for individual herring spawning data sources.

Data source	Data theme	Data notes	Confidence Score	Justification of confidence score
EMODnet 1:250,000 seabed sediment maps	Preferred sediment	Preferred sediment consists of Gravel (G) and sandy gravel (sG)	3	As detailed in Reach *et al*. (2013), herring are known to prefer Gravel and sandy Gravel substrates for spawning; and also have a marginal habitat sediment class of gravelly Sand. The Folk sediment classification therefore provides a spatially variable indicator to spawning and hence the level of confidence is also variable (MarineSpace, 2013).
	Marginal sediment	Marginal sediment consists of Gravelly sand (gS)	2	
IHLS (ICES, 2007-2020)	High number of small larvae (per m^2)	0-11 mm length of larvae[3]. Highest number recorded over period 2007-2020 for each survey station. Score applied within contoured area with >600 larvae per m^2.	5	Highest score assigned as it is a direct indicator of presence/absence of larvae at the surface of the spawning habitat.
Identified historic spawning grounds (Coull *et al*, 1998)	Identified spawning grounds	Historic herring spawning grounds.	3	Whilst the Coull *et al*. (1998) layer has specifically been developed to show spawning grounds, the methods reported do not detail what types of data were used, lowering the confidence score assigned. In addition, this is a relatively old dataset.

[3] 0-11 mm larval length. Herring larvae of <11 mm size generally with yolk-sac still attached and associated with the benthos; or just post yolk-sac and liberating into the plankton.

3.1.42 The heat mapping method indicates that the offshore portion of the ECC, and the southern part of the northern array area and the northwest portion of the southern array area are all located in an area of medium data confidence (score 5-7), due to the presence of 'Marginal' and 'Preferred' spawning substrates, and low densities of herring larvae (<600 larvae m^2). The north portion of the northern array area and the nearshore to mid portion of the offshore ECC are located within an area of low data confidence (score 0-3), due to the presence of 'Marginal' and 'Preferred' spawning substrates, and densities of >600 herring larvae per m^2.

3.1.43 The remainder of the southern array area is located in an area of medium to high data confidence (score 8-10). This is due to the overlap of this portion of the southern array with the historic herring spawning ground (as defined by Coull *et al*., 1998), the presence of 'Marginal' spawning substrates, and densities of >600 herring larvae per m^2. However, PSA analysis of site-specific sediment samples, confirms that much of the southern array area classified as 'Marginal' habitat, are in fact unsuitable (Figure 3.9). This suggests that Method 2, over-represents the extent of suitable spawning substrates in the VE array areas and offshore ECC.

3.1.44 It should be acknowledged, that whilst the southern array area lies within an area of medium to high data confidence (score 8-10), indicative of a higher confidence that the seabed may be suitable for spawning, on a broader scale, 'Preferred' spawning substrates, and significantly higher densities of herring larvae are located to the south of the array areas. The Dover Strait is predominantly classified as 'Preferred' spawning substrates for herring, with larval densities ranging from 14,000 to 35,000 larvae per m^2, significantly higher than the larval densities within the VE array areas (0.1 – 7,000 m^2) and corresponding with the locations of spawning substrates. Further south, within the eastern English Channel, larval densities are at their highest, peaking at 98,500 larvae per m^2, and aligning with the broadscale distribution of 'Preferred' spawning substrates.

3.1.45 To summarise, potentially suitable spawning grounds are situated within the array areas. Low herring larval densities (as informed by IHLS survey data) are present across the array areas, and a historic Downs stock spawning ground (as defined by Coull et al, 1998) overlaps the southern array area. 'Preferred' spawning substrates (on account of their gravel content) are located to the south of the array areas, within the Dover Strait and eastern English Channel, where high intensity spawning activity is also apparent (as indicated by high herring larval densities recorded in annual IHLS surveys).

300000
400000
500000
5800000
5700000
5600000
N
0
5
10
20
Kilometers
0
10
20
40
Kilometers

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits

Herring Habitat Suitability Assessment

- 0 (Low)
- 2
- 3
- 5
- 6
- 7
- 8
- 10
- 11 (High)

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Herring Spawning Potential Heat Map

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.9

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,000,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

SANDEEL

3.1.46 Sandeels are a group of shoaling fish which lie buried in seabed sediments at night and feed on planktonic prey such as copepods and crustacean larvae in mid-water during daylight hours. Sandeels are an important trophic link in the North Sea food chain, between zooplankton and sandeel predators including piscivorous fish, most seabirds and mammals. As many marine predators rely on sandeels, coupled with their vulnerability to changes in habitat, sandeels are of increasing conservation interest and listed as a species of principal importance in the UK and designated as a nationally important marine feature.

3.1.47 Sandeel spawn in coarse sediments although, their preferred spawning habitats are sandier than those of herring. Sandeel prefer habitats composed of sand to gravelly sand but will tolerate sandy gravels as a marginal spawning habitat.

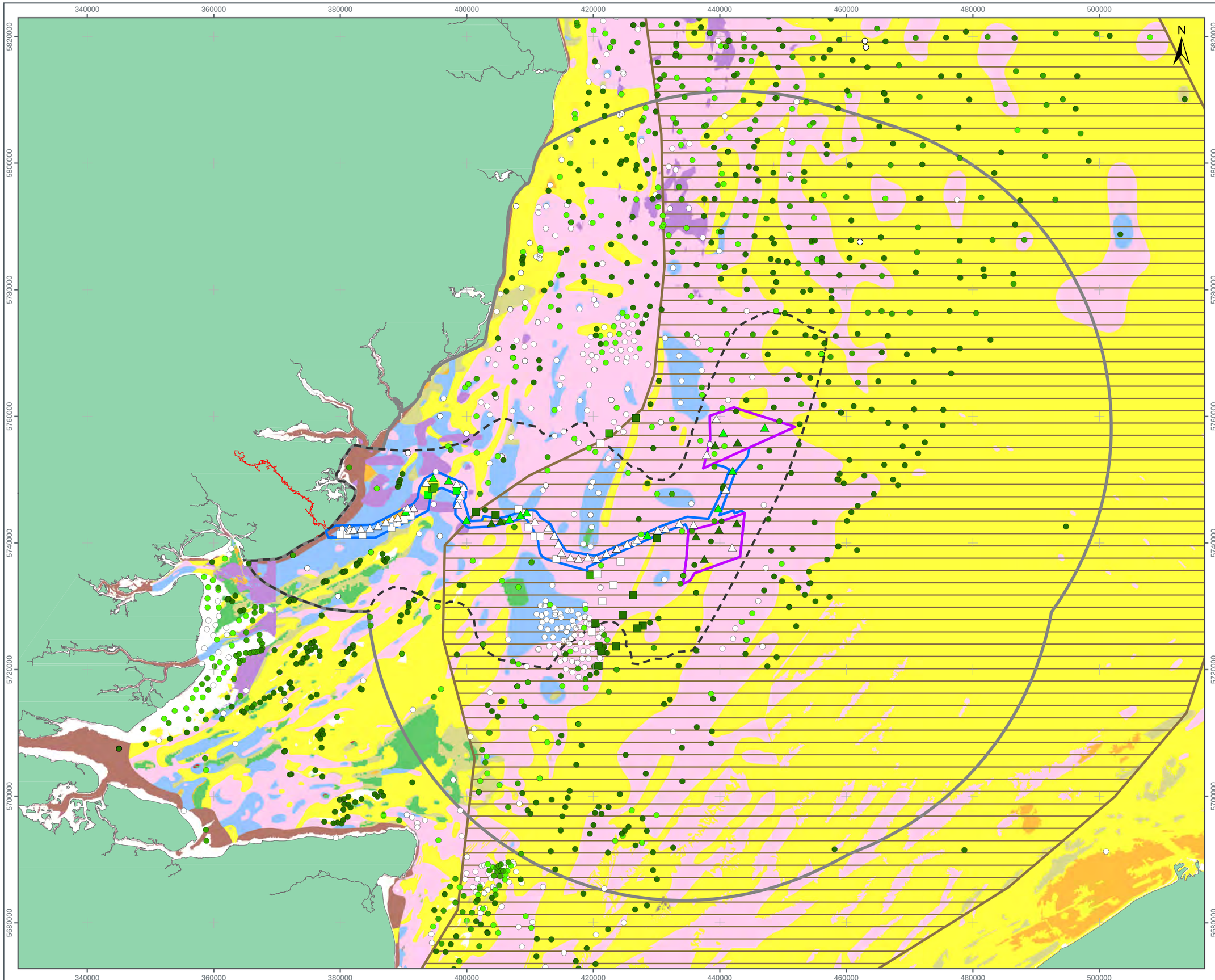
3.1.48 Sandeel are highly substrate specific (Wright *et al*., 2000); after an initial larval dispersal period, sandeel display a degree of site fidelity (Jensen *et al*., 2011) so their settled distribution reflects the distribution of preferred habitat. Sandeel rarely occur in sediments where the silt content (particle size <0.63µm) is greater than 4%, and they are absent in substrates with a silt content greater than 10% (Holland *et al*., 2005, Wright *et al*., 2000).

3.1.49 Areas of potential sandeel spawning habitat have been identified using site-specific PSA data (Fugro, 2022a,b). These data have been classified in accordance with the MarineSpace *et al*. (2013b) (adapted from Latto *et al.* (2013)) classifications as summarised in Table 3.3, for their suitability as sandeel habitat based on the distribution of sediment particle sizes, to further refine the understanding of areas of potential sandeel habitat within the proposed development site.

Table 3.3: Sandeel potential habitat sediment classifications (sources adapted from Latto *et al*., 2013).

Folk Class (Folk 1954)	Fractional composition	Habitat sediment preference	Habitat sediment classification
Part Sand, part slightly gravelly Sand and part gravelly Sand	<1% muds, >85% Sand	Prime	Preferred
Part Sand, part slightly gravelly Sand and part gravelly Sand	<4% muds, >70% sand	Sub-prime	Preferred
Part gravelly Sand and part sandy Gravel	<10% muds, >50% Sand	Suitable	Marginal
Everything excluding Gravel, part sandy Gravel and part gravelly sand	>10% muds, <50% sand	Unsuitable	Unsuitable

3.1.50 Site-specific PSA data (Fugro, 2022a,b) collected across the array areas were primarily characterised by coarse sediments, with sandy sediments located in both array areas, largely characterised as ‘prime, preferred’ and ‘sub-prime, preferred’ sandeel habitats. Site-specific PSA data (Fugro, 2022a,b) collected along the ECC show areas of ‘prime, preferred’ and ‘sub-prime, preferred’ sandeel habitat in the mid-section of the ECC, with nearshore and offshore sections of the ECC dominated in ‘unsuitable’ sandeel habitats (See Figure 3.10 and Figure 3.11).



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Sandeel Spawning Grounds (Coull *et al.*, 1998)

Sandeel Habitat Suitability (Latto *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Fine mud
- Muddy sand
- Seabed
- Coarse substrate
- Sediment
- Mixed sediment
- Worm reefs
- Sabellaria spinulosa reefs
- Rock or other hard substrata

0 5 10 20
Kilometers

Data Source:

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

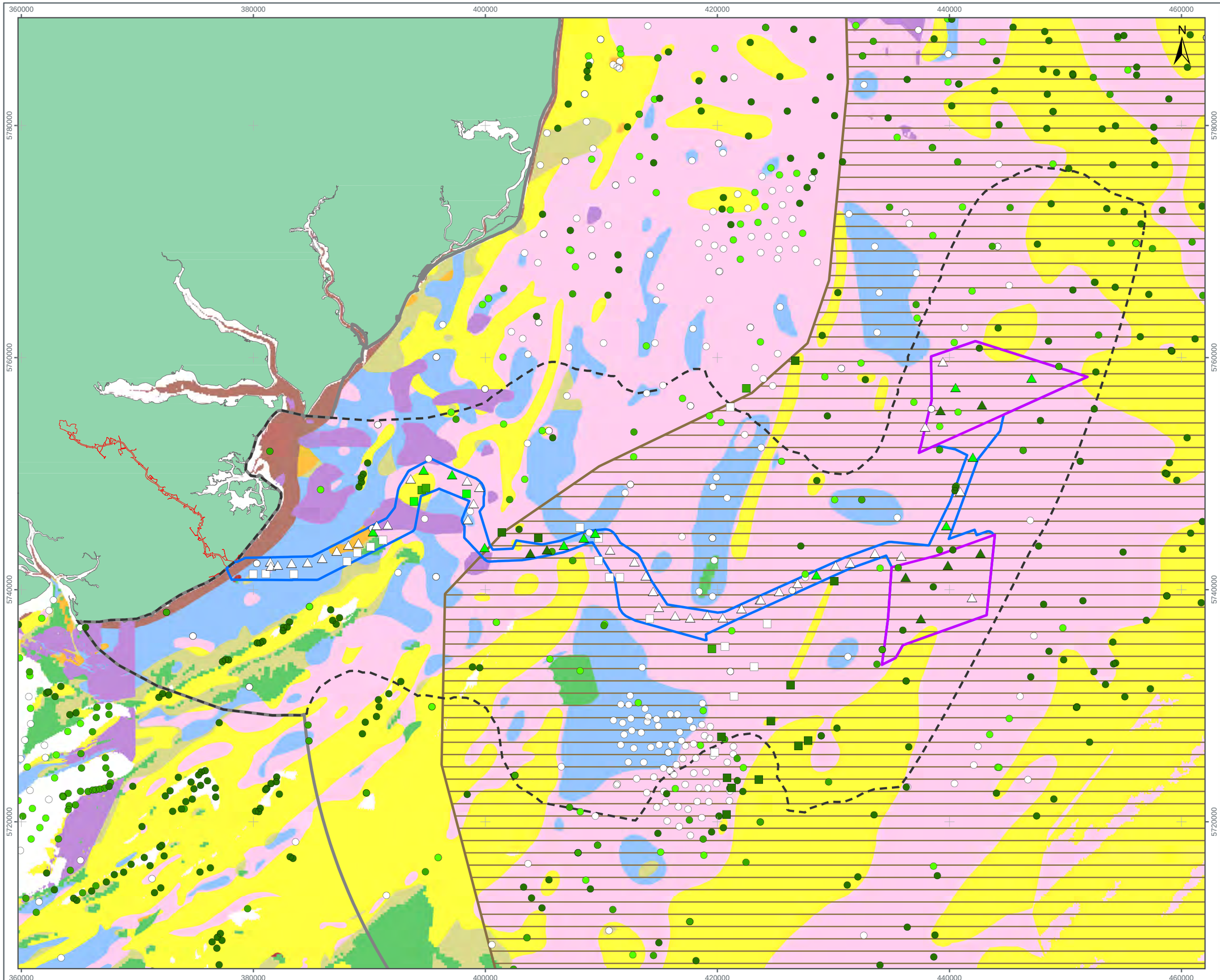
Sandeel Spawning Grounds relative to the Fish and Shellfish Study Area

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.10

SCALE: 1:550,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Sandeel Spawning Grounds (Coull *et al.*, 1998)

Sandeel Habitat Suitability (Latto *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Fine mud
- Muddy sand
- Seabed
- Coarse substrate
- Mixed sediment
- Worm reefs
- Sabellaria spinulosa reefs

0 2.5 5 10
Kilometers

Data Source:

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

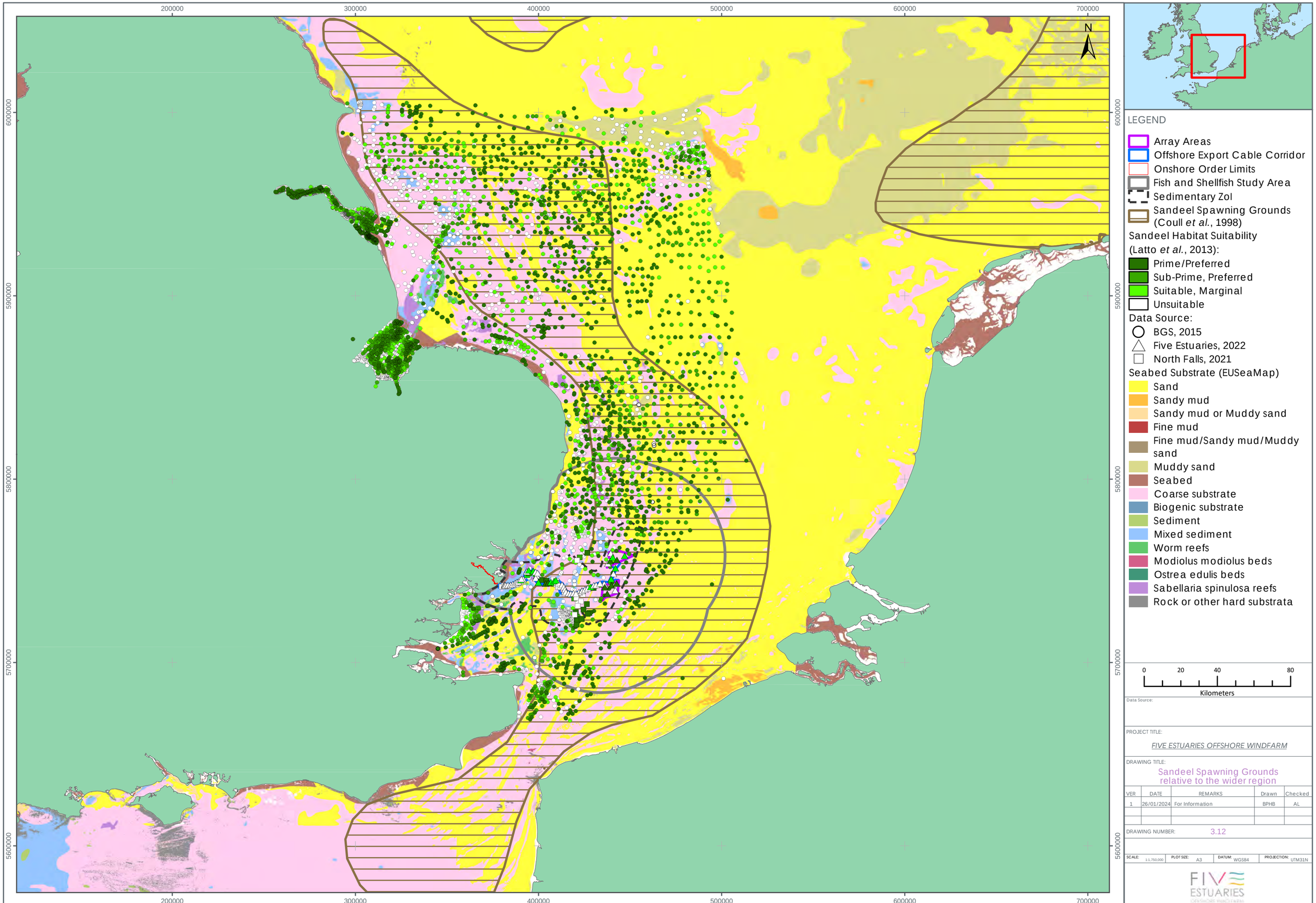
DRAWING TITLE:
Sandeel Spawning Grounds relative to Five Estuaries OWF

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.11

SCALE: 1:300,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES OFFSHORE WIND FARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Sandeel Spawning Grounds (Coull *et al.*, 1998)

Sandeel Habitat Suitability (Latto *et al.*, 2013):

- Prime/Preferred
- Sub-Prime, Preferred
- Suitable, Marginal
- Unsuitable

Data Source:

- BGS, 2015
- Five Estuaries, 2022
- North Falls, 2021

Seabed Substrate (EUSeaMap)

- Sand
- Sandy mud
- Sandy mud or Muddy sand
- Fine mud
- Fine mud/Sandy mud/Muddy sand
- Muddy sand
- Seabed
- Coarse substrate
- Biogenic substrate
- Sediment
- Mixed sediment
- Worm reefs
- Modiolus modiolus beds
- Ostrea edulis beds
- Sabellaria spinulosa reefs
- Rock or other hard substrata

0 20 40 80
Kilometers

Data Source:

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Sandeel Spawning Grounds relative to the wider region

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.12

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,750,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

3.1.51 Two methods have been used to map the distribution of suitability sandeel habitat in the areas between site specific PSA sampling locations:

METHOD 1

3.1.52 Site specific geophysical survey data were collected by Fugro across the VE array areas and offshore ECC in 2021 (Fugro, 2022c,d). Seafloor sediment classes were delineated from acoustic variations in the low frequency side scan sonar acoustic reflectivity and changes in morphology derived from the bathymetry. The seafloor sediments were also crosschecked against the sub-bottom profiler interpretation to ensure consistency between sensors. Sediment classifications were defined using a combination of the preliminary results of the environmental grab sampling, and BGS data.

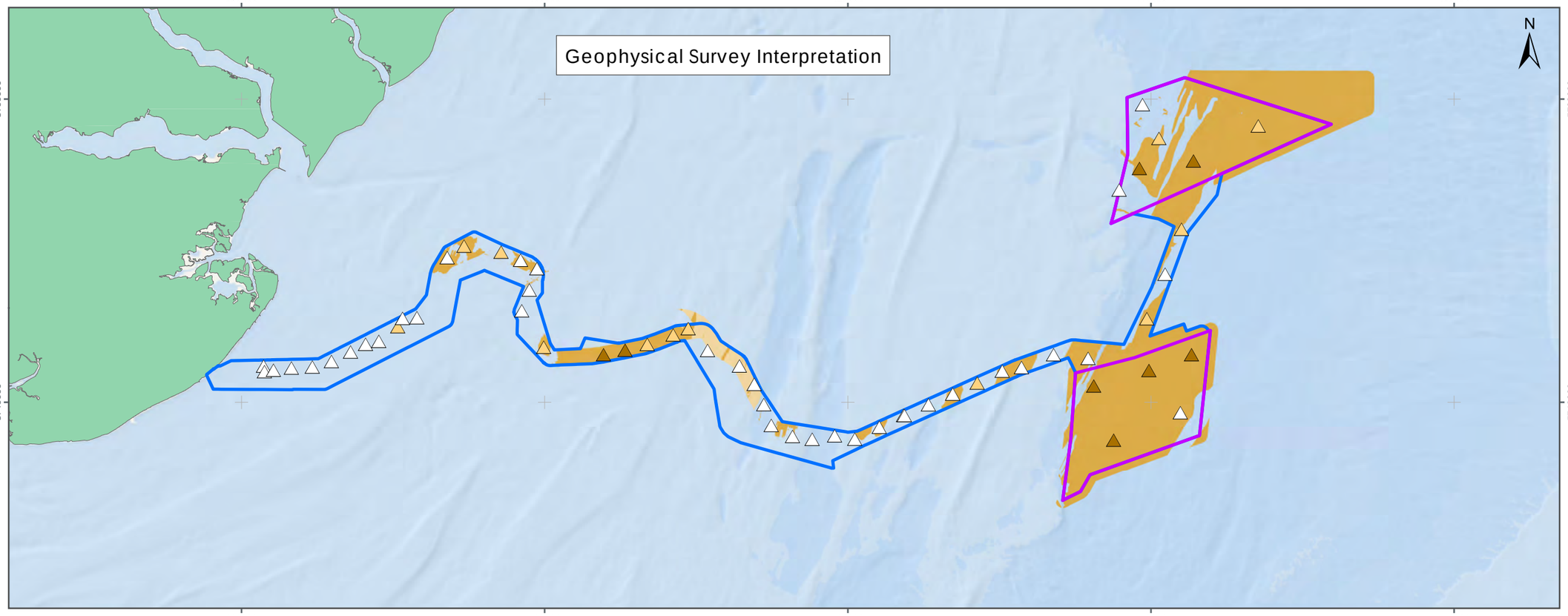
3.1.53 The seabed within the array areas is found to be dominated by coarse grained sediments, with sands and gravelly sands accounting for circa 75% of the footprint of the array areas. The remaining areas are characterised by the presence of muddy sand, which is found in the west of the northern array area and in localised northeast-to southwest-trending bands in the southern array area. The distribution of seabed sediments along the ECC is highly complex, with coarse grained (sands and gravels) and fine grained (muddy) sediments widespread (Fugro, 2022b). In many nearshore areas (<20 km from the coast), rock is found at or very near to the surface, alongside extensive areas of gravelly mud.

3.1.54 These have been classified using the Latto *et al*. (2013) sediment classifications to identify substrates suitable for sandeel spawning. This method has identified areas of 'Marginal' and 'Preferred' sandeel spawning habitat within the offshore portion of the ECC, and 'Preferred' spawning substrates within the nearshore portion of the ECC. The northern and southern array areas have also been classified as containing 'Preferred' sandeel substrates (Figure 3.11).

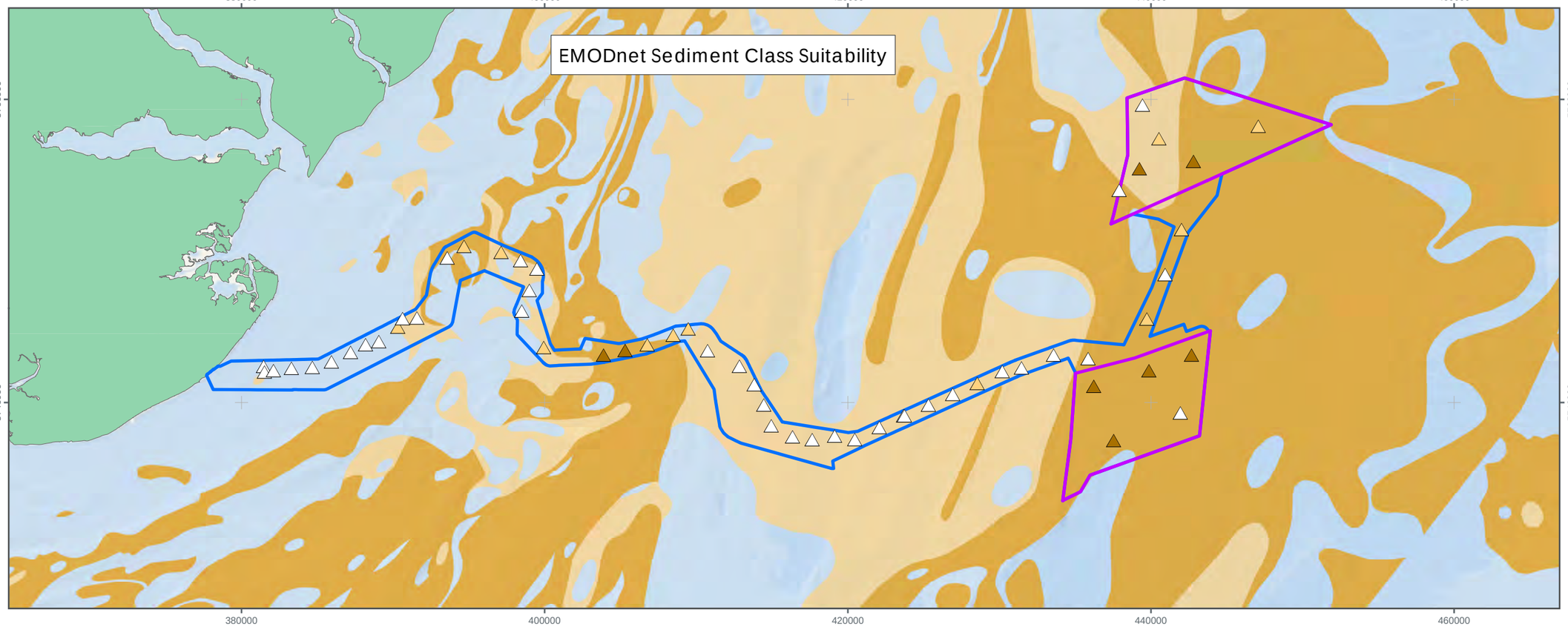
METHOD 2

3.1.55 This approach follows the methodology as detailed in MarineSpace Ltd *et al*., (2013b) and classifies existing EMODnet 1:250,000 sediment maps, which show the distribution of sediment classes, according to the sandeel spawning substrate preference categories as described in Table 3.3. The results show the presence of 'Preferred' sandeel habitats in the nearshore portion of the ECC, and 'Marginal' substrates in the offshore portion of the ECC. The northern array area consists of 'Marginal' and 'Preferred' sandeel substrates, and the southern array area is predominantly classified as 'Preferred' substrates (Figure 3.11).

Geophysical Survey Interpretation



EMODnet Sediment Class Suitability



LEGEND

- Array Areas
- Offshore Export Cable Corridor

Grab Samples - Sandeel Habitat Suitability (Latto *et al.*, 2013)

- Prime, Preferred
- Suitable, Marginal
- Unsuitable

Habitat Area
Sandeel Suitability

- Marginal
- Preferred

0 2.5 5 10
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Sandeel Habitat Suitability

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.13

SCALE: 1:300,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

3.1.56 Following the method similar to that described by MarineSpace Ltd *et al*., (2013b) potential sandeel habitat has been further assessed through the overlap of data layers that are deemed indicative of sandeel presence. The greater the number of overlapping data layers then the greater the 'heat' mapped and the higher the confidence that the seabed may be suitable and sandeels are present. The data layers used and the scores they contribute to the heat map, based on a confidence assessment of the data) are presented in Table 3.4.

Table 3.4: Confidence assessment for individual sandeel habitat data sources.

Data source	Data theme	Data notes	Confidence Score	Justification of confidence score
EMODnet 1:250,000 seabed sediment maps	Preferred sediment	Preferred sediment consists of Sand (S) and gravelly Sand (gS)	4	As detailed in Latto *et al*. (2013), sandeel is known to prefer Sand and gravelly Sand substrates for spawning; and also have a marginal habitat sediment class of sandy Gravel. The Folk sediment classification therefore provides a spatially variable indicator to spawning and hence the level of confidence is also variable (MarineSpace, 2013b).
	Marginal sediment	Marginal sediment consists of sandy Gravel (sG)	2	
Sandeel Fishing Grounds (Jensen *et al*. 2011)	Sandeel Fishing Grounds	Mapping of sandeel habitat based on GPS and VMS records of sandeel fishing vessels, and maps provided by fishers.	2	This dataset has been developed with the aim to identify sandeel fishing grounds. These data have therefore been used as a proxy for the presence of sandeel aggregations, lowering the confidence score assigned. In addition, this is a relatively old dataset.
Identified historic spawning grounds (Coull *et al*, 1998)	Identified spawning grounds	Historic sandeel spawning grounds.	3	Whilst the Coull *et al*. (1998) layer has specifically been developed to show spawning grounds, the methods reported do not detail what types of data were used, lowering the confidence score assigned. In addition, this is a relatively old dataset.

300000
400000
500000
5800000
5700000
5600000
N
0 5 10 20
Kilometers
LEGEND
Array Areas
Offshore Export Cable Corridor
Onshore Order Limits
Sandeel Spawning Area (Coull *et al.*, 1998)
Sandeel Fishing Grounds (Jensen *et al.*, 2011)
EMODnet Sediment Class
Sandeel Habitat Suitability
Marginal
Preferred
0 10 20 40
Kilometers
Data Source:
PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM
DRAWING TITLE:
Indicative Sandeel Spawning Data

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.14

SCALE: 1:1,000,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

3.1.57 The heat mapping indicates that the VE array areas and mid-section of the Offshore ECC lie within an area of high data confidence (score 6), due to the presence of 'Preferred' spawning substrates for sandeel, and the overlap of a historic spawning ground (as defined by Coull *et al*,.1998).

3.1.58 The nearshore portion of the Offshore ECC has been assigned a low confidence score (score 0-4) due to the absence of the historic sandeel spawning ground (as defined by Coull *et al*., 1998) and absence of suitable spawning substrates within the ECC. The offshore portion of the ECC is of medium confidence (score 4-5), due to the presence of 'Marginal' spawning substrates, and the overlap of offshore portion of the ECC with a historic sandeel spawning ground.

3.1.59 It should be acknowledged, that whilst the VE array areas and mid-section of the Offshore ECC lie within an area of high data confidence (score 6), indicative of a higher confidence that the seabed may be suitable for sandeel spawning, on a broader scale, 'Preferred' spawning substrates for sandeel are also located across the majority of the southern North Sea, Dover Strait, and eastern English Channel. Furthermore, the historic sandeel spawning ground as defined by Coull *et al*. (1998), also stretches across the southern North Sea.

3.1.60 To summarise, the presence of potentially suitable spawning substrates have been identified within the array areas mid-section of the ECC, which are located within a historic sandeel spawning ground (as defined by Coull *et al*, 1998). However, on a broader scale, significantly larger areas of 'Preferred' spawning substrates (on account of their sand content) are located across the southern North Sea, Dover Strait and eastern English Channel, within the defined sandeel spawning ground. Therefore, based on the available evidence outlined above, the area is considered to be unlikely to be a hotspot for sandeel spawning.

300000
400000
500000
5800000
5700000
5600000
N
0 5 10 20
Kilometers
0 10 20 40
Kilometers

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits

Sandeel Habitat Suitability Assessment

- 0 (Low)
- 2
- 3
- 4
- 5
- 6
- 7
- 9 (High)

Data Source:

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Sandeel Spawning Potential Heat Map

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.15

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,000,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

NURSERY GROUNDS

3.1.61 The North Sea provides important nursery ground habitat for a variety of fish species. A 'low intensity' nursery ground for mackerel intersects the study area (Ellis *et al.*, 2012). This assignment of 'low intensity' is supported by ICES International Bottom Trawl Surveys (ICES Database on Trawl Surveys (DATRAS), 2023b) undertaken across the North Sea. Relative frequencies of the presence of aggregations of juvenile mackerel (0 group), from 2010 to 2020 (Q4 and Q1), showed aggregations of juveniles in the northern North Sea and eastern channel, with comparatively lower aggregations of juveniles in the VE study area.

3.1.62 A 'low intensity' nursery ground for plaice intersects the study area (Ellis *et al.*, 2012). This assignment of 'low intensity' is supported by ICES Beam Trawl Surveys (ICES Database on Trawl Surveys (DATRAS), 2023a) undertaken across the North Sea. Relative frequencies of the presence of aggregations of juvenile plaice (0 group), from 2010 – 2020 (Q3 catches), showed aggregations of juvenile plaice (0 group) to the eastern extent of the Southern Bight, off the coasts of Belgium and the Netherlands, with comparatively smaller aggregations in the wider Thames Estuary.

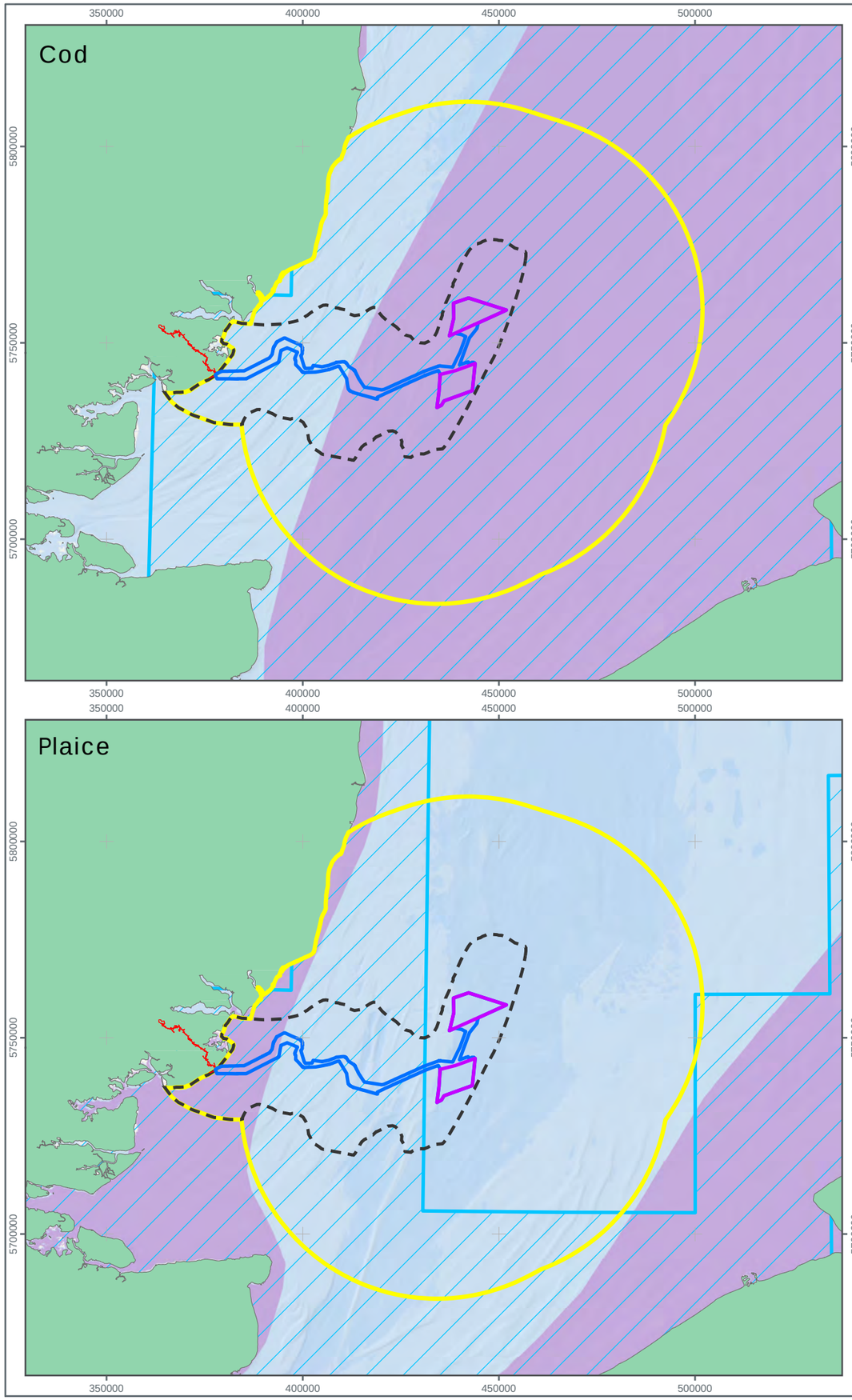
3.1.63 A 'low intensity' nursery ground for common sole intersects the study area (Ellis *et al.*, 2012). This is evidenced in the ICES North Sea beam trawl surveys (ICES DATRAS, 2023a), from 2010 – 2020 (Q3 catches), which show juvenile aggregates (relative frequency) (0 group) within the VE study area and across the Southern Bight, and the eastern channel. Comparatively lower aggregations of juvenile sole were observed in the northern North Sea.

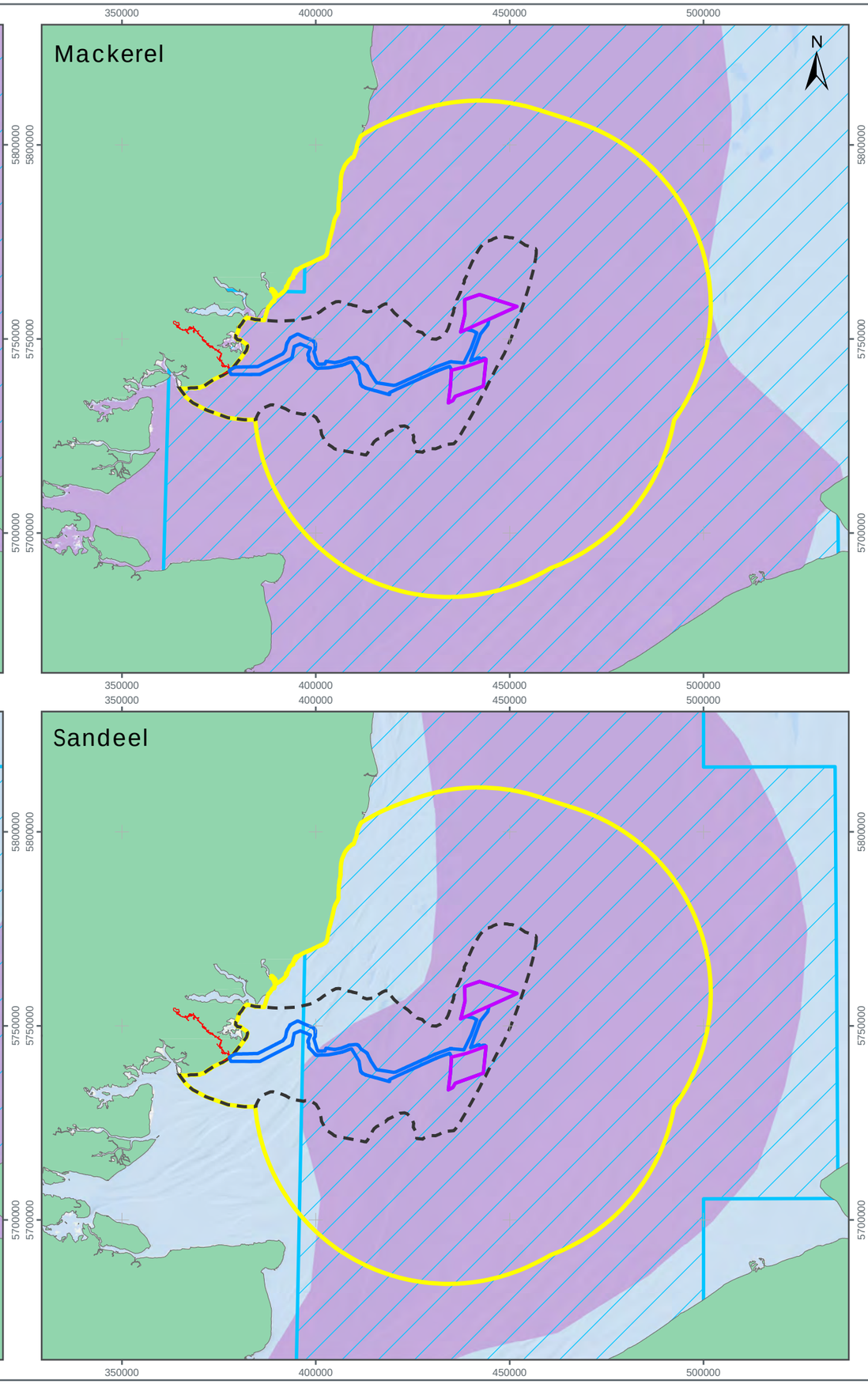
3.1.64 A 'low intensity' nursery ground for whiting intersects the study area (Ellis *et al.*, 2012). This assignment of 'low intensity' is supported by ICES International Bottom Trawl Surveys (ICES Database on Trawl Surveys (DATRAS), 2023b) undertaken across the North Sea. Relative frequencies of the presence of aggregations of juvenile whiting (0 group), recorded from 2010 to 2020 (Q3 and Q4), showed aggregations of juveniles in the southern North Sea, with comparatively lower aggregations of juveniles in the VE study area.

3.1.65 A 'high intensity' herring nursery ground also overlaps the nearshore section of the ECC (Ellis *et al.*, 2012) (Figure 3.9). Herring nursery grounds are significant in size, covering much of the coastal areas of the UK, and the Wadden Sea. This indicates that the study area only intersects with a small section of these high intensity nursery grounds. The study area also interacts with low intensity nursery grounds for cod, sandeel, thornback ray and tope (Ellis *et al.*, 2012) (Figure 3.16 and Figure 3.17). Nursery grounds for these species are significant in size, with coverage across much of the southern North Sea and the eastern Channel. Nursery grounds for lemon sole also intersect the study area (Coull *et al.*, 1998) (Figure 3.18). This is evidenced in the ICES bottom trawl surveys (ICES DATRAS, 2023a), from 2010 – 2020. Relative frequencies of the presence of aggregations of juvenile lemon sole (0 group), recorded from 2010 to 2020 (Q3), showed aggregations of juveniles across the North Sea, the eastern channel, and the wider Thames Estuary, within the VE study area.

3.1.66 Nursery grounds for sprat also intersect the study area (Coull *et al.*, 1998) (Figure 3.18). Relative frequencies of the presence of aggregations of juvenile sprat (0 group), recorded in International Bottom Trawl Surveys (ICES DATRAS, 2023b) from 2010 to 2020 (Q3 and Q4), showed aggregations of juveniles in the southern North Sea with a small aggregation identified in the wider Thames Estuary, aligning with the historic nursery ground (Coull *et al*, 1998) identified within the VE study area.

3.1.67 Key nursery areas for European seabass are present across the wider Thames estuary (Hyder *et al.*, 2018). Juvenile seabass occupy nursery grounds in estuaries and coastal areas for up to their first six years of life, during which time they are subject to being bycatch in fisheries. Bass Nursery Areas (BNAs) were designated in England and Wales in the 1990s to reduce the impact of commercial and recreational fishing in areas where the majority of sea bass were likely to be below the minimum conservation reference size (Hyder *et al.*, 2018). The nearest BNA to VE is located within the Blackwater estuary, approximately 23 km from the ECC, outside of the ZOI of the project (Figure 3.19). Whilst there are no BNAs within the ZOI of VE, the Eastern IFCA have proposed amendments representing new seabass nursery areas within the Alde and Ore, Orwell and Stour estuaries (Hyder *et al.*, 2018), following previous analysis of Environment Agency sampling in support of the Water Framework Directory (Longley and Rudd, 2014) alongside other local sources of data, which indicated the importance of the estuaries as nursery grounds for juvenile fish including seabass (Colclough, 2015).





LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI

Nursery Grounds (Ellis, 2012)

- Higher Intensity
- Lower Intensity

Nursery Grounds (Coull, 1998)

- Active Nursery Grounds

0 10 20 40

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Cod, Mackerel, Plaice and Sandeel Nursery Grounds relative to the Project

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.16

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

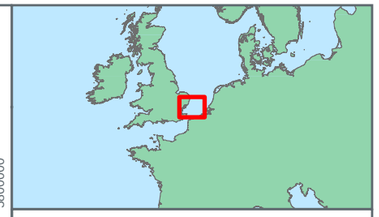
Sole

Thornback Ray

Tope

Whiting

N



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI

Nursery Grounds (Ellis, 2012)

- Higher Intensity
- Lower Intensity

Nursery Grounds (Coull, 1998)

- Active Nursery Grounds

0 10 20 40

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

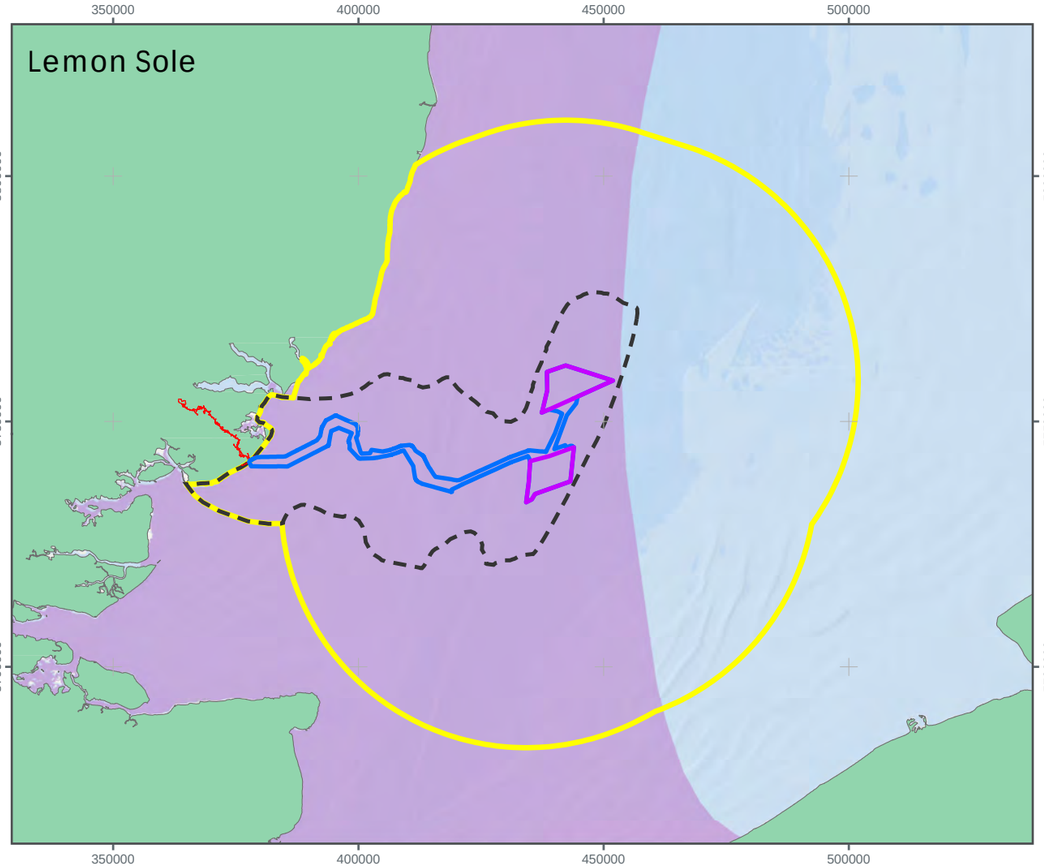
Sole, Thornback Ray, Tope and Whiting Nursery Grounds relative to the Project

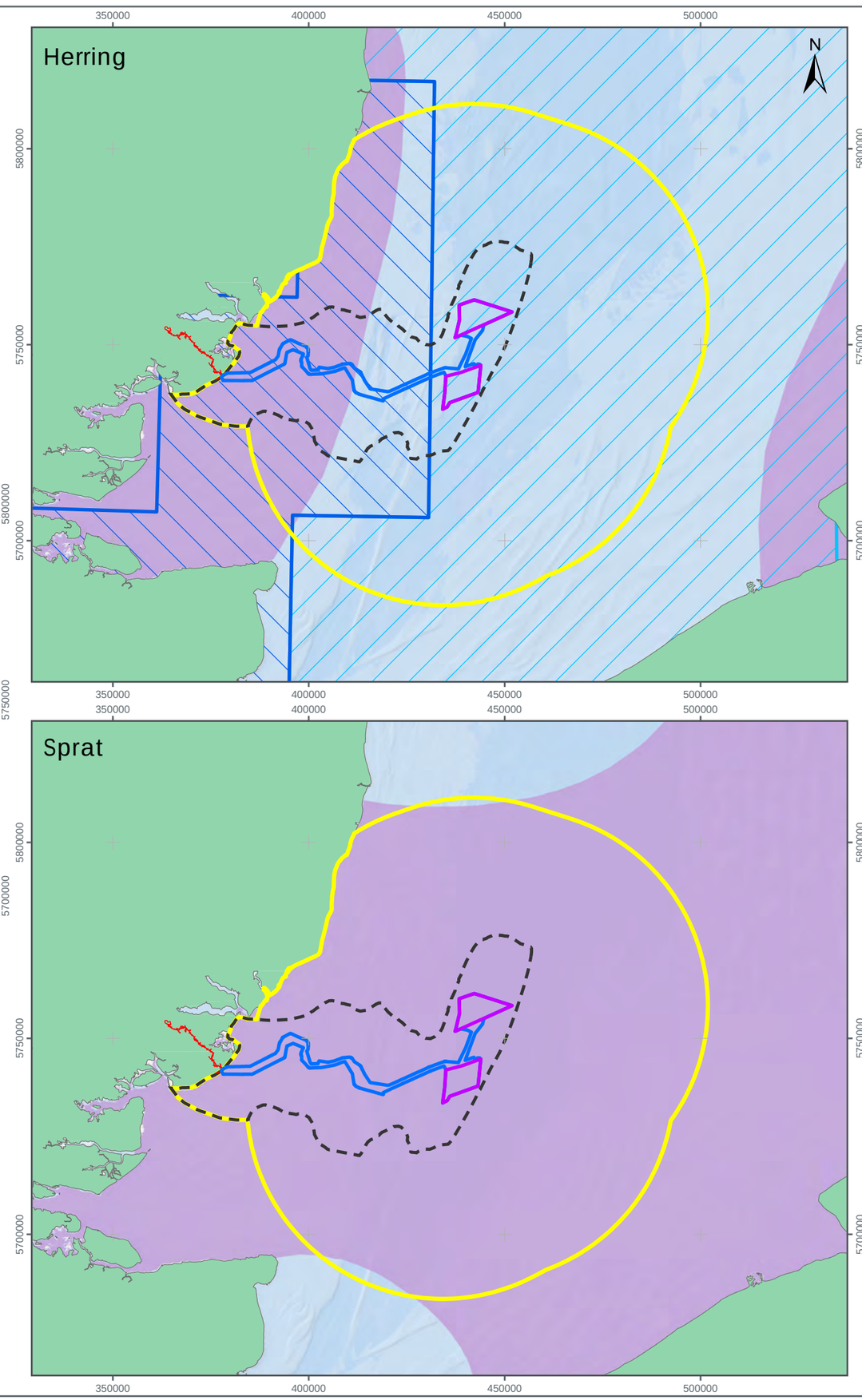
VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

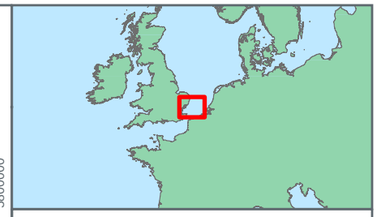
DRAWING NUMBER: 3.17

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM







LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI

Nursery Grounds (Ellis, 2012)

- Higher Intensity
- Lower Intensity

Nursery Grounds (Coull, 1998)

- Active Nursery Grounds

0 10 20 40
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

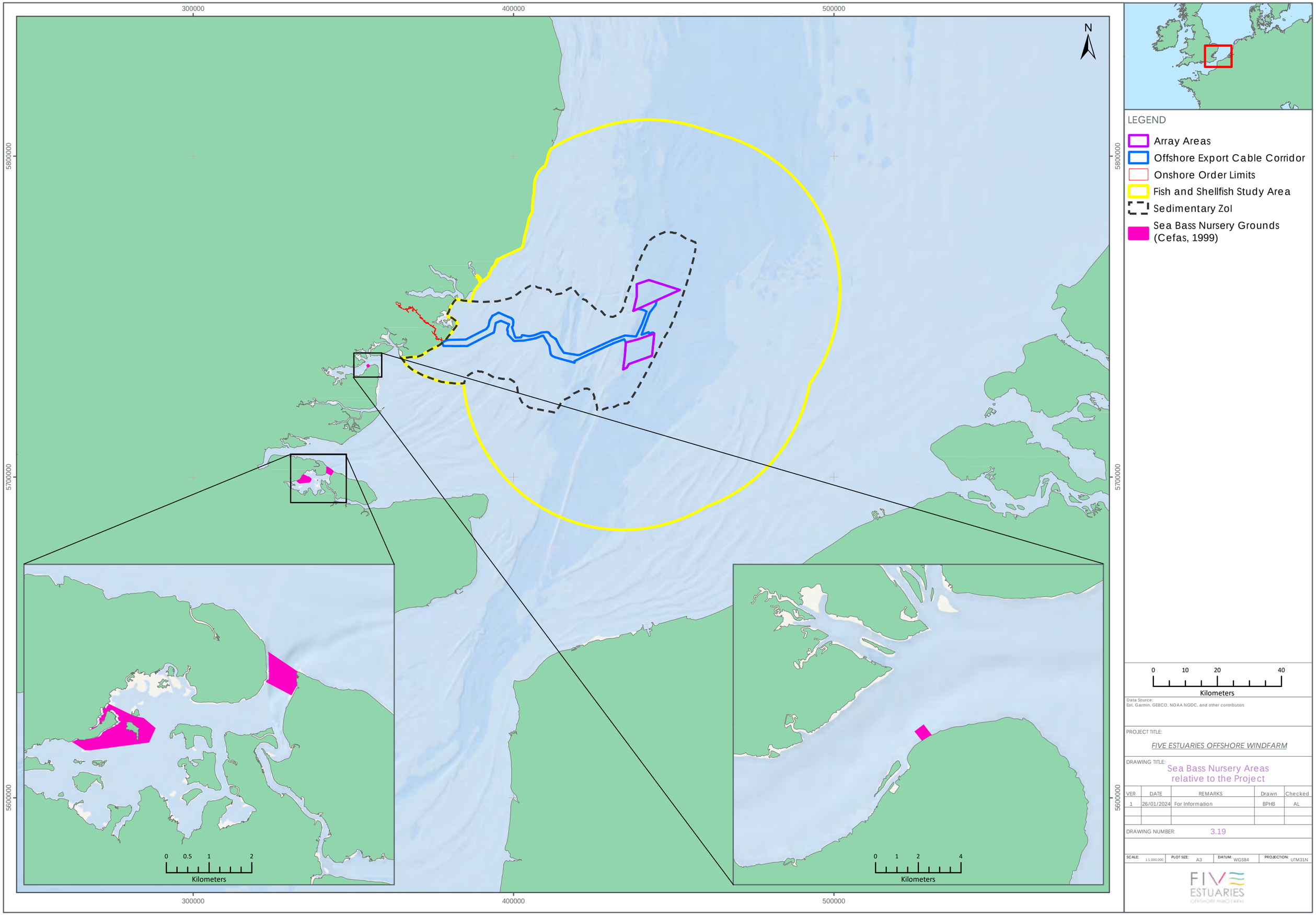
Lemon Sole, Herring, Sprat
Nursery Grounds relative to the Project

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	AL

DRAWING NUMBER: 3.18

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WINDFARM



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Sea Bass Nursery Grounds (Cefas, 1999)

0 10 20 40
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Sea Bass Nursery Areas relative to the Project

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.19

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,000,000	A3	WGS84	UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

. SPECIES OF COMMERCIAL IMPORTANCE

3.1.68 Detailed information on species of commercial importance is provided in Volume 6, Part 2, Chapter 8: Commercial Fisheries, which identifies cockle (*Cerastoderma edule*), whelk, lobster and brown crab as key commercial shellfish species in the region. Key commercially important demersal finfish were identified as sole, plaice, thornback ray, bass, red mullet, brill *Scophthalmus rhombus*, turbot, tub gurnard, whiting, dab and flounder. Pelagic species of commercial importance were identified in Volume 6, Part 2, Chapter 8: Commercial Fisheries as herring, mackerel, horse mackerel, sprat and bluefin tuna (*Thunnus thynnus*). It should be noted that bluefin tuna have not been identified or included in the assessment but are common seasonal visitors to the North Sea (Horton *et al*., 2021).

3.1.69 Fisheries landings from ICES rectangle 32F1 (VE offshore ECC) from 2016 to 2020 indicate that the key species landed are cockles, sole, common whelk, sea bass, thornback ray and European lobster. Landings from ICES rectangle 32F2 (inclusive of the array areas) are common whelk, sole, red mullet *Mullus surmuletus*, horse mackerel and plaice. By both weight (landed weight, tonnes) and value, landings from both rectangles have shown some fluctuation across the five-year time series, with a relative peak in 2019, and being at their lowest in 2017 (MMO, 2022).

3.1.70 Landings data in 2022 into Whitstable and Leigh-on-Sea ports were both dominated in shellfish in quantity. Landings from ICES rectangle 32F1 (VE offshore ECC) in 2022 were dominated in cockles, whelk, sole, sprats, bass, lobsters, thornback ray, Pacific oysters and brown crab by quantity (landed weight, tonnes) and value. Landings from ICES rectangle 32F2 (inclusive of the array areas) in 2022 were dominated in squid, whiting, striped red mullet, mackerel, horse mackerel, tub gurnards, whelks and cockles by weight and value (MMO, 2023).

3.1.71 Whelk fisheries are located along the east coast of the UK, with the highest fishing effort recorded in The Wash and North Norfolk. Various byelaws have been implemented by KEIFCA across the KEIFCA district to ensure the sustainable management of the whelk fisheries in the region for the benefit of fishermen, the local economy, and marine ecosystems alike. These include the Whelk Fishery Permit Byelaw (2013), the Whelk Fishery Flexible Permit Byelaw (2020) and the Whelk Minimum Size Emergency Byelaw (2020). The Whelk Permit Byelaw Update (KEIFCA, 2022a) reports an overall increase in fishing effort, landings and number of fishers since the introduction of the byelaws. Recent reports from the KEIFCA (EIFCA, 2020a) observe similar findings, highlighting an increase in annual landings of whelk in the past ten years in districts along the east coast of England, with the most significant increase recorded from 2008 to 2016, with recorded landings increasing from 8 tonnes to 2,274 tonnes. Landings per unit effort (LPUE) (used as an indication of the health of stocks) show an increase in whelk stock levels between 2015 and 2019 (2.2 - 2.8 LPUE (total landings/pots hauled), respectively) (KEIFCA, 2020a).

3.1.72 Two main cockle fisheries are located along the east coast; The Wash Fishery located to the north of VE, and the Thames Estuary fishery to the south of VE. Annual surveys of cockle and mussel stocks within The Wash indicated a significant decline in mussel stocks in 2019, this resulted in the closure of the 2019 cockle fishery prior to the exhaustion of the Total Allowable Catch (TAC)[4]. The closure of the 2019 cockle fishery therefore reduced potential impacts to the TAC for the 2020 cockle fishery and the fishery was re-opened in June 2020, with a TAC of 3,636 tonnes. Once the TAC was met, the fishery was closed again in August 2020 (EIFCA, 2020b). Annual surveys of cockle stocks within the Thames Estuary indicate periodic fluctuations in populations, which are considered within the natural range of the stocks. Recent observations made in the 2021 cockle stock surveys (Haupt, 2022) show a decline in adult cockle stock sizes to normal levels, following peaks in cockle stocks from 2017 to 2019. Although reportedly, the influence of two consecutive years of exceptionally low spatfall[5] as recorded in 2019 and 2020 on the adult stock of 2022 and potentially 2023 are considered likely to play out over the next two years, before the 2021 spat enters the adult population (Haupt, 2022).

3.1.73 A native oyster *Ostrea edulis* fishery lies within the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ), which lies approximately 4 km from the nearshore section of the VE ECR. This fishery has remained closed since 2015, under the Shellfish Beds Byelaw due to inadequate stock. The fishery will only be reopened once native oyster stocks within the public grounds of the MCZ have fully recovered. Oyster stock surveys undertaken in 2019 (Dyer, 2019) reported a stable oyster stock within the MCZ, although whilst the MCZ contains a significant stock of adult oysters, limited juveniles were present. Therefore, as clarified by Dyer (2019), significant spatfall and successful settlement of larvae will be necessary to support sustained growth of the population and recovery of oyster stocks within the MCZ on the basis of the results of these surveys, and under byelaw, it was determined that the oyster fishery within the MCZ is to remain closed.

[4] A decline in mussel stocks will mean a greater reliance on cockle stocks to ensure bird food resource, and therefore to ensure the resource requirements are met, cockle restrictions were required to be implemented) (EIFCA, 2020b).
[5] The settlement of small bivalves after their pelagic larval phase.

3.1.74 The southern North Sea brown crab stock supports three distinct fisheries, the Holderness fishery off Yorkshire, and two Norfolk fisheries (Cefas, 2020a) located to the North of VE and outside of the fish and shellfish study area. Landings of brown crab into Norfolk (ICES rectangles 34F1 and 35F0), make up 48.2% and 38.6% of total annual landings and 56.2% and 27.8% of total annual effort (pot hauls) respectively within the Eastern IFCA region. Whereas landings into the Kent and Essex IFCA region (ICES rectangle 33F1), within the northern extent of the study area are significantly lower, with lower levels of fishing effort (EIFCA, 2020c). The European lobster stock size in East Anglia is thought to be low, with a high exploitation rate around the Minimum Landing Size (Low sampling levels make the uncertainty on stock status high for this stock) (Cefas, 2020b). Although landings of European lobster into Norfolk (ICES rectangles 34F1 and 35F0) make up 49.5% and 32.2% of total annual landings, respectively within the Eastern IFCA region. Whereas landings into the Kent and Essex IFCA region (ICES rectangle 33F1), within the northern extent of the study area are significantly lower, with lower levels of fishing effort (EIFCA, 2021).

3.1.75 A herring fishery lies within the Outer Thames estuary; following stock declines, a redefined area for a licensed, driftnet-only herring fishery was introduced at the start of the 1988-1989 fishing season, and landings monitored so as not to exceed the annual Total Allowable Catch (TAC) (KEIFCA, 2022b). The fishery became the first accredited MSC fishery in the world in 2004, however this recognition did not raise significant interest or sales and the accreditation lapsed in 2010 (KEIFCA, 2022b). Since then, the fishery has continued intermittently at a small scale, managed by the MMO and Cefas. However, recent stock assessments of the fishery have identified that herring stocks in this area are below biomass limits, and the fishery is therefore currently closed (as of 31st January 2022) to the wider fishing community (MMO, 2022b).

MIGRATORY SPECIES

3.1.76 Migratory fish are fish that spend part of their life cycle in freshwater and part in seawater; such species are termed diadromous. The UK Salmon and Freshwater Fishery Act (1975) (amended) recognises three migratory species: Atlantic salmon *Salmo salar*, sea trout *Salmo trutta* and European eel.

3.1.77 There are a number of additional species known to migrate through the study area, of conservation interest and of relevance to VE. These include smelt, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* and two species protected under the Habitats Directive, the allis shad and twaite shad.

ATLANTIC SALMON

3.1.78 Atlantic salmon are designated under Annex III of the Bern convention and freshwater populations on Annexes II and V of the EC Habitats Directive. Atlantic salmon are also a UK Biodiversity Action Plan (BAP) priority fish species.

3.1.79 Atlantic salmon are anadromous fish, spawning in freshwater and feeding at sea. Salmon spawn in upper reaches of rivers, where they live for one to three years before migrating to sea as smolts. At sea, salmon grow rapidly and after one to three years return to their natal river to spawn.

3.1.80 Historically, salmon have been found to be distributed throughout the Thames estuary region and have been known to migrate to freshwater through the Thames estuary to spawn, and therefore have the potential to transit the study area. During migrations in coastal or offshore waters, salmon spend most of their time within 4 m of the surface, although frequent diving behaviour may also be observed (Malcolm *et al*., 2010).

3.1.81 Atlantic Salmon were recorded in the Stour, Duddon and Thames catchments from 2017-2019 (Environment Agency, 2020), although no Atlantic salmon were recorded in any of the monitoring surveys undertaken for offshore wind developments within the study area (noting that these surveys deployed demersal trawls only). Despite this, it is considered possible that this species will pass through the site on their migrations.

SEA TROUT

3.1.82 Sea trout are known to migrate through the Thames Estuary and could potentially pass in close proximity to VE. Sea trout do not appear to take the same sea migration as salmon, but remain in coastal waters, likely close to their natal river. In addition to this, they are considered more likely to enter an estuary and wait there in the pools for conditions to be right for the run upriver rather than remaining at sea off the estuary mouth as salmon tend to do (Wild Trout Trust, 2022).

3.1.83 Sea trout were found to present within the Colne and Stour catchments from 2018-2019 (Environment Agency, 2020). However, no sea trout were recorded in any of the monitoring surveys undertaken for offshore wind developments within the study area (noting that these surveys deployed demersal trawls only), although it is possible that this species will pass through the VE study area on their migrations.

EUROPEAN EEL

3.1.84 European eel are listed as critically endangered on the IUCN Red List and are UK BAP priority fish species. In addition, The Eels (England and Wales) Regulations 2009 (hereafter the Eels Regulations), and Eel Recovery Plan (Council Regulation No 1100/2007) as implemented in accordance with the Eels Regulations, have been established with an aim to protect migrating eels.

3.1.85 European eel are catadromous, feeding in freshwater and spawning at sea. The migration routes of adult eels do not appear to hug the UK coastline, however data on European eel movements is scarce (Malcolm *et al*., 2010).

3.1.86 European eel have long been associated with the River Thames, however monitoring of eels within the Thames has indicated that very few one year old eels are present and it has been suggested that most eels may spend their first year in the lower estuary (Defra, 2010). ICES (2021) reported significant declines in glass and yellow eel recruitment in the North Sea from 1980 to 2011, with time series data from 1980 to 2021 showing that glass eel recruitment remains at a very low level. The Thames European Eel Project has undertaken annual monitoring of eel populations since 2005 and has observed overall declines in recruitment (Zoological Society of London (ZSL), 2020), noting several anthropogenic, oceanic and climatic factors as potential causes of the recorded decline; these include loss of habitat, pollution, barriers to migration, hydropower, and exploitation from commercial and recreational fishing (Feunteun, 2002; Dekker, 2003; Chadwick *et al*., 2007). European eels were recorded in pre-construction seasonal fisheries surveys for Gunfleet Sands OWF in August 2007 (RPS, 2007a).

SMELT

3.1.87 Smelt are a UK BAP priority fish species and a Section 41 Priority species.

3.1.88 Smelt are an inshore migratory fish widely distributed in shallow waters of the continental shelf, but most common close to river mouths and in estuaries, especially in the southern North Sea. The strongest and most permanent stocks seem to be those associated with the larger estuaries (e.g., the Thames), especially where there is a complexity of minor or nearby smaller estuaries (Maitland, 2003). No smelt were recorded in any of the monitoring surveys undertaken for offshore wind developments within the study area (noting that these surveys deployed demersal trawls only), although it is possible that this species will pass through the VE study area on their migrations.

RIVER LAMPREY AND SEA LAMPREY

3.1.89 River lamprey and sea lamprey are designated under Appendix III of the Bern Convention, Annex II of the EC Habitats Directive, Schedule 5 of the Wildlife and Countryside Act, UK BAP priority fish species.

3.1.90 River and sea lamprey spend most of their life in coastal waters, entering estuaries to spawn in the spring. Sea lampreys spawn in the lower reaches of rivers before returning to sea in early summer, followed by young-of-the-year in the autumn. River lampreys migrate further upstream, and the juveniles remain in the river until spring when they emigrate to the lower estuaries or coastal waters where they remain for 1-2 years before returning to spawn.

3.1.91 Both river and sea lamprey appear to be re-establishing in the Thames, with sea lamprey being recorded within the summers of 2000 and 2001, and river lamprey recorded in autumn 2001 (Colclough, 2002).

3.1.92 Neither river nor sea lamprey were recorded in any of the monitoring surveys undertaken for offshore wind developments within the study area (noting that these surveys deployed demersal trawls only), although it is possible that these species will pass through the VE study area on their migrations.

ALLIS SHAD AND TWAITE SHAD

3.1.93 Allis shad and twaite shad are designated under Appendix III and Appendix II of the Bern Convention, respectively, Annexes II and V of the EC Habitats Directive, Schedule 5 of the Wildlife and Countryside Act 1981 and are UK BAP priority fish species.

3.1.94 Allis shad and twaite shad are members of the herring family that spend most of their late juvenile and adult life in coastal waters. In spring, the mature adults enter estuaries and move upstream to the lower reaches of freshwater where they lay their eggs before returning (May-June) to the sea. The post-larval fish drift downstream in late summer and young-of-the-year reach the estuaries in autumn where they probably remain over winter (Potts and Swaby, 1993). It should be noted however, that allis shad populations have declined considerably from pollution, over-fishing and river constructions, with the River Tamar being the only known spawning location in the UK (Hillman, 2020).

3.1.95 Studies of twaite shad in the southern North Sea have indicated an increase in the species' spawning population in recent decades (Magath and Thiel, 2013). This is supported by records of twaite shad in pre-construction fish surveys conducted for GGOWL in 2008 (Brown and May Ltd., 2009b), and beam trawl surveys conducted for the Galloper OWF (CMACS, 2010). No allis shad were recorded in any of the monitoring surveys undertaken for offshore wind developments within the study area (noting that these surveys deployed demersal trawls only).

ELASMOBRANCHS

3.1.96 Elasmobranchs are the group of electrosensitive fish that includes sharks, rays and skates. Elasmobranchs can detect the electrical fields emitted by themselves and other organisms. The most widely known use of electric fields is for prey detection, where the prey item generates an electric field that the predator senses. Electrosensitivity can also be used for orientation. Elasmobranchs are therefore considered a sensitive receptor to electromagnetic fields (EMF) emitted from operational cables.

THORNBACK RAY

3.1.97 Thornback ray, a species of conservation importance (Oslo Paris Convention (OSPAR)), have been recorded across the study area in surveys (Brown and May Ltd., 2009; Brown and May Ltd. 2010; Marine Space, 2015; RPS, 2007a,b; RWE, 2008; and Brown and May Ltd., 2014) conducted within the VE study area and across the wider region. There is also a thornback ray nursery ground located within the VE study area (Figure 3.17). In a broader context, thornback ray are typically most abundantly recorded in the southwestern North Sea, especially in the Outer Thames Estuary and the Wash.

LESSER SPOTTED DOGFISH

3.1.98 Lesser spotted dogfish have been recorded in in surveys within the study area (Brown and May Ltd., 2009; Brown and May Ltd., 2010; Marine Space, 2015; Brown and May Ltd., 2014) conducted within the VE study area and across the wider region. Lesser spotted dogfish are commonly found all around the UK but occur in greater numbers on the south and west coasts of the British Isles. Modelled spatial distributions of lesser-spotted dogfish showed populations concentrated within the southernmost parts of the North Sea, primarily in the Thames and Humber regions (Sguotti *et al*., 2016).

SPURDOG

3.1.99 Spurdog were recorded within Greater Gabbard OWF elasmobranch surveys within the VE study area (Brown and May Ltd., 2014). Spurdog are commonly found in the western North Sea and off the Orkney and Shetland. Modelled spatial distributions of spurdog showed populations were widely distributed within the North Sea, with concentrations varying between the Northern and Southern North Sea (Sguotti *et al*., 2016).

TOPE SHARK

3.1.100 Tope were recorded within Greater Gabbard OWF elasmobranch surveys within the VE study area (Brown and May Ltd., 2014), in addition tope also have low intensity nursery grounds within the study area (Figure 3.17). Tope are a species of conservation importance, listed as Vulnerable on the IUCN Red List. Tope are typically distributed along the south and west of England, in Welsh waters and along the west coast of Scotland, favouring mixed grounds, and sandy and shingle areas, usually in areas with a strong tidal flow. Modelled spatial distributions of tope show population concentrations within the eastern part of the North Sea, off the continental coast (Sguotti *et al*., 2016).

SMOOTHHOUND

3.1.101 Smoothhound were recorded within Greater Gabbard OWF elasmobranch surveys within the VE study area (Brown and May Ltd., 2014). The range of smoothhound within UK waters is increasing, once predominantly found to the south and west of the British Isles, smoothhound are now caught with some regularity from the east of England and have been reported in increasing numbers from the coastlines of Cumbria, Yorkshire and the Northeast. Modelled spatial distributions of smoothhound show population concentrations within the southern part of the North Sea (Sguotti *et al*., 2016).

DESIGNATED SITES

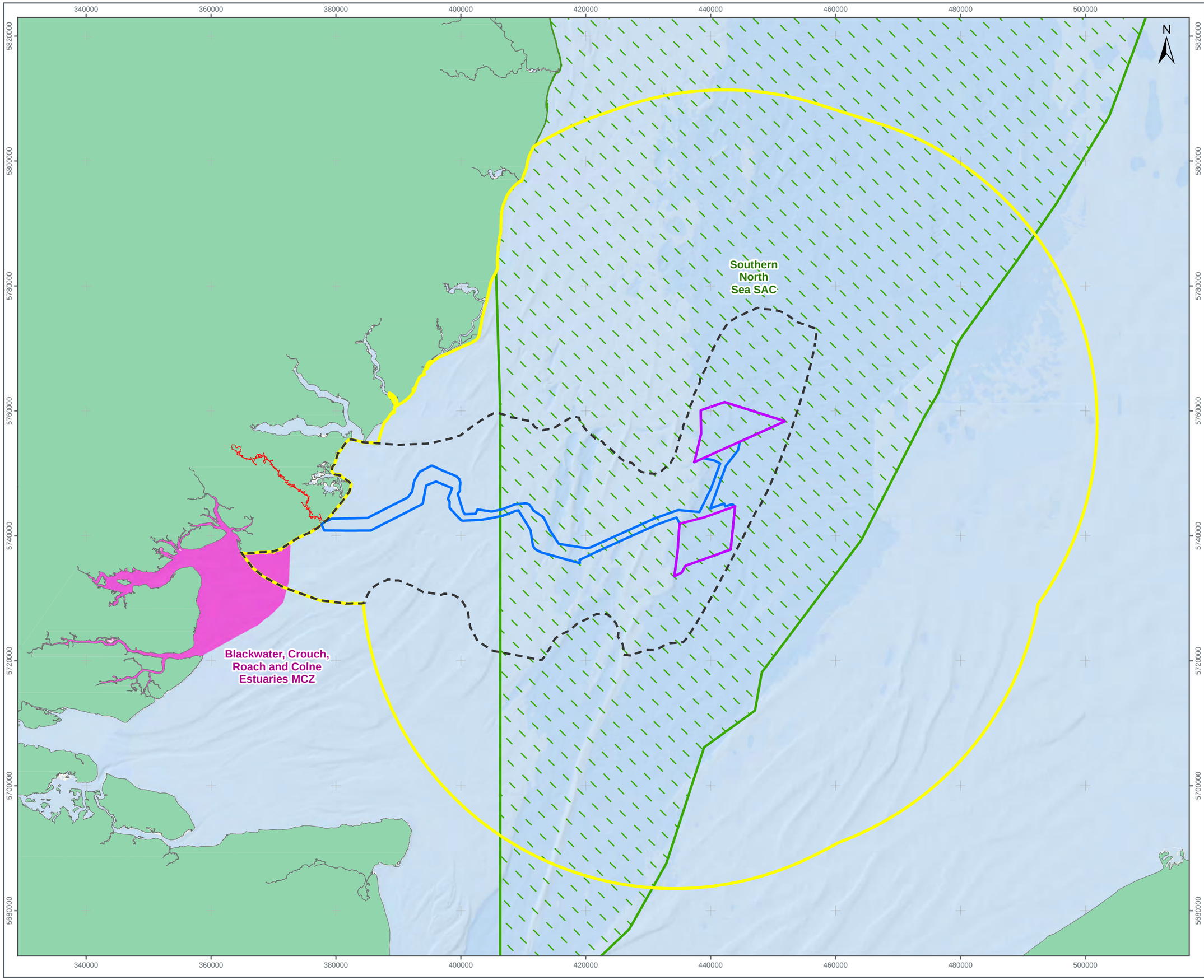
3.1.102 Various conservation sites designated for fish and shellfish features or habitats/species which are dependent on or associated with fish or shellfish lie within the VE study area. The sites are listed in Table 3.5 below and shown in Figure 3.20. It should be noted that a separate Report to Inform Appropriate Assessment (RIAA) has been produced which covers matters associated with European designations in more detail. No designated sites for migratory fish within 100 km of the RLB have been identified.

Table 3.5: Designated sites with relevance to fish and shellfish resource and VE

Site	Closest distance to the VE Site Boundary	Feature of description
Southern North Sea Special Area of Conservation (SAC)	Overlaps the VE ECC and Array areas.	Primary reason for site selection is harbour porpoise (*Phocoena Phocoena*), of which herring and sandeel are key prey species.
Blackwater, Crouch, Roach and Colne Estuary MCZ	4 km from the VE ECC.	Designated for native oyster and native oyster beds.

SPECIES OF CONSERVATION IMPORTANCE

3.1.103 Within the study area there are number of marine and estuarine species protected under national and international legislation that have the potential to be present within the VE study area. These are summarised alongside their corresponding legislation in Table 3.6.



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Fish and Shellfish Study Area
- Sedimentary ZoI
- Special Areas of Conservation
- Marine Conservation Areas

0 5 10 20
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Designated Sites relative to the Project

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AL

DRAWING NUMBER: 3.20

SCALE: 1:550,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM31N

FIVE ESTUARIES OFFSHORE WINDFARM

Table 3.6: Species of conservation importance with the potential to occur within the VE study area

Species	UK BAP Species	Annex II or V (Habitats Directive)	Annex III (Bern Convention)	Section 41 Priority species	OSPAR threatened or declining	MCZ features	IUCN red list	NERC Species of Principal Importance
Allis shad	✓	II, V	✓	✓	✓	X	Least concern	✓
Atlantic salmon	✓	II, V	✓	✓	✓	X	Endangered	✓
Bluefin Tuna *Thunnus thynnus*	✓	X	X	✓	✓	X	Least concern	✓
Cod	✓	X	X	✓	✓	X	Vulnerable	✓
European eel	✓	X	X	✓	✓	X	Critically endangered	✓
Herring	✓	X	X	✓	X	X	Least concern	✓
Horse mackerel	✓	X	X	✓	X	X	Least concern	✓
Lesser sandeel	✓	X	X	✓	X	X	Data deficient	X
Lesser spotted dogfish	X	X	X	✓	X	X	Least concern	X

Species	UK BAP Species	Annex II or V (Habitats Directive)	Annex III (Bern Convention)	Section 41 Priority species	OSPAR threatened or declining	MCZ features	IUCN red list	NERC Species of Principal Importance
Mackerel	✓	X	X	✓	X	X	Least concern	✓
Native oyster	✓	X	X	✓	✓	✓	X	✓
Plaice	✓	X	X	✓	X	X	Least concern	✓
River lamprey	✓	II,V	III	✓	X	X	Least concern	✓
Sea bass	X	X	X	X	X	X	Least concern	X
Sea lamprey	✓	II	III	✓	✓	X	Least concern	✓
Sea trout	X	X	X	✓	X	X	Least concern	✓
Smoothhound shark	X	X	X	X	X	X	Endangered	X
Smelt	✓	X	X	✓	X	X	Least concern	✓
Sole	✓	X	X	✓	X	X	Least concern	✓
Sturgeon	✓	X	X	✓	✓	X	Critically endangered	✓

Species	UK BAP Species	Annex II or V (Habitats Directive)	Annex III (Bern Convention)	Section 41 Priority species	OSPAR threatened or declining	MCZ features	IUCN red list	NERC Species of Principal Importance
Thornback ray	X	X	X	X	✓	X	Near threatened	X
Tope shark	✓	X	X	✓	X	X	Vulnerable	✓
Twaite shad	✓	II, V	✓	✓	X	X	Least concern	✓
Whiting	✓	X	X	✓	X	X	Least concern	✓

3.2 VALUED ECOLOGICAL RECEPTORS

3.2.1 The value of ecological features is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM, 2016). The most straightforward context for assessing ecological value is to identify those species and habitats that have a specific biodiversity importance recognised through national legislation or through local, regional or national conservation plans (e.g., Annex II or V species under the Habitats Directive, UK Section 41 Priority Species, or species of principal importance listed under the NERC Act 2006, and species listed as features of existing or recommended MCZs). However, only a very small proportion of marine habitats and species are afforded protection under the existing legislative or policy framework and therefore evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value (e.g., fish as prey species for protected bird or marine mammal species).

3.2.2 Table 3.7 shows the criteria applied to determining the ecological value of Valued Ecological Receptors (VERs) within the geographic frame of reference applicable to the VE fish and shellfish study area and have been derived using guidelines published by the CIEEM (2016).

Table 3.7: Criteria used to inform the valuation of ecological receptors in the VE fish and shellfish study area.

Value of VER	Criteria to Define Value
National	Species protected under national law (i.e., Annex II species listed as features of SACs) within the National Site Network. Annex II species which are not listed as features of SACs in the VE fish and shellfish study area. UK BAP priority species (including grouped action plans) that continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, MCZ/ rMCZ features (species classified as features of conservation importance and broad scale habitats), species of principal importance and NIMF that have nationally important populations within the VE fish and shellfish study area, particularly in the context of species/ habitat that may be rare or threatened in the UK*. Species that have spawning or nursery areas within the VE fish and shellfish study area that are important nationally (e.g., may be primary spawning/ nursery area for that species).
Regional	UK BAP priority species (including grouped action plans) that continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, MCZ/ rMCZ features (species classified as features of conservation importance and broad scale habitats), species of principal importance or NIMF that have regionally important populations within the VE fish and shellfish study area (i.e., are locally widespread and/ or abundant).

Value of VER	Criteria to Define Value
	Species that are of commercial value to the fisheries which operate within the region. Species that form an important prey item for other species of conservation or commercial value and that are key components of the fish assemblages within the VE fish and shellfish study area. Species that have spawning or nursery areas within the VE fish and shellfish study area that are important regionally (i.e., species may spawn in other parts of the UK but that this is key spawning/ nursery area within the region).
Local	Species that are of commercial importance but do not form a key component of the fish assemblages within the VE fish and shellfish study area (e.g., they may be exploited in deeper waters outside the VE fish and shellfish study area). The spawning/ nursery area for the species are outside the VE fish and shellfish study area. The species is common throughout the UK but forms a component of the fish assemblages in the VE fish and shellfish study area.
*Measured against criteria such as OSPAR threatened/ declining species and IUCN Red List of threatened species.	

3.2.3 The VERs listed below in Table 3.8 relate specifically to potential impacts which may arise during the construction, Operation and Maintenance (O&M), and decommissioning of the array areas and ECC. Justification for the potential sensitivity to effects from the array is provided alongside each species in Table 3.8 below.

Table 3.8: Summary of fish and shellfish Valued Ecological Receptors (VERs) and their value/ importance within the VE study area.

VER	Value	Justification
Demersal Fish VERs		
Brill	Regional	Commercially important to the region. Significant landings of this species from the study area.
Cod	International	Low intensity spawning and nursery grounds intersect with the study area (Figure 3.3 and Figure 3.16). Recorded in in study area within Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b), Gunfleet Sands pre-construction fish surveys (RPS 2007a,b; RPS 2008), London Array OWF pre- and post-construction surveys (Brown and May Ltd. 2010; Marine Space, 2015), Galloper OWF fish trawl surveys (CMACS), 2010), Cefas Young Fish

VER	Value	Justification
		Surveys (Burt *et al.*, 2019), and NSIBTS (ICES, 2018-2022). Additionally, Cod are listed as an OSPAR species of international importance. Cod are listed as a Section 41 priority species and listed as vulnerable on the IUCN Red List.
Dab	Regional	Recorded in study area within Cefas Young Fish Surveys (Burt *et al.*, 2019), Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b) and Gunfleet Sands pre- and post-construction fish surveys (RPS 2007a,b; RPS 2008; Brown and May Ltd., 2011). Commercially important to the region.
Flounder	Regional	Commercially important to the region.
Lemon Sole	Local	Spawning and nursery grounds overlap the study area (Figure 3.3 and Figure 3.18).
Plaice	Regional	Recorded throughout the region in NSIBTS (ICES, 2018-2022), Cefas Young Fish Surveys (Burt *et al.*, 2019) and within the study area in Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b) and Gunfleet Sands pre- and post-construction fish surveys ((RPS 2007a,b; RPS 2008; Brown and May Ltd., 2011). A high intensity plaice spawning ground overlaps the study area (Figure 3.2). A low intensity nursery ground also overlaps the study area (Figure 3.16). Commercially important to the region. Significant landings of this species from the study area. UK BAP species (commercial marine fish grouped action plan) and NERC species of principal importance.
Red Mullet	Regional	Significant landings of this species from the study area. It is for this reason that red mullet are of regional importance.
Sole	Regional	A high intensity sole spawning ground overlaps the study area (Figure 3.3). A low intensity nursery ground also overlaps the study area (Figure 3.17). Commercially important to the region.

VER	Value	Justification
		Recorded throughout the wider region in Cefas Young Fish Surveys (Burt *et al.*, 2019) and within the study area in Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b), Galloper OWF fish trawl surveys (CMACS), 2010), London Array OWF pre- and post-construction surveys (Brown and May Ltd., 2010; Marine Space, 2015) and Gunfleet Sands pre- and post-construction fish surveys (RPS 2007a,b; RPS 2008; Brown and May Ltd., 2011). Sole are listed as a UK BAP and Section 41 Species.
Tub gurnard	Local	Recorded in study area within Gunfleet Sands pre-construction fish surveys ((RPS 2007a,b; RPS 2008) and Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b). Commercially important to the region.
Turbot	Regional	Recorded in high abundances in pre-construction otter trawl fisheries surveys undertaken for Gunfleet Sands OWF. Commercially important to the region.
Whiting	Regional	High numbers of whiting were recorded across the region within NSIBTS (ICES, 2018-2022), and within the study area in Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b), London Array OWF pre- and post-construction surveys (Brown and MayLtd., 2010; Marine Space, 2015) and Gunfleet Sands pre-construction fish surveys ((RPS 2007a,b; RPS 2008). Whiting spawning grounds (Figure 3.2) and low intensity nursery grounds (Figure 3.17) are present across the region. Whiting are listed as a UK BAP and Section 41 Species. Commercially important to the region.
Migratory VERs		
Atlantic salmon	International	Annex III of the Bern convention and freshwater populations on Annexes II and V of the Habitats Directive, and it a UK BAP priority fish species.

VER	Value	Justification
		Additionally, Atlantic salmon are listed as an OSPAR species of international importance and classified as under threat and in decline. Atlantic salmon have been reclassified by the IUCN as “Endangered” in the UK with projected population decline from 50-80% between 2010 and 2025 and listed as “Near threatened” internationally (IUCN, 2023). Potential for this species to transit the site.
European eel	International	Designated under the Eel Regulations. Listed as Section 41 and UK BAP priority species and European eel is listed as critically endangered. Potential for this species to transit the site. Recorded in NSIBTS (ICES, 2018-2022) and Cefas Young Fish surveys (Burt *et al.*, 2019). European eel are listed critically endangered on the IUCN Red List. Additionally, European eel are listed as an OSPAR species of international importance and classified as under threat and in decline.
Allis shad	International	Appendix III of the Bern Convention, Annexes II and V of the Habitats Directive, Schedule 5 of the Wildlife and Countryside Act 1981 and are UK BAP priority fish species. Potential for this species to transit the site. Additionally, Allis shad are listed as an OSPAR species of international importance and classified as under threat and in decline.
Twaite shad	National	Appendix II of the Bern Convention, Annexes II and V of the Habitats Directive, Schedule 5 of the Wildlife and Countryside Act and are UK BAP priority fish species. Potential for this species to transit the site. Recorded in NSIBTS (ICES, 2018-2022).
River lamprey	National	Appendix III of the Bern Convention, Annex II of the Habitats Directive, Schedule 5 of the Wildlife and Countryside Act, UK BAP priority fish species. Potential for this species to transit the site.

VER	Value	Justification
Sea lamprey	International	Appendix III of the Bern Convention, Annex II of the Habitats Directive, Schedule 5 of the Wildlife and Countryside Act, UK BAP priority fish species. Additionally, Sea lamprey are listed as an OSPAR species of international importance and classified as under threat and in decline. Potential for this species to transit the site.
Sea trout	Regional	Section 41 and UK BAP Priority species. Potential for this species to transit the site.
Smelt	Regional	Section 41 and UK BAP Priority species. Potential for this species to transit the site. Recorded in Cefas Young Fish Surveys (Burt *et al.*, 2019).
Pelagic Fish VERs		
Bluefin tuna	International	Species of conservation importance, listed as a Section 42 species, and on the IUCN Red List. Seasonal visitors to the North Sea (Horton *et al.*, 2021). Additionally, Bluefin tuna are listed as an OSPAR species of international importance and classified as under threat and in decline.
Sprat	Regional	Recorded within the study area in Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b), Galloper OWF fish trawl surveys (CMACS), 2010) and Gunfleet Sands post-construction fish surveys (Brown and May Ltd., 2011). Commercially important to the region. Spawning (Figure 3.3) and nursery grounds (Figure 3.18) overlap the study area. Important prey species for bird and marine mammal species.
Mackerel	Regional	Spawning (Figure 3.2) and nursery grounds (Figure 3.16)) overlap the study area. UK BAP Species, and Section 41 Priority Species. Prey species for birds and marine mammals and forming key components of the ecosystem. Commercially important to the region.

VER	Value	Justification
Horse mackerel	Regional	Spawning grounds (Figure 3.3) intersect with the study area. UK BAP Species, and Section 41 Priority Species. Significant landings of this species from the study area. Prey species for birds and marine mammals and forming key components of the ecosystem.
Sea Bass	Regional	Key nursery areas (Figure 3.19) present across the wider Thames estuary. Recorded within the study area in Gunfleet Sands pre-construction fish surveys (RPS 2007a,b; RPS 2008). Significant landings of sea bass from the study area. Taking into consideration the key nursery areas present in the wider Thames Estuary, and commercial importance of this species, sea bass have been allocated regional importance.
Benthopelagic Fish VERs		
Sandeel	Regional	Spawning grounds (Figure 3.10) located across the study area. A low intensity nursery ground (Figure 3.16) also overlaps the study area. Found throughout the region and recorded in Greater Gabbard OWF pre-construction fish surveys (Brown and May Ltd., 2009a,b), NSIBTS (ICES, 2018-2022), Cefas Young Fish Surveys (Burt *et al.*, 2019) and London Array pre-construction fish surveys (Brown and May Ltd., 2010). Important prey species for fish, birds and marine mammals. Commercially important species. Section 41 priority species.
Herring	Regional	Commercially important to the region. Closed sentinel herring fishery within the region. Spawning (Figure 3.4) and nursery grounds (Figure 3.18) intersect with the study area. Section 41 priority species. Prey species for birds and marine mammals. Found throughout the region and recorded in Greater Gabbard OWF pre-construction fish

VER	Value	Justification
		surveys (Brown and May Ltd., 2009a,b), NSIBTS (ICES, 2018-2022), Cefas Young Fish Surveys (Burt *et al.*, 2019) and London Array pre-construction fish surveys (Brown and May Ltd., 2010).
Shellfish VERs		
Nephrops	Local	Found throughout the region, and recorded in NSIBTS (ICES, 2018-2022).
Cockle	Regional	Found throughout the region, of commercial value to fisheries that operate in the region, it is on this basis that this species is considered of regional importance.
Common whelk	Regional	Found throughout the region, of commercial value to fisheries that operate in the region, it is on this basis that this species is considered of regional importance. Recorded in NSIBTS (ICES, 2018-2022) and Galloper OWF fish trawl surveys (CMACS), 2010).
King and Queen scallop	Local	Found throughout the region, and recorded in NSIBTS (ICES, 2018-2022).
Native Oyster	Regional	Found throughout the region, of commercial value to fisheries that operate in the region, it is on this basis that this species is considered of regional importance.
European lobster	Regional	Found throughout the region, recorded in NSIBTS (ICES, 2018-2022) and London Array OWF pre-construction monitoring (Brown and May Ltd., 2010). A fishery is located to the north of VE (off the Norfolk coast). Significant landings of lobster from the study area. It is for this reason that lobster are of regional importance.
Brown crab	Regional	Found throughout the region, of commercial importance to the region. Recorded in NSIBTS (ICES, 2018-2022), Greater Gabbard OWF pre-construction monitoring (Brown and May Ltd., 2009) and London Array OWF pre-construction monitoring (Brown and May Ltd., 2010). A fishery is located to the north of VE (off the Norfolk coast), outside of the study area.
Elasmobranch VERs		

VER	Value	Justification
Blonde ray	Local	Recorded in Cefas Young Fish Surveys (Burt *et al.*, 2019). Listed as Near Threatened by the global IUCN Red List
Cuckoo ray	Local	Recorded in NSIBTS (ICES, 2018-2022). Listed as Least Concern by the global IUCN Red List
Lesser spotted dogfish	Local	Found throughout the region and recorded in Greater Gabbard OWF pre-construction monitoring (Brown and May Ltd., 2009) and elasmobranch surveys (Brown and May Ltd., 2014) and London Array OWF pre- and post-construction monitoring (Brown and May Ltd., 2010; Marine Space, 2015), Cefas Young Fish Surveys (Burt *et al.*, 2019) and NSIBTS (ICES, 2018-2022). Listed as Least Concern by the global IUCN Red List
Thornback ray	International	A low intensity nursery ground overlaps the study area. Additionally, thornback ray are listed as an OSPAR species of international importance and classified as under threat and in decline Found throughout the region, recorded in Greater Gabbard OWF pre-construction monitoring (Brown and May Ltd., 2009) and elasmobranch surveys (Brown and May Ltd., 2014); London Array OWF pre- and post-construction monitoring (Brown and May Ltd., 2010; Marine Space, 2015), Gunfleet Sands pre-construction monitoring (RPS, 2007a,b; RWE 2008), NSIBTS (ICES, 2018-2022) and Cefas Young Fish Surveys (Burt *et al.*, 2019). Significant landings of thornback ray from the study area. Listed as Near Threatened by the global IUCN Red List
Tope	International	A low intensity nursery ground overlaps the study area. Tope are a UK BAP species and NERC species of principal importance. Listed as Vulnerable on the IUCN Red List.

VER	Value	Justification
		Recorded in Greater Gabbard OWF elasmobranch surveys (Brown and May Ltd., 2014).
Small eyed ray	Local	Recorded in Cefas Young Fish Surveys (Burt *et al.*, 2019). Listed as Near Threatened on the IUCN Red List.
Smoothhound	International	Recorded in Greater Gabbard OWF elasmobranch surveys (Brown and May Ltd., 2014), London Array pre-construction fish surveys (Brown and MayLtd., 2010), NSIBTS (ICES, 2018-2022), and Cefas Young Fish Surveys (Burt *et al.*, 2019). Listed as Endangered on the IUCN Red List.
Spotted ray	International	Recorded in NSIBTS (ICES, 2018-2022), Cefas Young Fish Surveys (Burt *et al.*, 2019) and London Array pre-construction fish surveys (Brown and MayLtd., 2010). Listed as Least Concern on the IUCN Red List. Additionally, spotted ray are listed as an OSPAR species of international importance and classified as under threat and in decline
Spurdog	International	Recorded in Greater Gabbard OWF elasmobranch surveys (Brown and May Ltd., 2014). Listed as Endangered on the IUCN Red List. Additionally, spurdog are listed as an OSPAR species of international importance and classified as under threat and in decline.
Velvet belly lanternshark	Local	Recorded in NSIBTS (ICES, 2018-2022). Listed as Vulnerable on the IUCN Red List

4 CONCLUSIONS

4.1.1 After consideration of the range of existing site-specific and regional information over a broad time series, it is concluded that the level of information available is adequate for the purposes of characterising the existing environment in terms of fish and shellfish ecology.

4.1.2 The information and analysis presented within this report provides a robust evidence base to justify the use of existing data to describe the likely spawning and nursery grounds present. The analysis also describes appropriately the fish community with regards migratory species, commercial species, and species of conservation importance, such that it is considered a further survey will not identify any additional receptors that may constitute valued ecological receptors for the purposes of undertaking an EIA.

4.1.3 The information presented within this technical annex is therefore considered to be an appropriate characterisation of the receiving environment with regards fish and shellfish receptors. It is concluded that the presence of a combination of site specific and regional data sets across a range of temporal scales precludes the need for further site-specific surveys.

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