RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Heat Mapping Report: Atlantic Herring and Sandeel

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Glossary

Term	Definition
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables would be located. The Array Areas do not include the Offshore Export Cable Corridor or the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Array cables	Offshore cables which link the wind turbines to the Offshore Converter Platform(s).
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
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 value, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Electrical Switching Platform (ESP)	The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area.
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 (ES).
EIA Directive	The EU directive on the assessment of the effects of certain public and private projects on the environment (2011/92/EU as amended by 2014/52/EU)
EIA Regulations	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Fish and Shellfish Ecology Study Area	The Fish and Shellfish Ecology Study Area for the Projects is defined as International Council for the Exploration of the Sea (ICES) Rectangles 36E9; 36F0; 37E9; 37F0; 37F1; 37F2; 38F0; 38F1; and 38F2. It covers a total of 26,858km^2, and includes the Offshore Development Area with a minimum buffer distance of 7km.

Term	Definition
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Inter-Platform Cable Corridor	The area where Inter-Platform Cables would route between the DBS East and DBS West Array Areas, should both Projects be constructed.
Offshore Converter Platforms (OCPs)	The OCPs are fixed structures located within the Array Areas that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the Offshore Export Cables to the Project's Onshore Grid Connection Points.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the Offshore Export Cables (and potentially the ESP) between the Offshore Converter Platforms and Transition Joint Bays at the landfall.
Projects Design (or Rochdale) Envelope	A concept that ensures the EIA is based on assessing the realistic worst case scenario where flexibility or a range of options is sought as part of the consent application.
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension.
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
BGS	British Geological Survey
DBS	Dogger Bank South
DC	Direct Current
DCO	Development Consent Order
EEZ	Exclusive Economic Zone
EGL2	Eastern Green Link 2
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESFJC	Eastern Sea Fisheries joint Committee
ESP	Electrical Switching Platform
ICES	International Council for the Exploration of the Sea
IHLS	International Herring Larval Survey
KP	Kilometre Point
MMO	Marine Management Organisation
nm	Nautical Miles
OCP	Offshore Converter Platforms
PSD	Particle Size Distribution
TTS	Temporary Threshold Shift
UWN	Underwater Noise
VMS	Vessel Monitoring System

1 Preface

1. This report presents an update to the herring *Clupea harengus* spawning and sandeel *Ammodytidae* spp. habitat suitability heat maps presented within **Chapter 10 Fish and Shellfish Ecology** [APP-091] of the Environmental Statement (ES), submitted as part of the Dogger Bank South (DBS) East and DBS West (the 'Projects') Development Consent Order (DCO) application in June 2024. The original heat maps were produced using the methodologies presented in Reach *et al*. (2013) and Latto *et al*. (2013), representing best practice at the time of writing the ES (**Chapter 10 Fish and Shellfish Ecology** [APP-091]). Since the time of submission, these methodologies have been updated by Kyle-Henney *et al*. (2024) (for Atlantic herring) and Reach *et al*. (2024) (for sandeel).The original Atlantic herring and sandeel heat maps from **Chapter 10 Fish and Shellfish Ecology** [APP-091] are presented in **Figure A-1** and **Figure A-2** of Appendix 1 respectively.

2. This report has been produced as a supplementary resource to **The Applicants' Responses to Relevant Representations** [PDA-013] which was produced in response to representations provided by the Marine Management Organisation (MMO) (RR-030: 3.21.3; RR-030: 5.5.1; RR-030: 5.5.3 to 5.5.7; RR-030: 5.5.9 to 5.5.10; RR-030: 5.5.12; RR-030: 5.5.20 to5.5.21; and RR-030: 5.5.34 to 5.5.35) and Natural England (RR-039: E1 to E3; RR-039: E11; RR-039: E13; and RR-039: E17).

3. This report presents the updated heat maps and associated data-layers used to define 'heat' – or the estimated distribution of preferred herring spawning habitat and preferred sandeel habitat - and provides a comparison with the heat maps produced using project-specific sediment Particle Size Distribution (PSD) data. In so doing this report provides verification of the underlying EMODnet seabed sediment data used within the heat maps, in accordance with the recommendations of Kyle-Henney *et al*. (2024) and Reach *et al*. (2024).

4. In addition to the updated heat map for Atlantic herring, data from the most recent International Herring Larval Survey (IHLS) (High Abundance) are provided as a supplementary resource in accordance with Kyle-Henney *et al*. (2024). This enables an assessment of the importance of the Offshore Export Cable Corridor as potential spawning habitat for Atlantic herring to be undertaken.

5. In their relevant representations on the Projects' DCO application the MMO proposed a complete restriction on all works interacting with the seabed along the Offshore Export Cable Corridor during the Banks herring spawning season, stated as being 1st August – 31st October inclusive (RR-030: 3.21.2 to 3.21.3; RR-030: 5.5.26; RR-030: 5.5.30; and RR-030: 5.5.32 to 5.5.33).

6. The Applicants have responded to this proposal through the analyses and evidence presented in this report which support the Applicants' position (outlined in **The Applicants' Responses to Relevant Representations** [PDA-013]) that any such restriction should be evidence-based in terms of its temporal and spatial limits in line with the approach agreed on with the MMO during the Marine Licence determination for the Eastern Green Link 2 (EGL2) project (L/2023/00211/2).

7. In using the above approach, the Applicants have determined that there is no justification for imposing seasonal or spatial restrictions on cable-laying activities within the defined Offshore Export Cable Corridor, as the potential effects of construction work are not considered to be detrimental to the Banks spawning population.

2 Updated Heat Map – Atlantic Herring

8. The updated heat map for identifying potential spawning habitat for Atlantic herring is derived from the methodology proposed by Kyle-Henney *et al*. (2024).

9. The heat map depicting potential spawning habitat for Atlantic herring in the vicinity of the Offshore Export Cable Corridor and the Array Areas is shown in **Figure 2-1**.

10. In addition to the underlying heat map, **Figure 2-1** also shows the position of the Offshore Export Cable Corridor and Array Areas, and the underwater noise contours associated with monopiling activities within the Array Areas. The underwater noise contours have been included for reference when considering **The Applicants' Responses to Relevant Representations** [PDA-013] related to potential effects of piling on Atlantic herring spawning grounds (produced in response to RR-030: 5.5.15, 5.5.20, Appendix 1; and RR-039: E1, E11, and E13). Kilometre Points (KPs) have also been included within **Figure 2-1** for reference to specific extents of the Offshore Export Cable Corridor.

11. The heat map has been created by overlapping multiple data-layers, each assigned a confidence score of their ability to identify potential spawning habitat. In the case of the Projects, the following datasets have been used to inform the heat map:

- EMODnet 1:250k seabed sediments map (preferred habitat – Gravel and sandy Gravel; and marginal habitat – gravelly Sand);
- 2007-2023 International Herring Larval Survey (IHLS) (General)[1];
- Known spawning grounds defined by Coull *et al*. (1998);
- 2020 Vessel Monitoring System (VMS) data for fishing vessels targeting Atlantic herring; and
- Eastern Sea Fisheries Joint Committee (ESFJC) fishing grounds for Atlantic herring[2].

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[1] The IHLS (General) data-layer depicts the extent of IHLS survey stations that have recorded 0-ringer larvae at any time during the dataset timeseries (2007-2023). This data-layer makes no reference to the abundance of larvae caught.

[2] This data-layer has been included for completeness in accordance with Kyle-Henney *et al*. (2024) as the ESFJC data is located within the Humber region. However, this data-layer is sufficiently distant from the Offshore Export Cable Corridor that is not present within the extent of the Humber region displayed in **Figure 2-1**, and therefore does not contribute to the allocation of heat surrounding the Projects' Offshore Export Cable Corridor and Array Areas.

12. All of the above data sources were used within the original heat map presented within **Chapter 10 Fish and Shellfish Ecology** [APP-091], but the datasets have been refreshed to incorporate the most recent updates (specifically the IHLS dataset). These updates align with specific requests from the MMO to include recent data (see RR-030: 5.5.3 and RR-030: 5.5.6).

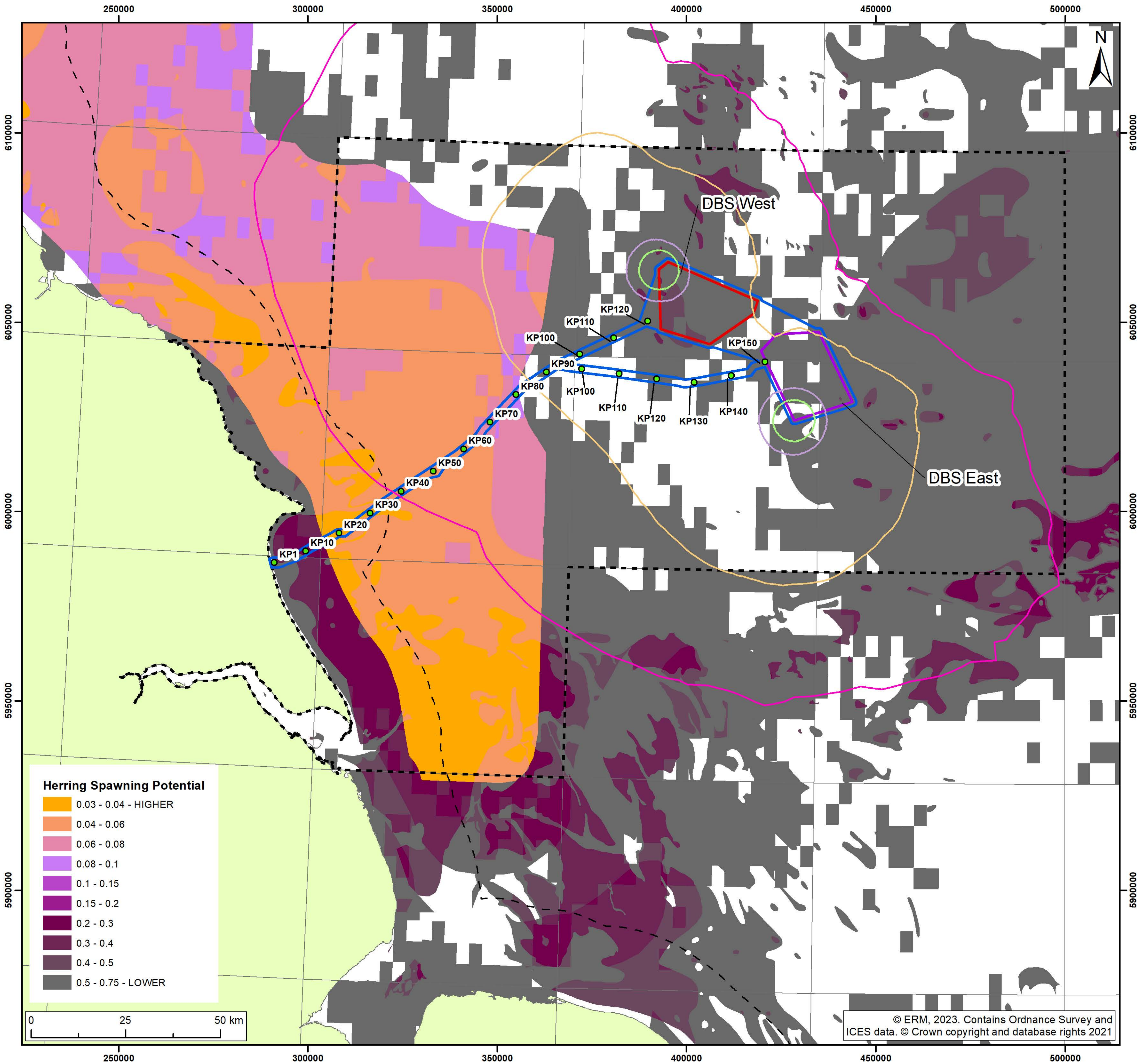
13. It is noted that the EMODnet 1:250k seabed sediments map incorporates the British Geological Society (BGS) 1:250k seabed sediments map used within the Reach *et al*. (2013) method. The EMODnet map selected for use in this report was chosen in preference to the BGS map within the updated methodology as it is not limited to the UK EEZ, and therefore presents a wider representation of seabed sediments at a population scale (Kyle-Henney *et al*., 2024).

14. Please refer to Kyle-Henney *et al*. (2024) for further information regarding the differences between the Reach *et al*. (2013) method used in **Chapter 10 Fish and Shellfish Ecology** [APP-091] and the updated Kyle-Henney *et al*. (2024) method used within this report.

15. The updated Atlantic herring heat map (**Figure 2-1**) indicates that the Offshore Export Cable Corridor (KP10-KP80) intersects with a large extent of 'high' spawning potential (represented by heat scores <0.08). The assessment of 'high' is based on expert judgement of the continuous heat scale, in accordance with the recommendations of Kyle-Henney *et al*. (2024). The remaining Offshore Export Cable Corridor and Array Areas are located outside of high potential spawning habitat for Atlantic herring. The Atlantic herring heat map submitted within **Chapter 10 Fish and Shellfish Ecology** [APP-091] is presented within Appendix 1 for comparison (**Figure A-1**).

16. In addition to the overlap between the Offshore Export Cable Corridor and the Array Areas, **Figure 2-1** indicates that modelled underwater noise effects overlap with potential spawning habitat for Atlantic herring. It is noted that standard practice for the assessment of effects of underwater noise utilise the extent of Temporary Threshold Shift (TTS) as the worst case scenario. The extent of overlap with the TTS contour in **Figure 2-1** is limited compared to the extent of potential spawning habitat in the Humber region.

17. Whilst the heat map presents areas of high herring spawning potential, it does not confirm the presence of suitable seabed sediment, and therefore overrepresents the location of Atlantic herring spawning habitat. Therefore, it is important to understand the datasets contributing to the heat scores and to compare the underlying EMODnet 1:250k seabed sediment to recent site-specific seabed sediment samples.



Legend:

- DBS East Array
- DBS West Array
- Offshore Development Area
- KP Points
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL_{ss} (Behaviour Threshold)

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL_{cum} (TTS) 186
- 203 dB re 1 μPa^{2}s SEL_{cum} (Recoverable Injury) 203
- 207 dB re 1 μPa^{2}s SEL_{cum} (Mortality/Potential Mortal Injury) 207

S1	P01	22/03/23	PB2340-MAR-OF-ZZ-DR-Z-0025	NB	IW	TM
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:
Potential spawning habitat heat map for Atlantic herring in the vicinity of Dogger Bank South Offshore Wind Farms. Produced following approaches from Kyle-Henney et al. (2024). The underwater noise (UWN) contour used within the EIA has been included for reference.

Figure: 2-1 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0025

Co-ordinate system:	Page Size:	Scale:
WGS 1984 UTM Zone 31N	A3	1:1,000,000

Project:	Report:
Dogger Bank South Offshore Wind Farms	Heat Mapping Report: Atlantic Herring and Sandeel

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2.1 Individual Data-Layers

18. Following the request of stakeholders within **The Applicants' Responses to Relevant Representations** [PDA-013] (RR-030: 5.5.2 to 5.5.6; RR-030: 5.5.10 to 5.5.12; and RR-030: 5.5.35), the individual data-layers used to develop the updated heat map (**Figure 2-1**) are presented in this section, with the exception of ESFJC data as noted in the section 2 bullet list above.

2.1.1 Seabed Sediment Type

19. The EMODnet 1:250k seabed sediment types displayed in **Figure 2-2** indicate a large area of preferred and marginal potential spawning habitat surrounding Flamborough Head, with the majority of preferred habitat located south of Flamborough Head towards the Humber Estuary. There are discrete areas of unsuitable seabed sediment type mosaiced throughout the extent of preferred and marginal potential spawning habitat; of which an overlap with the Offshore Export Cable Corridor is present at approximately 7 nautical miles (nm) from shore. Sediment PSD data have been used to ground-truth[3] the Atlantic herring heat map in section 2.2, allowing a site-specific interpretation of the heat map in accordance with the recommendations of Kyle-Henney *et al*. (2024).

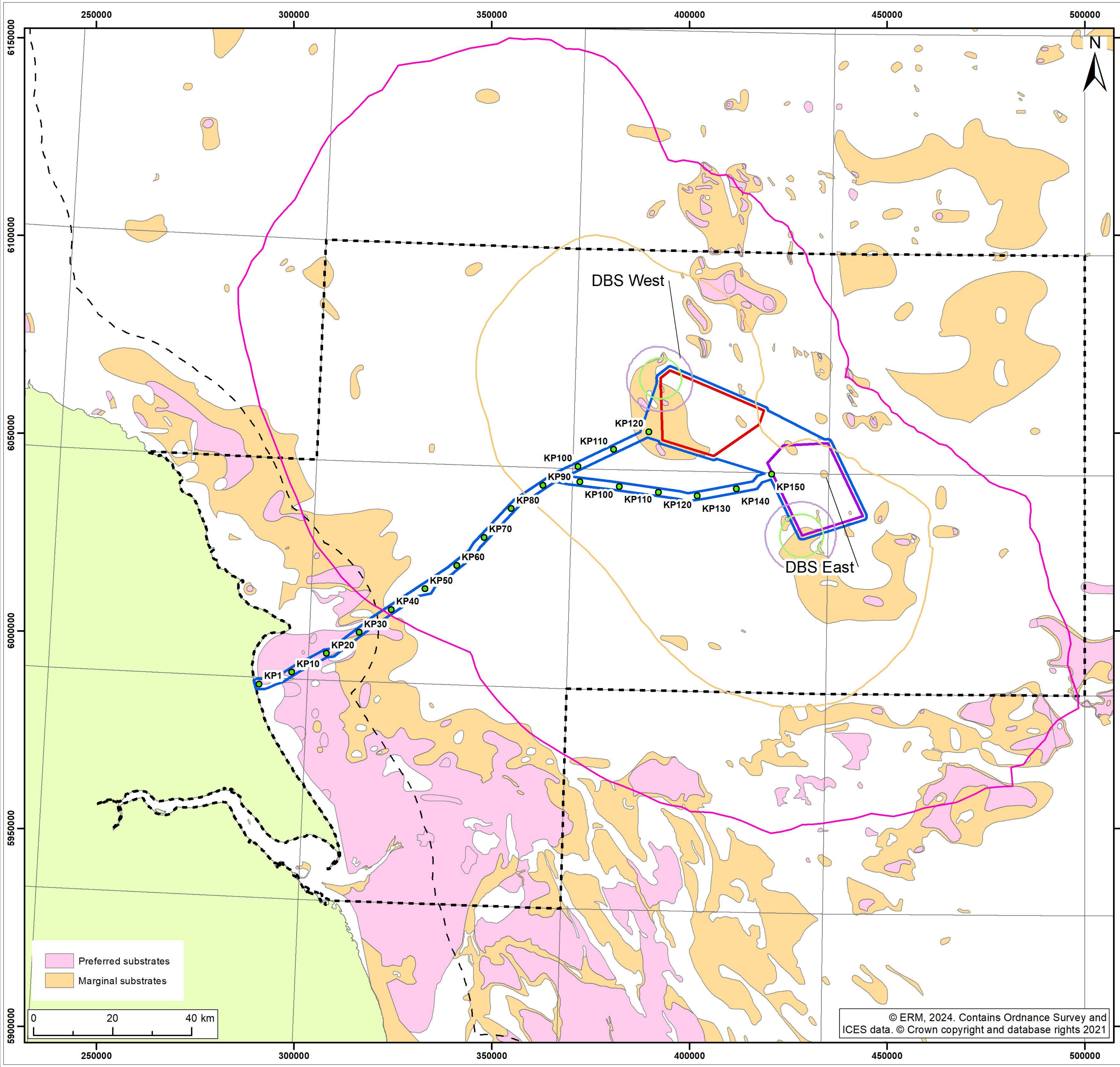
2.1.2 Known Spawning Grounds

20. The Offshore Export Cable Corridor crosses through a large extent of 'high' potential spawning habitat (areas with a heat score <0.08 in **Figure 2-1**), which is primarily defined by the extent of the IHLS (General) and the Coull *et al*. (1998) data-layers shown in **Figure 2-3** and **Figure 2-4** respectively. However, both of these data-layers are relatively low in resolution and do not account for variation in seabed sediment type (particularly unsuitable sediment types). Therefore, the IHLS (General) and Coull *et al*. (1998) data-layers are considered to over-represent potential spawning habitat for Atlantic herring in this region.

[3] Ground-truthing involves the collection of site-specific survey data to characterise current seabed sediment type and 'fact-check' interpolated datasets that use historic data sources (e.g. the EMODnet 1:250k seabed sediments dataset).

2.1.3 Fishing Activity

21. The 2020 VMS data (MMO, 2023) presented in **Figure 2-5** show the extent of the pelagic fishery within the vicinity of the Projects, which includes the Atlantic herring fishery. Whilst Atlantic herring fisheries target spawning aggregations, there is limited confidence in VMS data providing an indication of the presence of substrates known for their herring spawning potential (Kyle-Henney *et al*., 2024). Similar to the IHLS (General) and Coull *et al*. (1998) data-layers, the VMS data over-represent potential spawning habitat for Atlantic herring.



Legend:

- DBS East Array Area
- Offshore Development Area
- DBS West Array Area
- KP Points
- Preferred substrates
- Marginal substrates
- Fish and Shellfish Ecology Study
- UK 12 nm limit
- ICES Rectangles

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL$_{ss}$ (Behaviour Threshold)

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$ (TTS)
- 203 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable Injury)
- 207 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal Injury)

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0013	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0013	IW	MKH	OW

Title:
The extent of preferred and marginal potential spawning habitats for Atlantic herring, represented by the EMODnet 1:250k seabed sediment data-layer, used in the development of the Atlantic herring heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 2-2 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0013

Co-ordinate system:	Page Size:	Scale:
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Heat Mapping Report: Atlantic Herring and Sandeel

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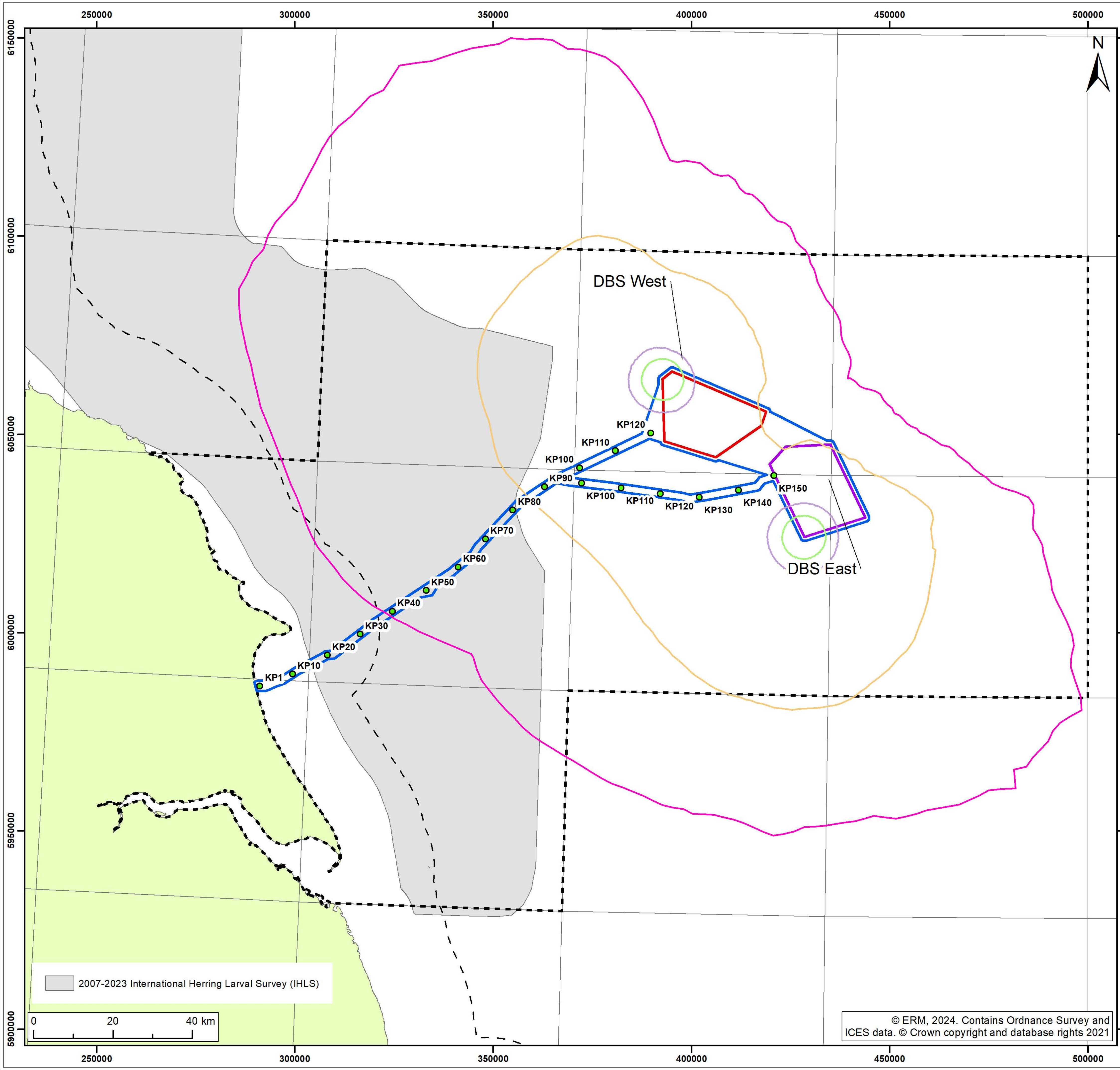

Legend:

- DBS East Array
- Offshore Development Area
- DBS West Array
- KP Points
- 2007-2023 International Herring Larval Survey (IHLS)
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL$_{ss}$ (Behaviour

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$
- 203 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable
- 207 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal

S2	P02	31/10/24	PB2340-MAR-OF-ZZ-DR-Z-0014	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0014	IW	MKH	OW
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:

The extent of the IHLS (General) data-layer used in the development of the Atlantic herring heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 2-3 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0014

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

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Report: Heat Mapping Report: Atlantic Herring and Sandeel

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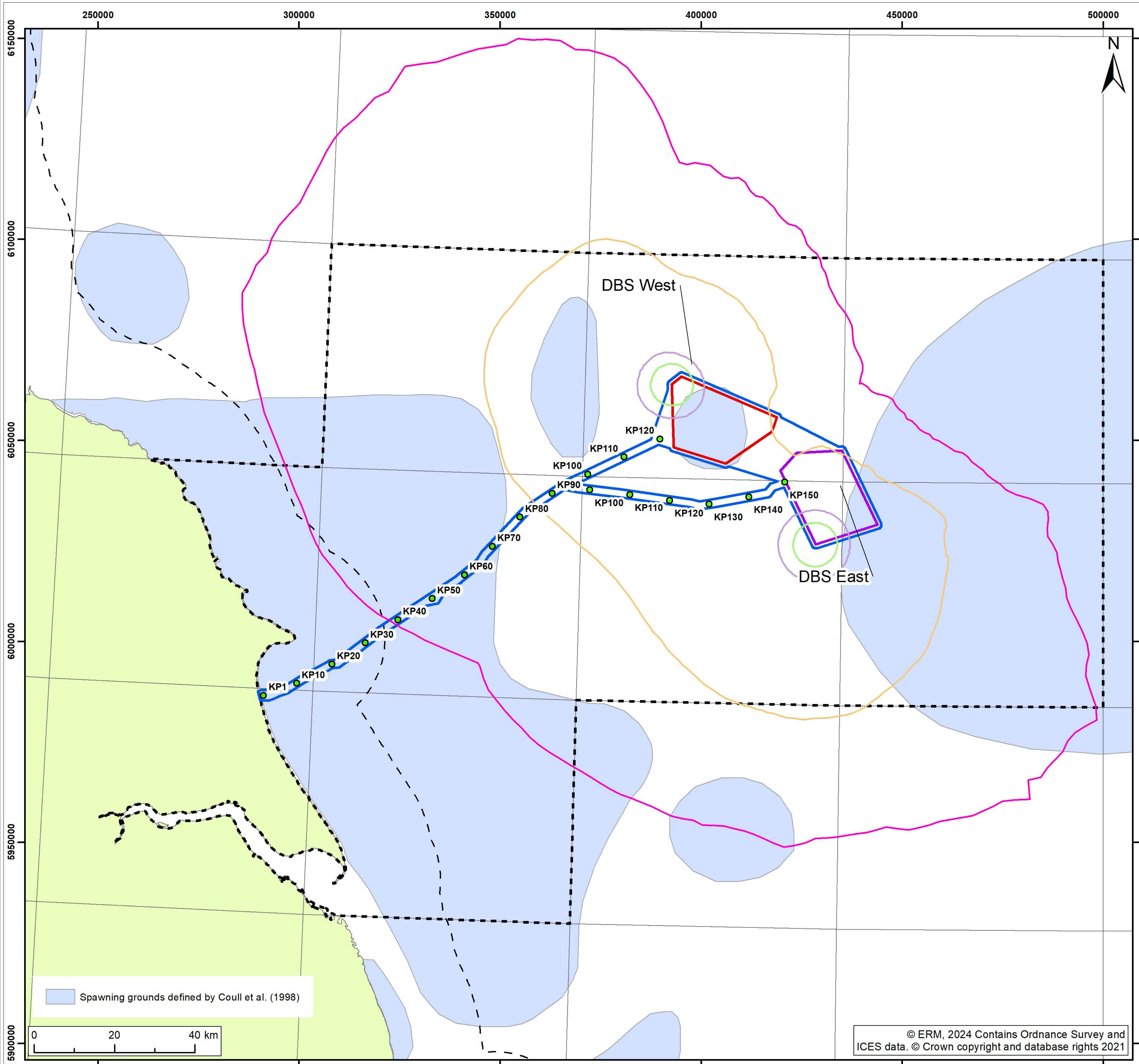

Legend:

- DBS East Array
- Offshore Development Area
- DBS West Array
- KP Points
- Spawning grounds defined by Coull et al. (1998)
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL$_{ss}$ (Behaviour

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$
- 203 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable
- 207 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0015	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0015	IW	MKH	OW

Title:

The extent of the Coull et al. (1998) data-layer used in the development of the Atlantic herring heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 2-4 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0015

Co-ordinate system:	Page Size:	Scale:
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Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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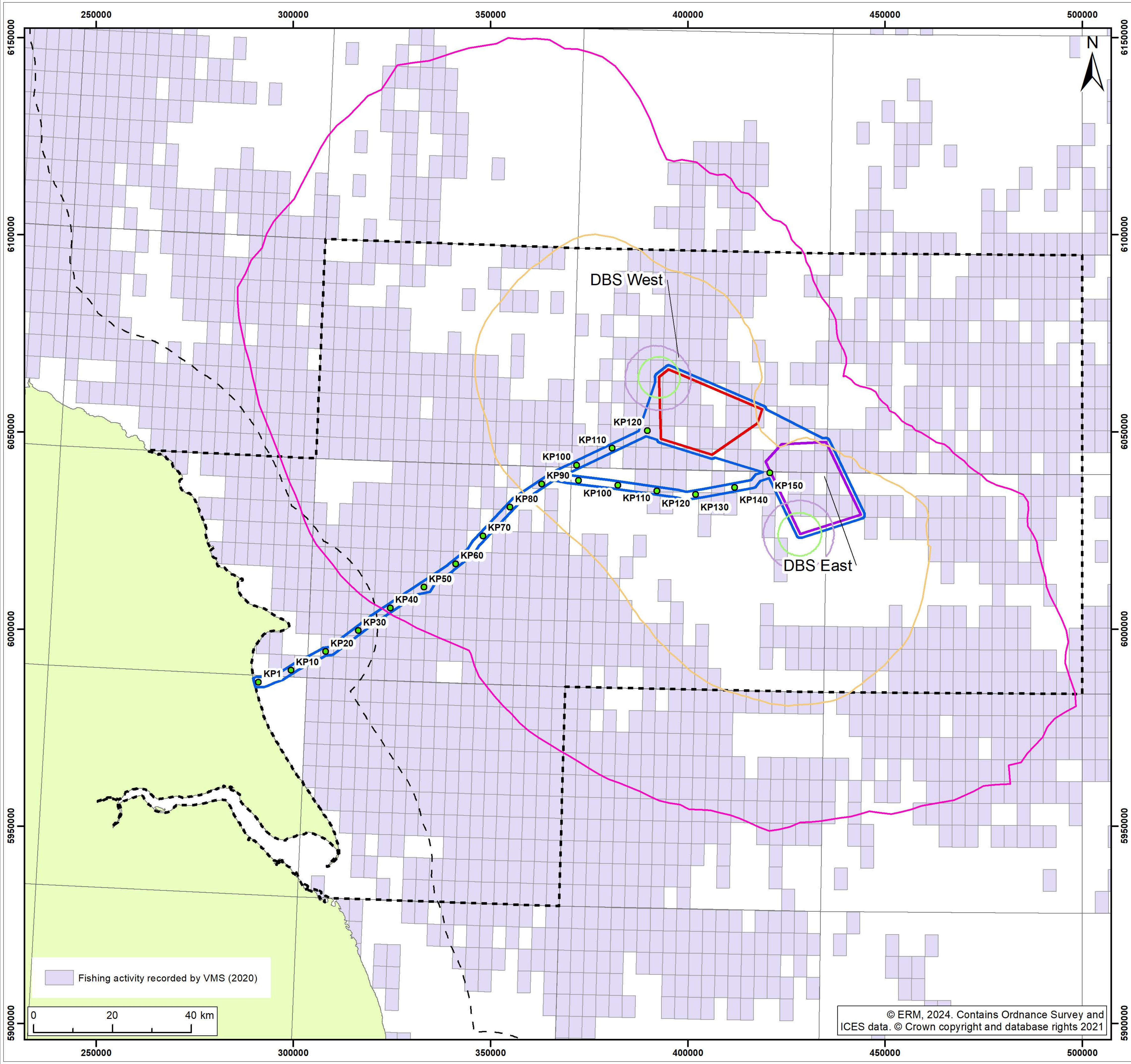

Legend:

- DBS East Array
- Offshore Development Area
- DBS West Array
- KP Points
- Fishing activity recorded by VMS (2020)
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL$_{ss}$ (Behaviour

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$
- 203 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable
- 207 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0016	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0016	IW	MKH	OW

Title:

The extent of the VMS data-layer used in the development of the Atlantic herring heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 2-5 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0016

Co-ordinate system:	Page Size:	Scale:
WGS 1984 UTM Zone 31N	A3	1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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2.2 Particle Size Distribution Analysis

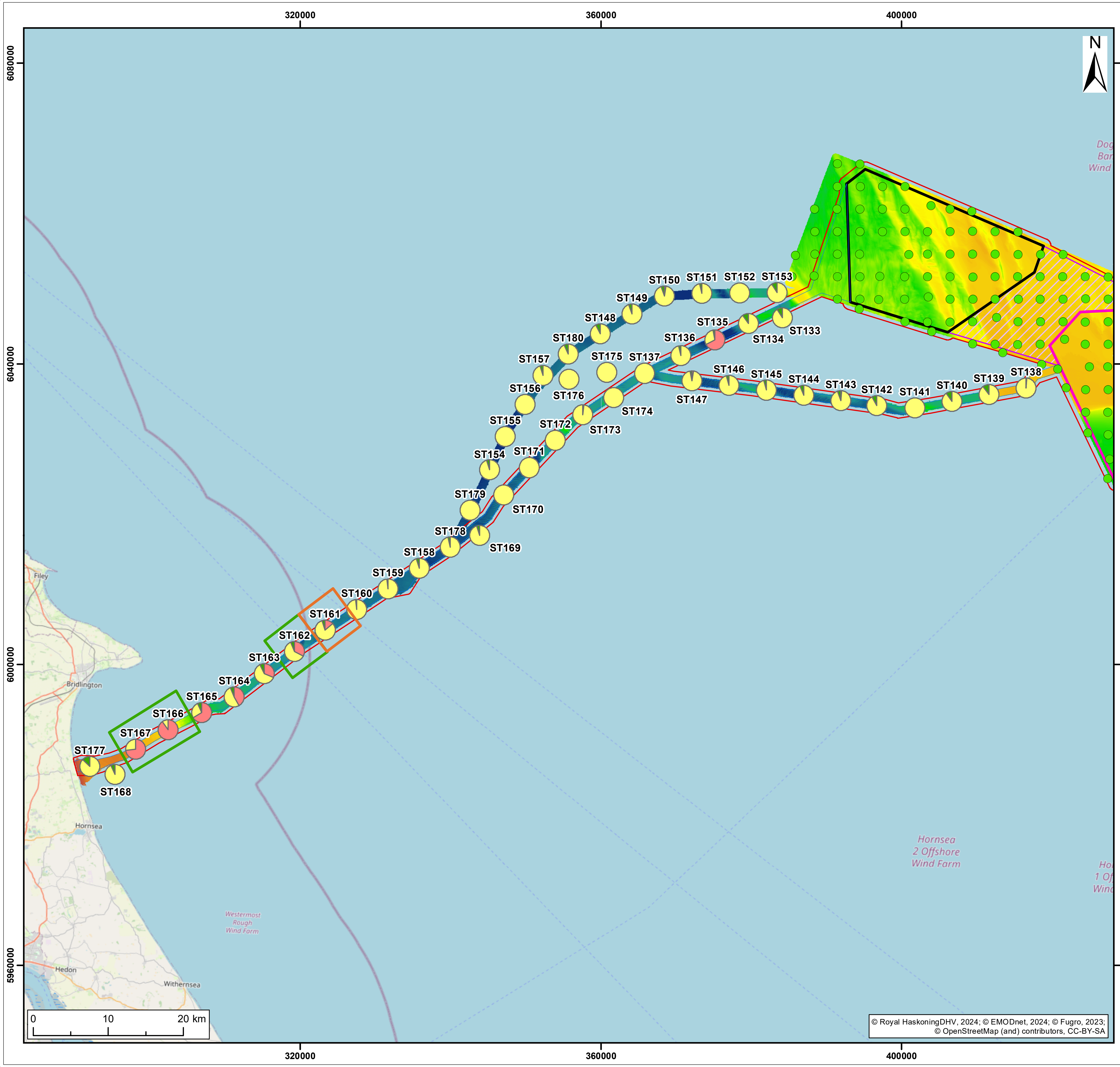
22. As stated in section 2.1.2, the identification of 'high' potential spawning habitat in **Figure 2-1** may be over-representative of localised preferred or marginal seabed sediment types. As such, sediment PSD data should be used to ground-truth a heat map produced at a site-specific scale (Kyle-Henney *et al*. 2024).

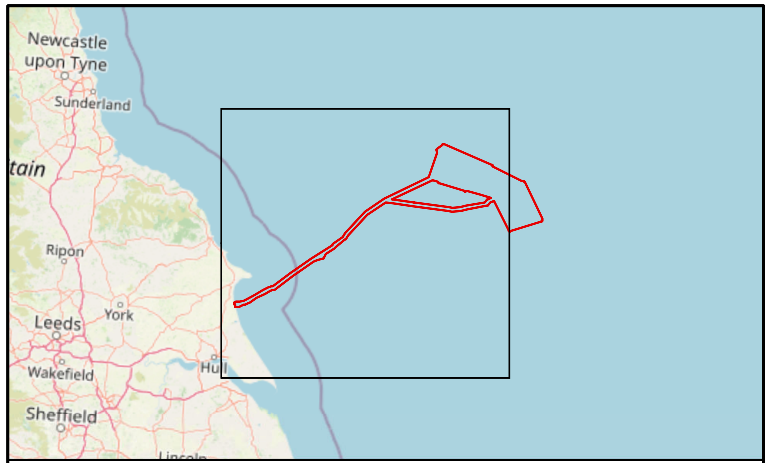
23. **Table 2-1** shows the locations of sediment sampling stations surveyed on behalf of the Projects along the Offshore Export Cable Corridor identified as of high potential spawning habitat (ST159-ST168) (Fugro, 2023). It can be clearly seen that the PSD data shows current seabed sediment types to be primarily unsuitable for Atlantic herring spawning within this region, with the exception of ST161-ST162 and ST167-ST168 where potential spawning habitat has been identified. Whilst Atlantic herring have a tolerance for variation in sediment type from Gravel-through sandy Gravel to gravelly Sand, the species will not spawn in any other Folk-16 seabed sediment type (i.e. sand dominated or containing fines) (Kyle-Henney *et al*., 2024). The distribution of sampling stations ST159-ST168 relative to the Projects' Offshore Export Cable Corridor is shown in **Figure 2-6**.

Table 2-1: Particle Size Distribution (PSD) data collected within the Offshore Export Cable Corridor on behalf of the Projects. Survey stations ST159-ST168 overlap with high potential spawning habitat for Atlantic herring in Figure 2-1.

Station	% Gravel	% Sand	% Fines	Folk Description
ST159	0.74	97.05	2.22	Sand
ST160	0.79	97.02	2.19	Sand
ST161	13.84	81.02	5.13	Gravelly Sand
ST162	32.58	61.64	5.78	Sandy Gravel
ST163	31.70	61.08	7.23	Muddy Sandy Gravel
ST164	42.29	51.48	6.23	Muddy Sandy Gravel
ST165	66.12	27.00	6.88	Muddy Sandy Gravel
ST166	89.87	9.43	0.69	Gravel
ST167	72.78	26.58	0.63	Sandy Gravel
ST168	0.07	92.78	7.15	Sand

Unsuitable Potential Spawning Habitat	Marginal Potential Spawning Habitat	Preferred Potential Spawning Habitat





Legend:

- Offshore Development Area
- Offshore Export Cable Corridor
- DBS East Array Area
- DBS West Array Area
- Inter-Platform Cable Corridor

Fractional Sediment Composition

- Gravel
- Sand
- Fines
- Array Station

Sediment type

- Marginal sediment type at ST161
- Preferred sediment type at ST162, ST166 & ST167

Remaining stations are unsuitable for Atlantic herring spawning activity

Bathymetry (LAT)

High : 1.90336

Low : -69.8343

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S3	P02	26/11/2024	Suitable for review & comment	SM	JH	RF
S2	P01	23/10/2024	Suitable for Information	SM	JH	RF

Title:

Spatial Variations of Percentage of Sand, Gravel and Fines Across the Offshore Export Cable Corridor for DBS East and DBS West (Fugro, 2023)

Figure: 2-6 Drawing No: PC2340-RHD-OF-ZZ-DR-Z-0903

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:500,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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2.3 Additional Ecological Data

24. The EGL2 project is a new high voltage direct current electricity cable connection from Peterhead in Aberdeenshire, Scotland to Drax in North Yorkshire, England, and has the potential to interact with herring spawning grounds. The EGL2 project undertook several consultations with the MMO and Cefas to refine a 3 month stand-down period (from 01st August to 31st October – similar to the one proposed for the Projects) to a 1 month stand-down period (from 31st August to 30th September) for a greater extent of high potential spawning habitat surrounding Flamborough Head. This refinement was achieved through the presentation of ecological data used to identify the peak in spawning within the 3 month period.

25. Following the rationale developed (October 2024) to allow the Marine Licence determination for the EGL2 project which presented the 1 month stand-down period (to protect herring spawning habitat during the herring spawning season, and to ensure eggs and newly hatched larvae remain undisturbed during their development period), similar ecological data is presented in this section to demonstrate the importance of potential spawning habitat for Atlantic herring within the Offshore Export Cable Corridor. This has been done as per recommendations by the MMO to include such data for the EGL2 project.

26. The additional information builds upon the IHLS (High Abundance) data recommended within the Kyle-Henney *et al*. (2024) method, and includes IHLS nearbed temperature records, egg development rates (Russell, 1976), yolk sac absorption rates (Russell, 1976), and 0.25mm day^{-1} larval growth rates (Heath, 1993). These data are deemed appropriate for use by the MMO and Cefas, and have been used to inform other environmental assessments within the region, notably those undertaken for EGL2.

2.3.1 Nearbed Temperatures and Development Rates

27. The IHLS provides data on the number of 0-ringer larvae caught within each sample, labelled as 'AbSmall' in the IHLS dataset. 0-ringer larvae represent the first larval development stage post-hatching, following a temperature-dependent egg development phase and yolk-sac absorption phase.

28. Nearbed temperature samples taken at the IHLS sampling sites surrounding the Offshore Export Cable Corridor record consistent temperatures of >13°C, resulting in an egg development period of <7 days (**Table 2-2)** and yolk sac absorption period of <3 days (**Table 2-3**); giving a combined development period of <10 days from the time of fertilisation (Russell, 1976).

Table 2-2: Egg development periods for Atlantic herring (Kotthaus, 1939 and Meyer, 1878 in Russell, 1976; Eastern Green Link 2, 2024)

Average Temperature (Kotthaus, 1939)	Egg Development in Days (Kotthaus, 1939)	Average Temperature (Meyer, 1878)	Egg Development in Days (Meyer, 1878)
12.3°C	7-9	N/A	N/A
10.7°C	10-12	10-11°C	11
8.7°C	14-18	7-8°C	15
8.3°C	17-20	3.5°C	49

Table 2-3: Yolk-sac absorption periods (Kotthaus, 1939 in Russell, 1976; Eastern Green Link 2, 2024)

Average Temperature (Kotthaus, 1939)	Yolk-sac Absorption in Days (Kotthaus, 1939)	
	External Disappearance of the Yolk Sac (Days)	Full Absorption of the Yolk Sac (Days)
12.8	3	9
12.0	5	14
10.7	7	16
10.3	7	20

29. Atlantic herring are not considered sensitive to sediment plumes within the water column once the yolk within the yolk sac has been absorbed (i.e. before the yolk sac itself is absorbed) (Messiah *et al.*, 1981; Kiørboe *et al.*, 1981; Griffin *et al.*, 2009; Griffin *et al.*, 2012; Eastern Green Link 2, 2024). Once hatched, larvae remain near the seabed whilst the yolk is absorbed prior to ascent into the water column to commence feeding (Eastern Green Link 2, 2024). Therefore, the potential impact arising from cable-laying activities is considered limited to the <10 day period from the point of egg laying to the point of yolk absorption.

30. Atlantic herring are unlikely to lay eggs consistently on one day of the year, therefore it is appropriate to consider a range of days upon which cable laying activities may result in potential impact to eggs and larvae on and / or associated with the seabed. The EGL2 project back-calculated from the peak spawning period to identify the peak in egg laying and larval development. This back-calculation resulted in a condition on the Marine Licence in which no cable-laying works could occur between 31st August-30th September (MMO, 2024). This 31 day (inclusive) period accounts for variation in egg laying date based upon larval lengths caught within the IHLS.

2.3.1.1.1 Peak Egg Laying and Development Period Back-Calculation

31. To provide context to this report, the equivalent input parameters for a back-calculation relevant to the Projects' Offshore Export Cable Corridor are presented below.

32. When considering the variation in larval length, the growth period must be incorporated within the back calculation. Assuming an MMO-acknowledged larval growth rate of 0.25mm day^{-1} (Heath, 1993) from 5mm yolk-free larvae, and a larval size of 8mm on the 23rd September 2008 as the worst case scenario presented by EGL2 (Eastern Green Link 2, 2024), the back-calculation is presented as follows:

33. **7 days** precautionary egg development period + **3 days** precautionary yolk absorption period + **11 days** precautionary larval growth period = **21 days** back-calculated from the 23rd September (inclusive).

34. Assuming a similar justification to the EGL2 Marine Licence condition that the peak larval abundance period should be included as part of the back-calculation, the 21 day back-calculation from the 23rd September would result in a **theoretical** 'stand-down' period of **27 days (3rd-30th September inclusive)** **should any detrimental[4] effect be predicted**. If a temporary restriction upon the Projects is required, it should be limited to this 27 day period, rather than the 3 month period originally proposed.

35. Irrespective of any requirement for a temporal restriction, the evidence used to define a 'stand-down' period relevant to the Offshore Export Cable Corridor for the Projects results in a refinement of the 3 month period using similar data to the refinement presented by the EGL2 project. The lower number of days is a result of the Offshore Export Cable Corridor supporting temperatures of >13°C, whereas the EGL2 project included temperatures of <13°C that subsequently increase the egg and larval development periods.

[4] The latest ICES advice for Atlantic herring in the North Sea (ICES, 2024a) state that 'Activities that have a negative impact on the spawning of herring should not occur unless the effects of these activities have been assessed and shown not to be detrimental to the productivity of the stock.'

2.3.2 IHLS (High Abundance)

36. In addition to the heat map, Kyle-Henney *et al*. (2024) recommend the use of IHLS abundance data to identify variations in spawning over time. The EGL2 project utilised this data to identify a peak in spawning activity within the vicinity of Flamborough Head, and is therefore relevant to the Projects.

37. IHLS data within the region are generally collected within the period of 16th-30th September each year, with the exception of some surveys conducted between the 1st-15th September and 1st-15th October pre-2003 (ICES, 2024b; Eastern Green Link 2, 2024). As such, the peak spawning period is considered to occur between 16th-30th September (Eastern Green Link 2, 2024).

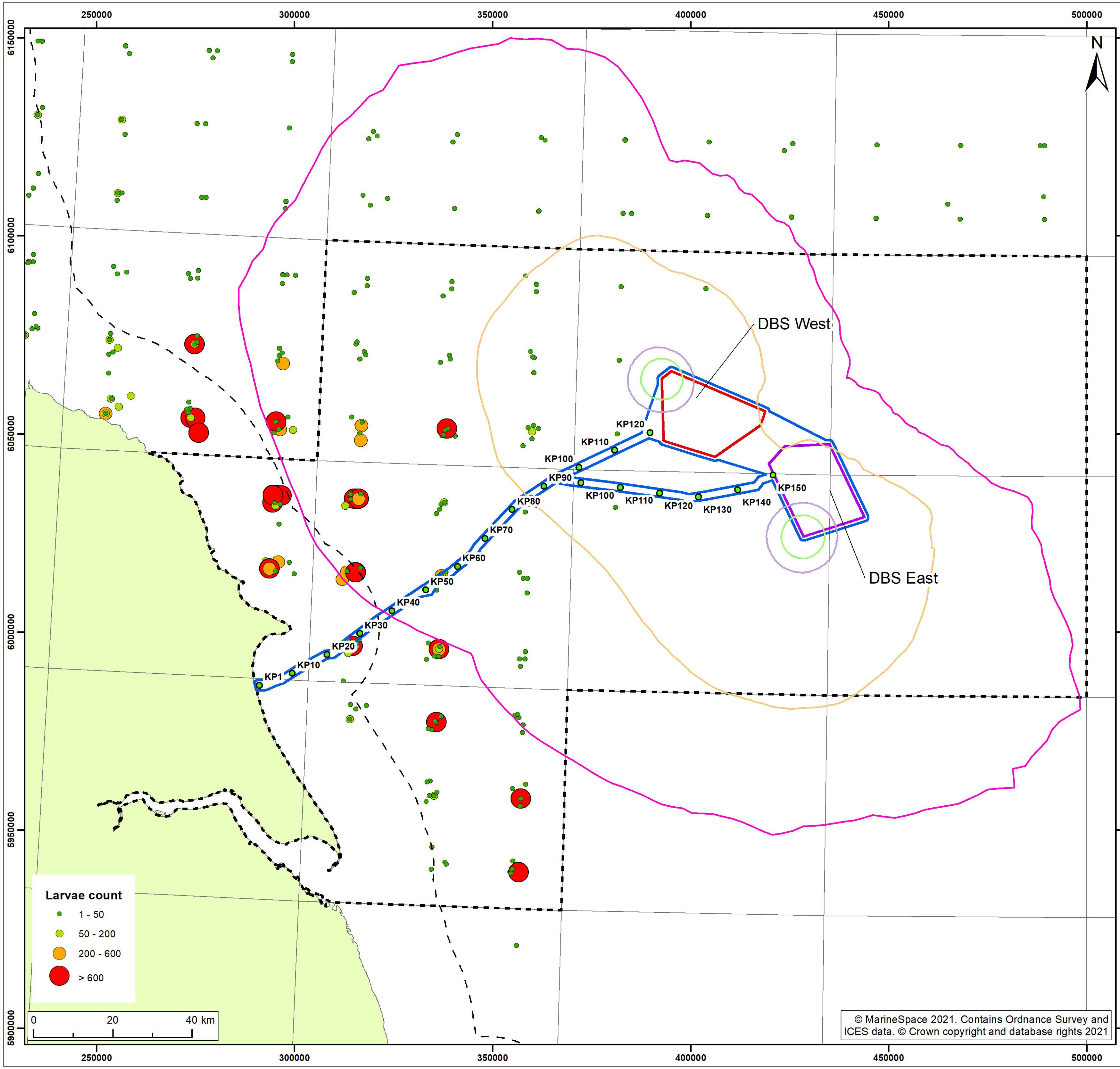
38. When plotting IHLS 'AbSmall' data against the spatial distribution of the Offshore Export Cable Corridor, abundances are high in the closest IHLS sampling stations to Flamborough Head, with abundances decreasing in an easterly direction, such as along the offshore trajectory of the Offshore Export Cable Corridor (**Figure 2-7**). The only IHLS sampling station (which includes an AbSmall record) that overlaps with the Offshore Export Cable Corridor is located between ST163 and ST164 (approximately 2.5km from each ST sampling location), which were both ground-truthed as unsuitable spawning habitat (muddy sandy Gravel, see **Table 2-1**). Given the proximity of unsuitable habitat type within the underlying EMODnet dataset, it can be determined with reasonable confidence that the seabed sediments at the IHLS sampling location (between ST163 and ST164) are unlikely to be suitable for spawning due to their high mud content.

39. It is important to note at this stage that the IHLS does not sample larvae on the seabed, but rather at approximately 5m above the seabed, in the water column. As such, larvae caught by the IHLS are likely to be mobilised by nearbed currents, and are not directly associated with the seabed at point of capture and therefore not considered to be at risk of potential impacts associated with the installation of cables (Kyle-Henney *et al*., 2024; EGL2, 2024). Considering the high energy environment off Flamborough Head and the proximity of suitable sediments either side of the Offshore Export Cable Corridor (based on EMODnet data and not site-specific ground-truthing surveys), it is likely that the majority of larvae caught at the IHLS sampling station between ST163 and ST164 hatched from spawning beds outside of the Offshore Export Cable Corridor.

40. ST161 and ST162 were ground-truthed as marginal and preferred habitat respectively, so it is also possible that 0-ringer larvae identified at the IHLS sampling station between ST163 and ST164 originated from this area. The direction of currents off Flamborough Head and within the Offshore Export Cable Corridor are predominantly south-east and north-west, parallel with the shoreline (**Chapter 8 Marine Physical Environment** [APP-080]). Therefore, it is unlikely that significant quantities of larvae were transported ~7.5km in a westerly direction from the ST161-ST162 area to the IHLS sampling station between ST163 and ST164. ST166 and ST167 were ground-truthed as preferred habitat, however these sampling stations lie outside of the IHLS survey area within an extent of moderate potential spawning habitat.

41. When considering the potential effects associated with the installation of export cables, the lack of suitability of sediments at the IHLS sampling station between ST163 and ST164 for supporting Atlantic herring spawning activity, it can be concluded that the IHLS (High Abundance) data layer does not provide a sufficient representation of the degree of spawning activity occurring at a site-specific scale, but rather the activity surrounding the sampling station at a wider spatial scale.

42. Given the localised nature of impacts associated with the installation of export cables and low confidence in the IHLS (High Abundance) datalayer in this location, conclusions should be weighted towards the site-specific seabed sediment type analyses.



Legend:

- DBS East Array
- Offshore Development Area
- DBS West Array
- KP Points

Disturbance Threshold (based on Hawkins et al., 2014)

- 135 dB re 1 μPa^{2}s SEL_{ss} (Behaviour Threshold)

Key UWN Thresholds (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL_{cum} (TTS)
- 203 dB re 1 μPa^{2}s SEL_{cum} (Recoverable Injury)
- 207 dB re 1 μPa^{2}s SEL_{cum} (Mortality/Potential Mortal Injury)
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0024	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0024	IW	MKH	OW

Title:

IHLS abundance data from 2007-2023 indicating the combined distribution of spawning activity within the IHLS survey area.

Figure: 2-7 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0024

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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2.4 Summary – Atlantic Herring

43. The evidence presented within this section represents an update to the original EIA within **Chapter 10 Fish and Shellfish Ecology** [APP-091], in accordance with MMO and Natural England's Relevant Representations (refer to **The Applicants' Responses to Relevant Representations** [PDA-013]). The updated Atlantic herring potential spawning habitat heat map presented in **Figure 2-1** incorporates current UK best practice, upon the request of the MMO. The subsequent analyses of **Figure 2-1** do not represent a substantial change in the baseline understanding of Atlantic herring spawning grounds presented within **Chapter 10 Fish and Shellfish Ecology** [APP-091], by virtue of similarities in the datasets used within the Reach *et al*. (2013) and Kyle-Henney *et al*. (2024) methods.

44. Given the evidence presented within this report, it has been determined that **the Offshore Export Cable Corridor is located within proximity to potential spawning grounds for Atlantic herring, but that the spatial extent of potential spawning habitat between ST161-ST162 and ST166-ST167 is not sufficient to categorise the seabed sediments within the Offshore Export Cable Corridor as of high importance to Atlantic herring** (in-particular the Banks North Sea Autumnal Spawning population). There is no potential spawning habitat within or immediately surrounding the Array Areas.

45. This determination is further supported when the relevant part of the Offshore Export Cable Corridor is compared to the area of high potential spawning habitat either side of the Offshore Export Cable Corridor: to the north of Flamborough Head and to the south (as indicated by the IHLS (High Abundance) data). In these areas (where no project-specific ground-truthing data are available), the EMODnet seabed sediment data represents the best available data. These data indicate a large spatial extent of preferred and marginal potential spawning habitat. Furthermore, **the distribution of IHLS sampling stations is not reflective of suitable sediment types to support Atlantic herring spawning**, with sampling stations to the east of the 12 nm boundary overlapping with unsuitable sand-dominated sediments (confirmed by EMODnet 1:250k seabed sediment type and ground-truthing undertaken by the Projects).

46. The potential disturbance and smothering effects of offshore cable laying activities are temporary (suitable sediment type for spawning is expected to return to baseline conditions within one spawning season) and are highly limited in spatial extent, often depositing suspended seabed sediments within a few metres either side of the cable plough (**Chapter 8 Marine Physical Environment** [APP-080]). As such, the updated evidence presented within this report reinforces the determination of non-significance arising from cable installation activities, as determined within the EIA for Fish and Shellfish Ecology (**Chapter 10 Fish and Shellfish Ecology** [APP-091]). The additional information presented **<u>does not alter the conclusions within the EIA</u>** for Fish and Shellfish Ecology (**Chapter 10 Fish and Shellfish Ecology** [APP-091]**)**.

47. **Considering the above, the Applicants therefore maintain the position that there is no justification for imposing a seasonal restriction on cable-laying activities within the Offshore Export Cable Corridor, as potential effects are not considered to be detrimental to the Banks spawning population.**

3 Updated Heat Map – Sandeel

48. The updated heat map for identifying potential supporting habitat for sandeel is derived from the methodology proposed by Reach *et al*. (2024). This update has been prepared following commitments made by the Applicants pertaining to sandeel habitats as documented within **The Applicants' Responses to Relevant Representations** [PDA-013] (specifically in response to RR-030: 5.5.2; RR-030: 5.5.4 to 5.5.11; RR-030: 5.5.13; RR-030: 5.5.21, RR-030:5.5.38, RR-039: E2, E3, E13, and E17).

49. The heat map depicting potential supporting habitat for sandeel in the vicinity of the Offshore Export Cable Corridor and the Array Areas for the Projects is shown in **Figure 3-1**. In addition to the underlying heat map, **Figure 3-1** also shows the position of the Offshore Export Cable Corridor and Array Areas, and the underwater noise contours relevant to fish without a swim bladder (Popper *et al*., 2014) associated with monopiling activities within the Array Areas. The sandeel heat map submitted within **Chapter 10 Fish and Shellfish Ecology** [APP-091] is presented within Appendix 1 for comparison (**Figure A-2**).

50. The heat map has been created by overlapping multiple data-layers, each assigned a confidence score relating to their ability to identify potential supporting habitat. In the case of the Projects, the following datasets have been used to inform the heat map:

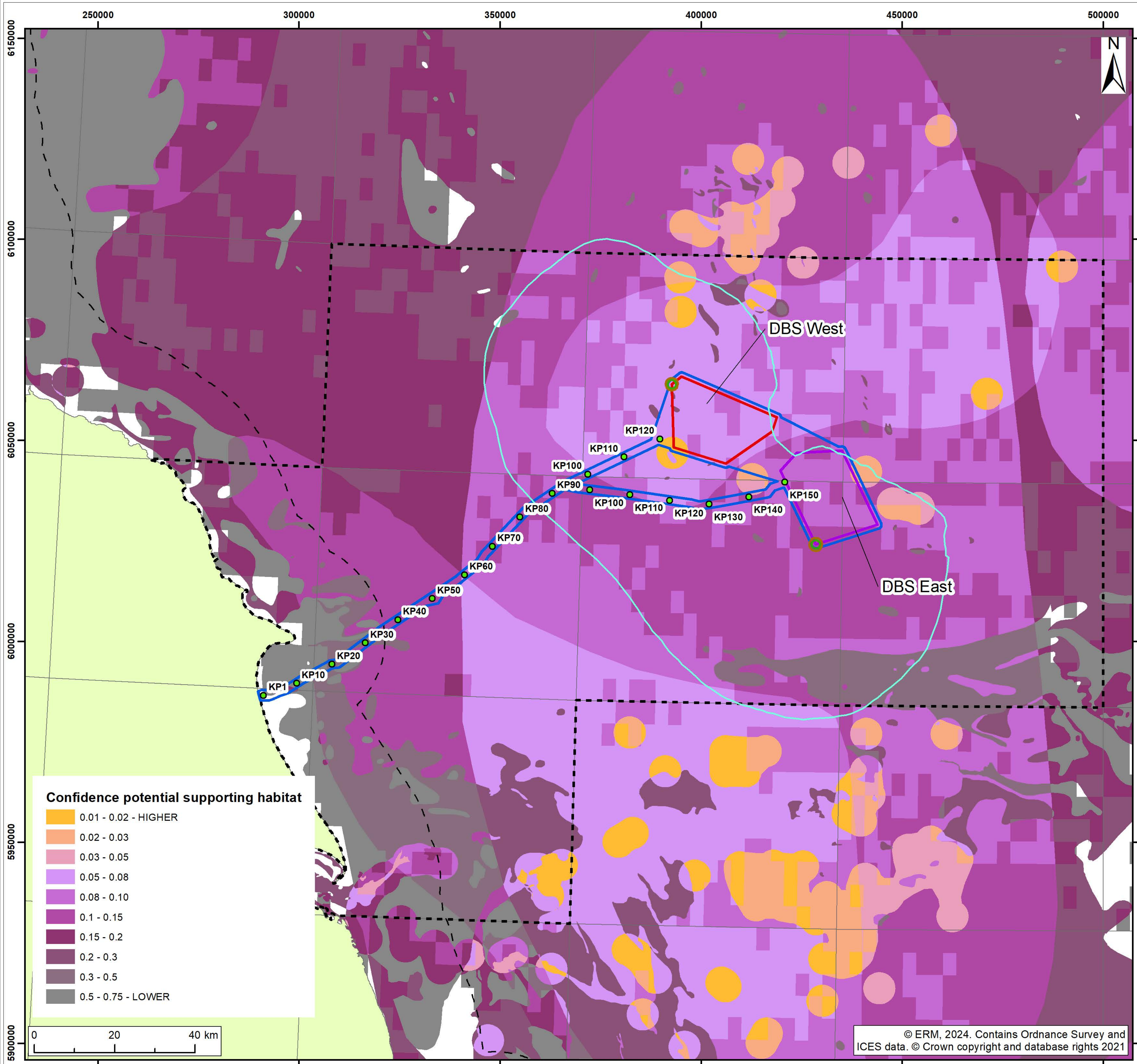
- EMODnet 1:250k seabed sediments map (preferred habitat – Sand, slightly gravelly Sand, and gravelly Sand; marginal habitat – sandy Gravel);
- Known sandeel grounds defined by Coull *et al*. (1998);
- Known sandeel grounds defined by Wright *et al*. (2019);
- OneBenthic sandeel presence; and
- 2020 VMS for fishing vessels targeting sandeel.

51. These data sources were included within the original heat map presented in **Chapter 10 Fish and Shellfish Ecology** [APP-091], but have been updated to incorporate additional datasets (specifically the Wright *et al*. (2019) and OneBenthic sandeel presence datasets).

52. It is noted that the EMODnet 1:250k seabed sediments map incorporates the BGS 1:250k seabed sediments map used within the Latto *et al*. (2013) method. The EMODnet map was selected for use in preference to the BGS map within the updated Reach *et al*. (2024) methodology as it is not limited to the UK Exclusive Economic Zone (EEZ), and therefore presents a wider representation of seabed sediments at a population scale.

53. Please refer to Reach *et al*. (2024) for further information regarding the differences between the Latto *et al*. (2013) method used in **Chapter 10 Fish and Shellfish Ecology** [APP-091] and the updated Reach *et al*. (2024) method used within this report.

54. The updated sandeel heat map (**Figure 3-1**) indicates that the majority of the Humber region, including the Offshore Export Cable Corridor and the Array Areas represents suitable supporting habitat for sandeel. Discrete areas of 'higher' supporting potential are generated by OneBenthic sandeel presence data, which are highly localised and therefore not reflective of the extent of sandeel presence at a regional scale. As such, it can be assumed that the heat scores of <0.08 are indicative of 'high-higher' potential supporting habitat at a regional scale, and that sandeel are considered present within the Array Areas and the offshore extent of the Offshore Export Cable Corridor (beyond 12nm from the coastline).



Legend:

- DBS East Array Area
- Offshore Development Area
- DBS West Array Area
- KP Points

Key UWN Thresholds for fish without swim bladder (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$ (TTS)
- 216 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable Injury)
- 219 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal Injury)
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles

S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0022	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0022	IW	MKH	OW
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:
Potential supporting habitat heat map for sandeel species in the vicinity of Dogger Bank South Offshore Wind Farms. Produced following approaches from Reach et al. (2024). The underwater noise (UWN) contour used within the EIA has been included for reference.

Figure: 3-1 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0022

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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3.1 Individual Data-Layers

55. Following requests from stakeholders within the Relevant Representations (RR-030: 5.5.2; RR-030: 5.5.4 to 5.5.1; RR-030: 5.5.13; RR-030: 5.5.21; RR-030: 5.5.38; RR-039: E2, E3, E13, and E17), the individual data-layers used to develop the updated heat map (**Figure 3-1**) are presented in this section.

3.1.1 Seabed Sediment Type

56. The EMODnet 1:250k seabed sediment types displayed in **Figure 3-2** indicate that the Offshore Export Cable Corridor and Array Areas are located in a very large area of preferred seabed sediment type (sand, slightly gravelly sand, and gravelly sand), with comparably limited extents of marginal seabed sediment type (sandy gravel) primarily located within 12nm. There are discrete areas of unsuitable seabed sediment type mosaiced throughout the extent of preferred and marginal potential spawning habitat. The largest of which is located within the southeastern extent of the Fish and Shellfish Ecology Study Area (**Figure 3-2**). PSD data have been used to ground-truth the sandeel heat map in section 3.2 for site-specific interpretation of the heat map; in accordance with the recommendations of Reach *et al*. (2024).

3.1.2 Known Sandeel Grounds

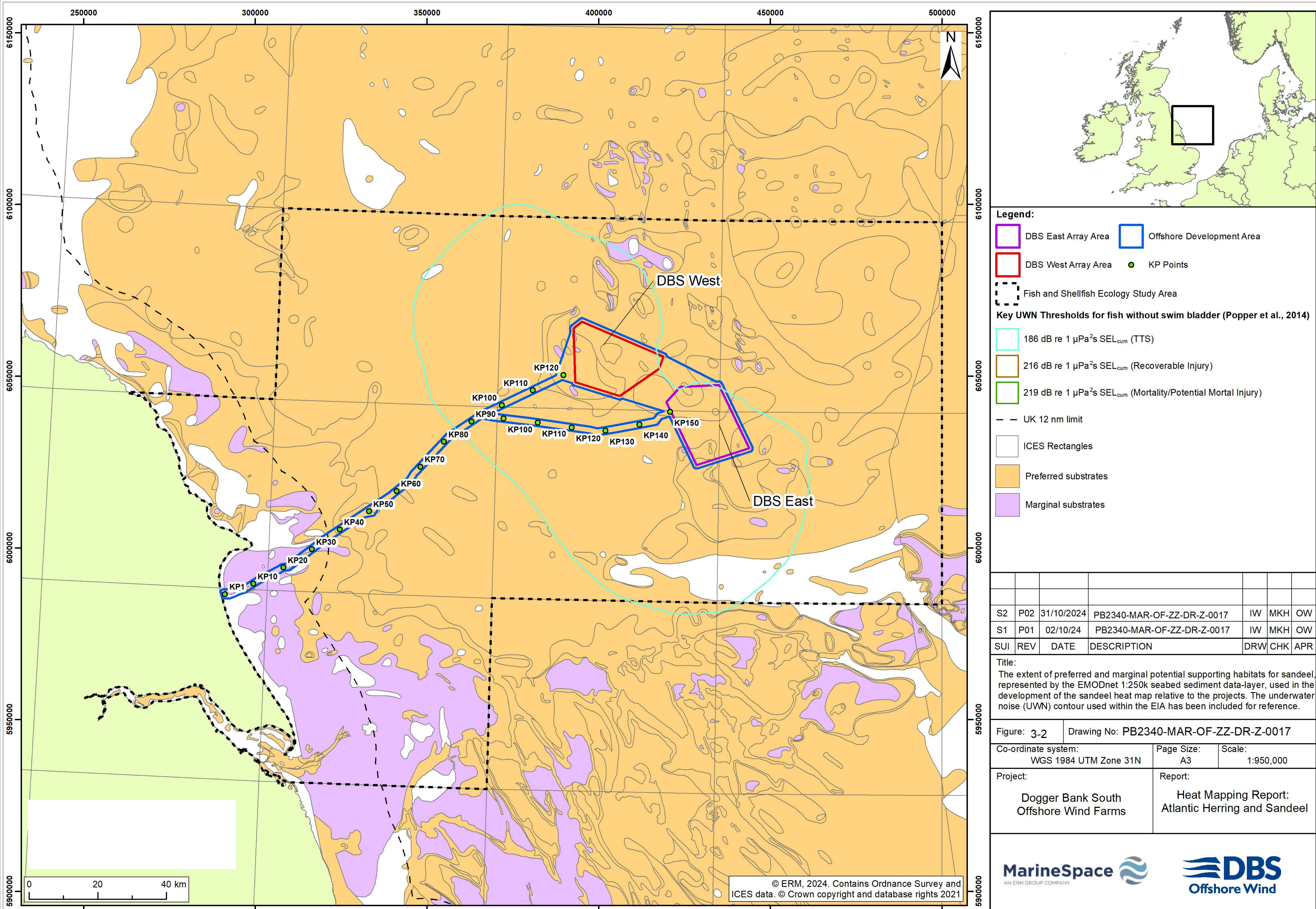
57. Data included within the heat map relating to known sandeel grounds include OneBenthic sandeel presence (**Figure 3-3**), Wright *et al*. (2019) sandeel grounds (**Figure 3-4**), and Coull *et al*. (1998) sandeel grounds (**Figure 3-5**). All three data sources identify the Array Areas and parts of the Offshore Export Cable Corridor to be of importance to sandeel, however the extents of each layer do not entirely correlate with one another.

58. The OneBenthic sandeel presence data are limited to specific areas due to the nature of the OneBenthic data, representing individual sandeel records as points rather than polygons. These point data have been buffered to create polygons for the purposes of the heat map in accordance with Reach *et al*. (2024). Sandeel records collected on behalf of the Projects have not been included within the OneBenthic database, and therefore are not displayed in **Figure 3-3**. The use of OneBenthic sandeel presence data is considered best practice for inclusion within the heat map (Reach *et al*., 2024). No additional survey data has been assessed for confidence or subsequently incorporated into the heat map.

59. Sandeel presence data recorded on behalf of the Projects were presented within the EIA; with the majority of records located within the DBS West Array Area, and a few records within the northeastern corner of the DBS East Array Area. When comparing these data to the known sandeel ground data-layers, this correlates well with the Coull *et al*. (1998) data-layer within the Array Areas. The Wright *et al*. (2019) data-layer is over-representative of the distribution of sandeel recorded on behalf of the Projects, whereas the OneBenthic sandeel presence data-layer under-represents the same distribution.

3.1.3 Fishing Activity

60. The 2020 VMS data (MMO, 2023) presented in **Figure 3-6** shows the extent of the demersal fishery within the vicinity of the Projects, of which the sandeel fishery is included. Whilst sandeel fisheries target sandeel on the seabed, there is limited confidence in VMS data indicating suitable substrate types (Reach *et al*., 2024). Similarly to the Wright *et al*. (2019) and Coull *et al*. (1998) data-layers, the VMS data are over-representative of potential supporting habitat for sandeel.



SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0017	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0017	IW	MKH	OW

Title:
The extent of preferred and marginal potential supporting habitats for sandeel, represented by the EMODnet 1:250k seabed sediment data-layer, used in the development of the sandeel heat map relative to the projects. The underwater noise (UWN) contour used within the EIA has been included for reference.

Figure: 3-2 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0017

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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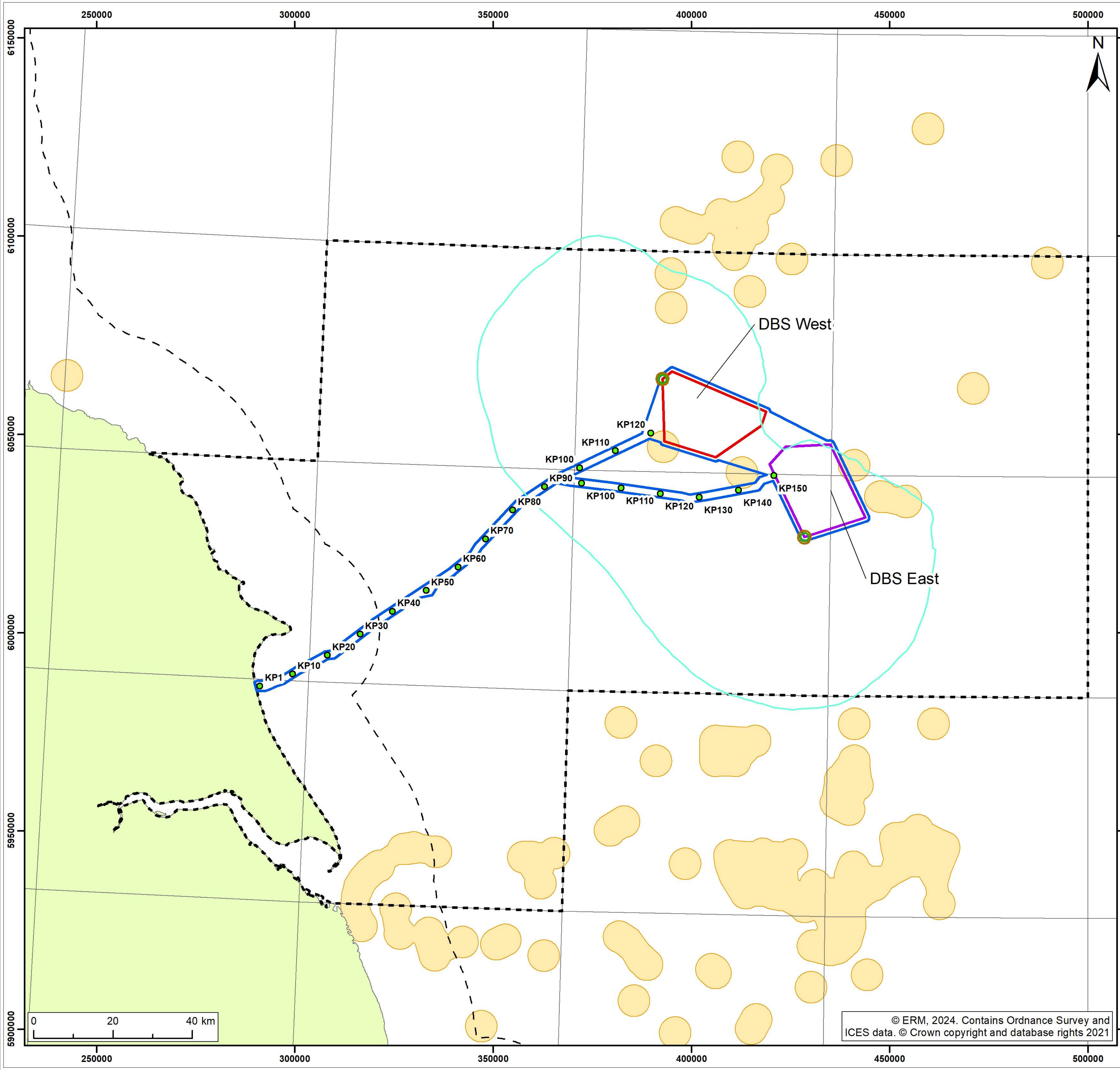


Legend:

- DBS East Array
- Offshore Development
- DBS West Array
- KP Points

Key UWN Thresholds for fish without swim bladder (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$
- 216 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable
- 219 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles
- OneBenthic Sandeel

S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0018	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0018	IW	MKH	OW
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:
The extent of the OneBenthic Sandeel Presence data-layer used in the development of the sandeel heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

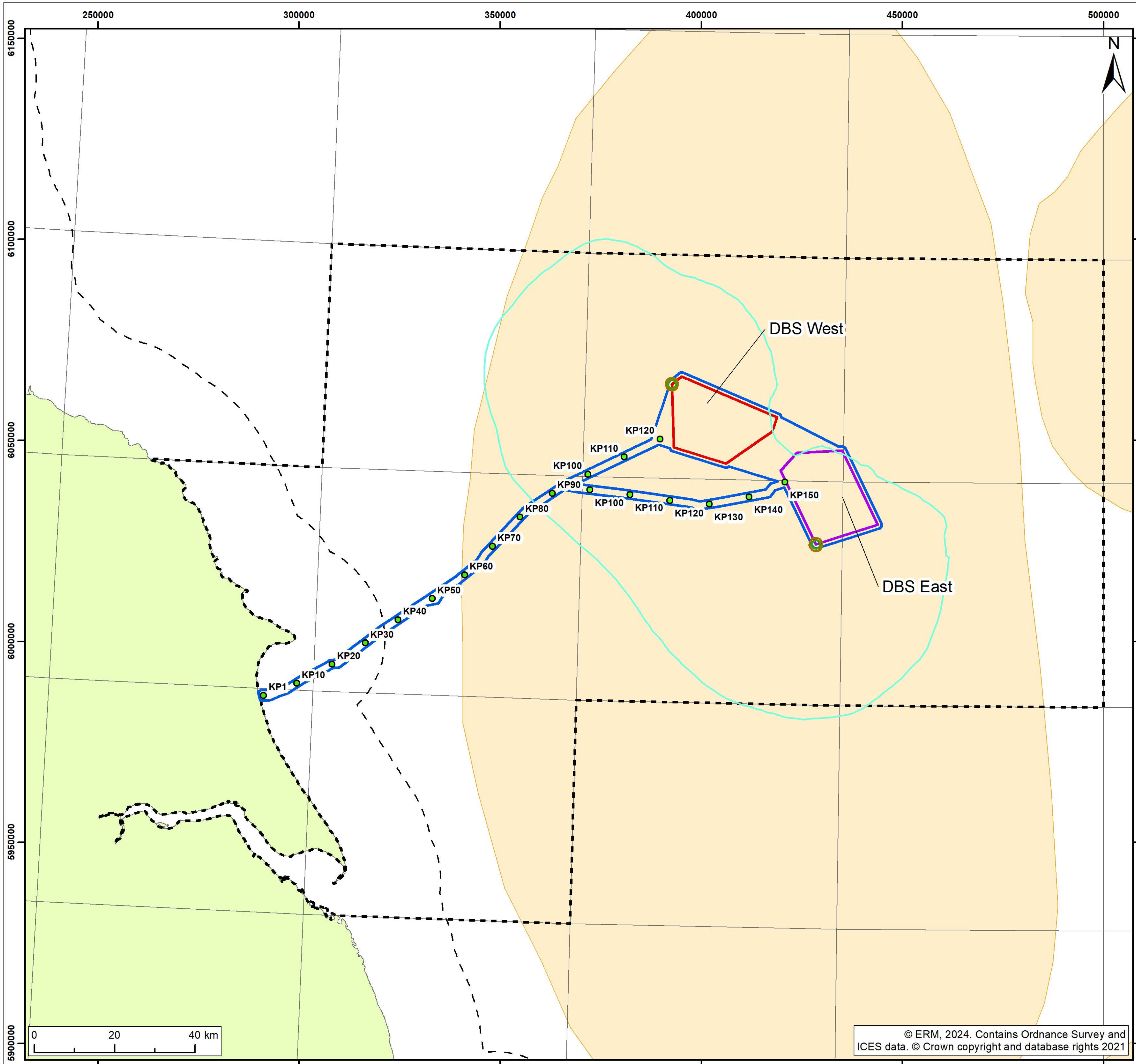
Figure: 3-3 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0018

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

MarineSpace
AN ERM GROUP COMPANY
DBS Offshore Wind



Legend:

- DBS East Array Area
- Offshore Development Area
- DBS West Array Area
- KP Points

Key UWN Thresholds for fish without swim bladder (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL_{cum}
- 216 dB re 1 μPa^{2}s SEL_{cum} (Recoverable
- 219 dB re 1 μPa^{2}s SEL_{cum} (Mortality/Potential Mortal
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles
- Known Sandeel Grounds (Wright et al., 2019)

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0019	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0019	IW	MKH	OW

Title:

The extent of the Wright et al. (2019) data-layer used in the development of the sandeel heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 3-4 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0019

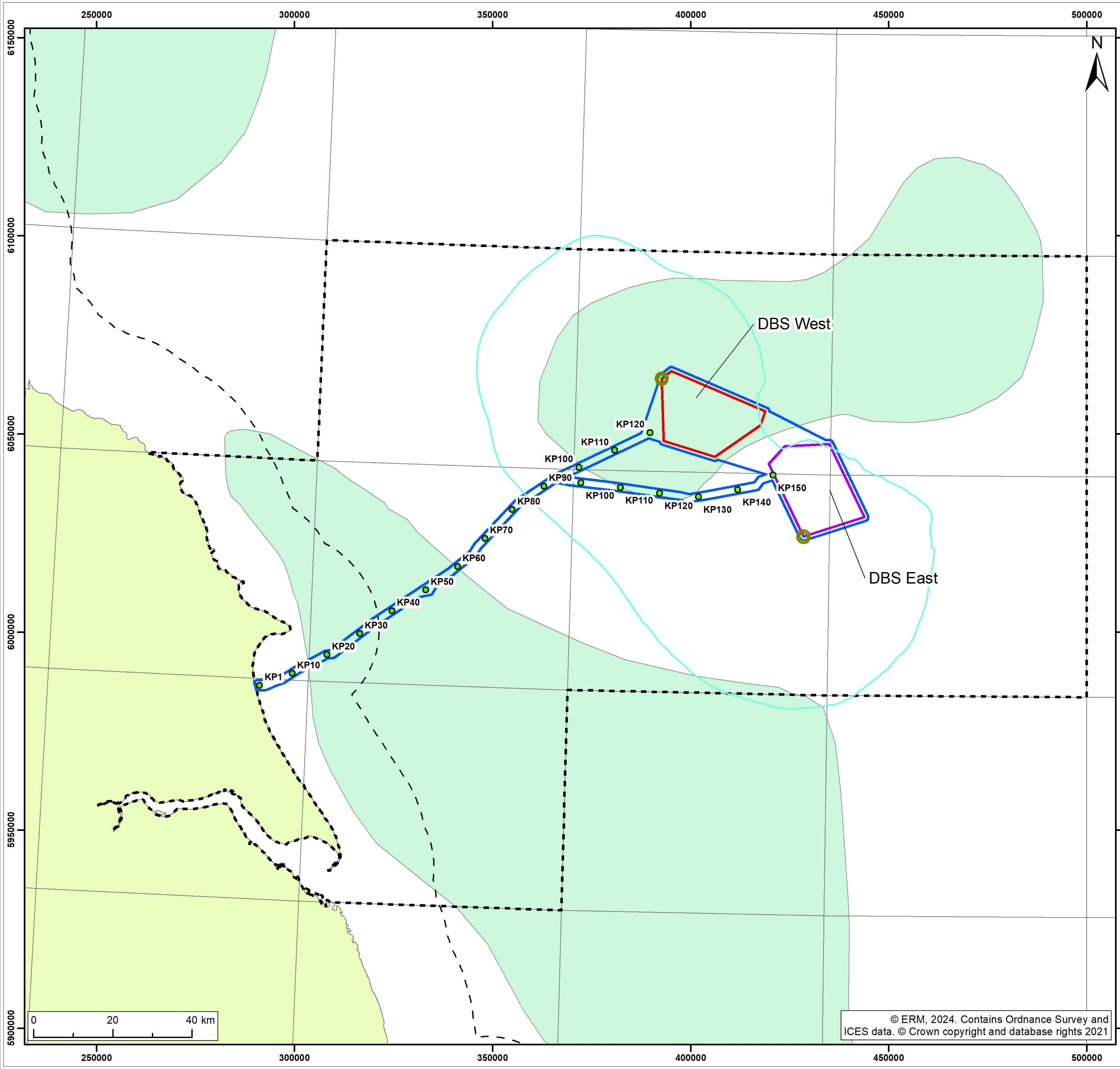
Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

MarineSpace AN ERM GROUP COMPANY

DBS Offshore Wind



Legend:

- DBS East Array
- Offshore Development
- DBS West Array
- KP Points

Key UWN Thresholds for fish without swim bladder (Popper et al., 2014)

- 186 dB re 1 μPa^{2}s SEL$_{cum}$
- 216 dB re 1 μPa^{2}s SEL$_{cum}$ (Recoverable
- 219 dB re 1 μPa^{2}s SEL$_{cum}$ (Mortality/Potential Mortal
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles
- Spawning grounds defined by Coull et al. (1998

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0020	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0020	IW	MKH	OW

Title:

The extent of the Coull et al. (1998) data-layer used in the development of the sandeel heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 3-5 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0020

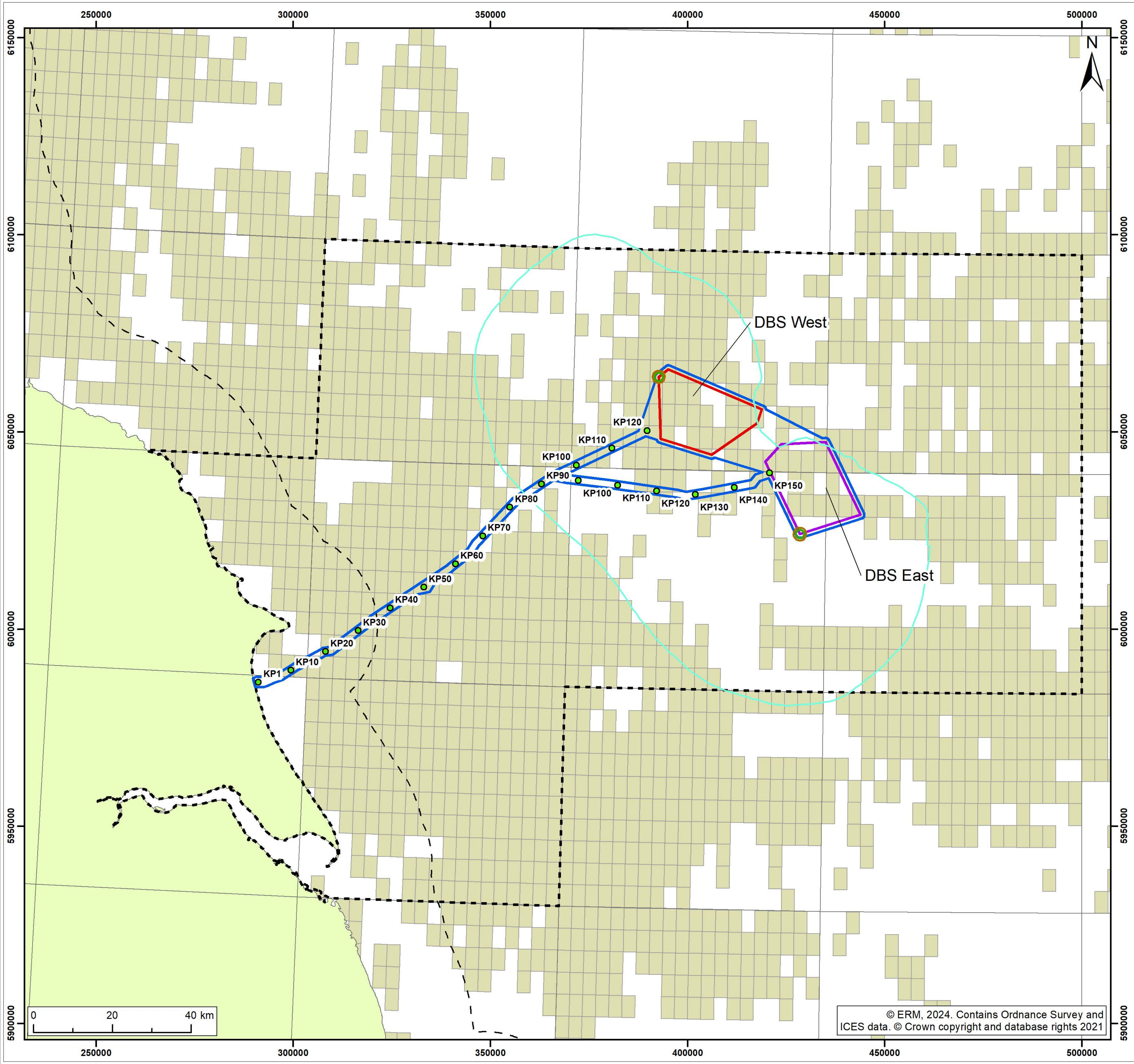
Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

MarineSpace AN ERM GROUP COMPANY

DBS Offshore Wind



Legend:

- DBS East Array
- Offshore Development
- DBS West Array
- KP Points

Key UWN Thresholds for fish without swim bladder (Popper et al., 2014)

- 186 dB re 1 µPa^{2}s SEL_{cum}
- 216 dB re 1 µPa^{2}s SEL_{cum} (Recoverable
- 219 dB re 1 µPa^{2}s SEL_{cum} (Mortality/Potential Mortal
- Fish and Shellfish Ecology Study Area
- UK 12 nm limit
- ICES Rectangles
- Fishing Activity recorded by VMS (2020)

S2	P02	31/10/2024	PB2340-MAR-OF-ZZ-DR-Z-0023	IW	MKH	OW
S1	P01	02/10/24	PB2340-MAR-OF-ZZ-DR-Z-0023	IW	MKH	OW
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:

The extent of the VMS (2020) data-layer used in the development of the sandeel heat map relative to the Projects. Underwater noise (UWN) contours used within the EIA have been included for reference.

Figure: 3-6 | Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0023

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:950,000

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

MarineSpace AN ERM GROUP COMPANY

DBS Offshore Wind

East_Corridor_10KP_Points_20241010

3.2 Particle Size Distribution Analysis

61. As stated in section 3, the identification of high potential supporting habitat in **Figure 3-1** may be over-representative of localised preferred or marginal seabed sediment types. As such, sediment PSD data should be used to ground-truth the heat map at a site-specific scale (Reach *et al*., 2024).

62. **Table 3-1** shows the locations of sediment sampling locations surveyed on behalf of the Projects within the Array Areas (ST001-ST132) and along the Offshore Export Cable Corridor (ST133-ST180) (Fugro, 2023). Stations that are no longer within the red line boundary (due to refinements since the time of data collection) are marked with an asterisk, but remain relevant to characterising the sediment type within the vicinity of the red line boundary.

63. It can be clearly seen that the sediment data show current seabed sediment types to be primarily suitable for supporting sandeel populations within this region; with the exception of a limited number of sampling stations and areas where unsuitable habitat has been identified.

64. The distribution of sampling stations ST001-ST132 relative to the Projects' Array Areas is shown in **Figure 3-7**; with ST133-ST180 relative to the Offshore Export Cable Corridor shown in **Figure 2-6**. Whilst some stations identify the presence of unsuitable supporting habitats due to a significant % of fines, the majority of the Array Areas and Offshore Export Cable Corridor are consistent with suitable (preferred and marginal) supporting habitats.

Table 3-1: PSD data collected within the Array Areas and Offshore Export Cable Corridor on behalf of the Projects.

Station	% Gravel	% Sand	% Fines	Folk Description
Array Areas				
ST001	4.88	91.37	3.76	Sand
ST002	5.79	91.26	2.96	Gravelly sand
ST003	1.34	94.91	3.74	Sand
ST004	2.87	95.16	1.96	Sand
ST005	38.75	57.49	3.76	Sandy gravel
ST006	0.09	94.8	5.11	Sand
ST007	14.32	74.05	11.63	Gravelly muddy sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST008	0.33	94.47	5.2	Sand
ST009	0.21	89.22	10.56	Muddy sand
ST010	0.02	89.47	10.51	Muddy sand
ST011	17.89	73.19	8.93	Gravelly muddy sand
ST012	53.34	43.17	3.49	Sandy gravel
ST013	0.47	91.8	7.73	Sand
ST014	2.55	95.71	1.74	Sand
ST015	69.46	29.28	1.26	Sandy gravel
ST016	0.07	99.93	0	Sand
ST017	0.73	93.68	5.59	Sand
ST018	0.53	93.8	5.67	Sand
ST019	0.3	94.48	5.22	Sand
ST020	4.18	90.75	5.07	Sand
ST021	1.82	94.64	3.54	Sand
ST022	0.63	95.89	3.48	Sand
ST023	2.21	97.79	0	Sand
ST024	0.1	99.9	0	Sand
ST025	1.74	98.26	0	Sand
ST026	2.18	97.82	0	Sand
ST027	0.67	99.33	0	Sand
ST028	0.47	99.53	0	Sand
ST029	0.72	99.28	0	Sand
ST030	1.15	98.85	0	Sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST031	0.58	99.42	0	Sand
ST032	1.55	98.45	0	Sand
ST033	1.28	98.72	0	Sand
ST034	1.31	98.69	0	Sand
ST035	0.42	99.58	0	Sand
ST036	6.27	93.73	0	Gravelly sand
ST037	0.15	99.85	0	Sand
ST038	0.33	99.67	0	Sand
ST039	0.05	99.95	0	Sand
ST040	2.09	97.91	0	Sand
ST041	3.2	96.8	0	Sand
ST042	7.49	92.51	0	Gravelly sand
ST043	1.4	98.6	0	Sand
ST044	0.26	99.74	0	Sand
ST045	4.59	95.41	0	Sand
ST046	0.81	99.19	0	Sand
ST047	0.62	99.38	0	Sand
ST048	12.5	69.43	18.07	Gravelly muddy sand
ST049	51.16	47.05	1.79	Sandy gravel
ST050	0.02	99.98	0	Sand
ST051	2.24	97.76	0	Sand
ST052	1.51	98.49	0	Sand
ST053	1.5	98.5	0	Sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST054	1.49	98.51	0	Sand
ST055	1.05	98.95	0	Sand
ST056	1.21	98.79	0	Sand
ST057	69.72	26.17	4.12	Muddy, sandy gravel
ST058	1.45	98.55	0	Sand
ST059	0.53	99.47	0	Sand
ST060	0.23	99.77	0	Sand
ST061	30.37	59.53	10.1	Muddy, sandy gravel
ST062	0.5	99.5	0	Sand
ST063	47.95	51.51	0.54	Sandy gravel
ST064	16.51	83.49	0	Gravelly sand
ST065	0.07	99.93	0	Sand
ST066	0.12	99.64	0.24	Sand
ST067	0.09	99.91	0	Sand
ST068	11.37	88.63	0	Gravelly sand
ST069	0.89	99.11	0	Sand
ST070	2.88	97.12	0	Sand
ST071	1.62	98.38	0	Sand
ST072	0.27	98.85	0.88	Sand
ST073	0.17	99.83	0	Sand
ST074	0.14	99.86	0	Sand
ST075	0.66	98.64	0.7	Sand
ST076*	0.44	99.56	0	Sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST077*	0	100	0	Sand
ST078	24.13	70.09	5.78	Gravelly sand
ST079	0.54	99.46	0	Sand
ST080	50.84	49.16	0	Sandy gravel
ST081	55.01	44.03	0.96	Sandy gravel
ST082	0.06	99.94	0	Sand
ST083	0.06	99.94	0	Sand
ST084	23.4	73.35	3.25	Gravelly sand
ST085	0.01	99.99	0	Sand
ST086	0.7	99.3	0	Sand
ST087	0.13	99.87	0	Sand
ST088	0.95	99.05	0	Sand
ST089	1.76	98.24	0	Sand
ST090	10.63	89.37	0	Gravelly sand
ST091	1.51	94.05	4.44	Sand
ST092*	0.16	98.99	0.85	Sand
ST093*	30.72	66.09	3.19	Sandy gravel
ST094*	57.31	42.32	0.36	Sandy gravel
ST095	52.54	42.54	4.92	Muddy, sandy gravel
ST096	41.17	53.55	5.28	Sandy gravel
ST098	0.14	99.86	0	Sand
ST099	0.28	99.72	0	Sand
ST100	0.05	99.95	0	Sand

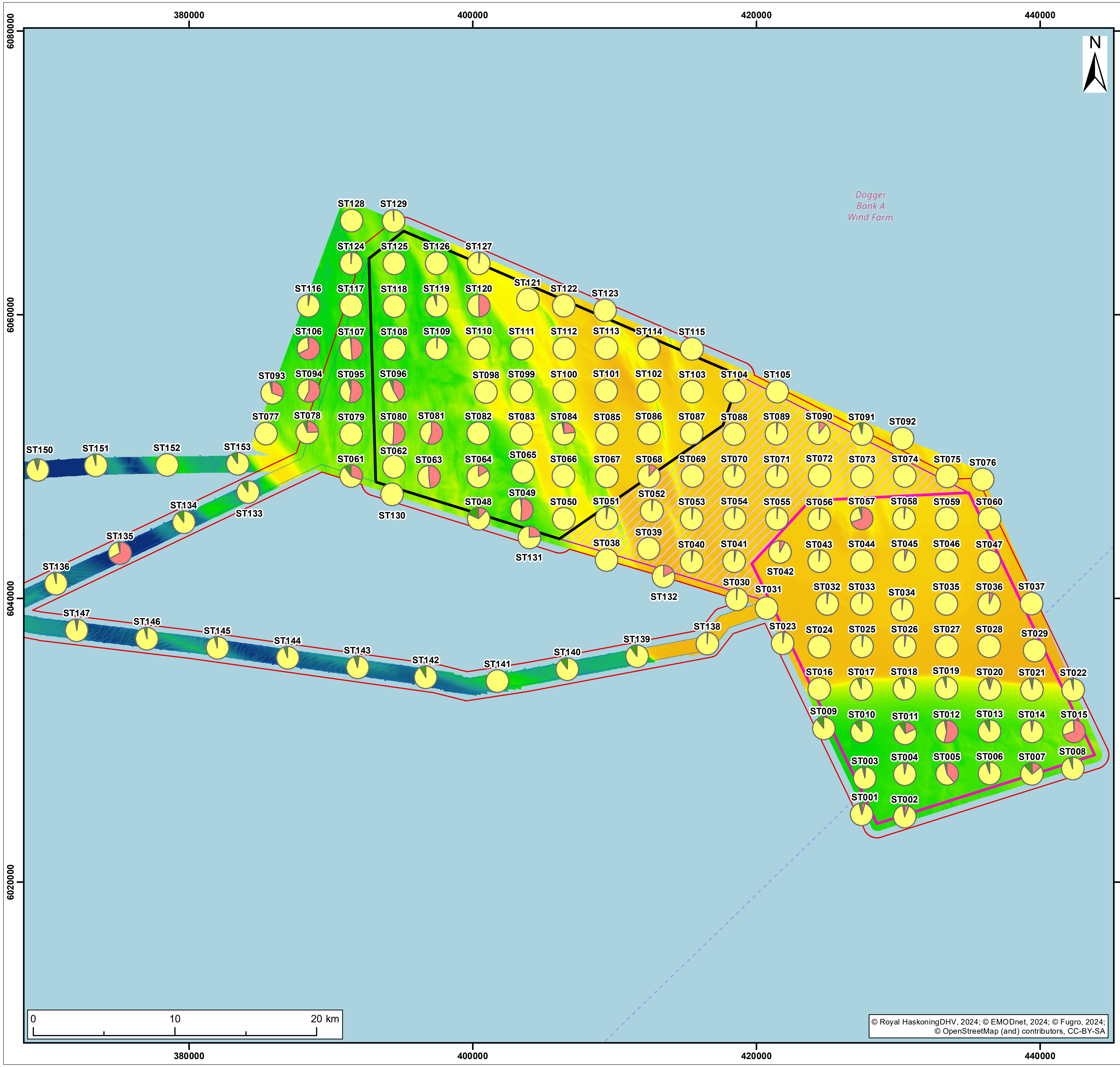
Station	% Gravel	% Sand	% Fines	Folk Description
ST101	0.24	99.76	0	Sand
ST102	0.3	99.7	0	Sand
ST103	0.1	99.9	0	Sand
ST104	0.69	99.31	0	Sand
ST105	0.47	99.53	0	Sand
ST106*	67.32	31.35	1.33	Sandy gravel
ST107	48.66	50.01	1.33	Sandy gravel
ST108	0.49	98.96	0.55	Sand
ST109	1.47	98.14	0.38	Sand
ST110	0.23	99.77	0	Sand
ST111	0.01	99.99	0	Sand
ST112	0.82	99.18	0	Sand
ST113	0.56	99.44	0	Sand
ST114	0.02	99.98	0	Sand
ST115	0.16	99.84	0	Sand
ST116*	2.66	96.89	0.45	Sand
ST117	0.72	99.28	0	Sand
ST118	0.08	99.92	0	Sand
ST119	0.32	94.95	4.73	Sand
ST120	49.38	50.4	0.22	Sandy gravel
ST121	0.1	99.9	0	Sand
ST122	0.56	99.44	0	Sand
ST123	0.41	99.59	0	Sand

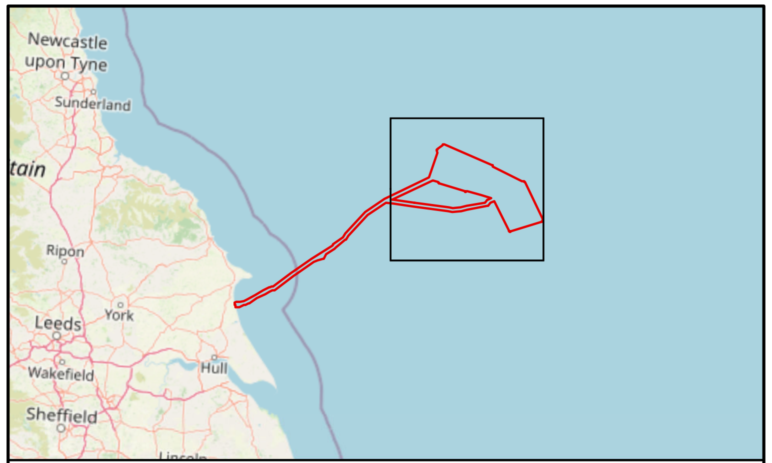
Station	% Gravel	% Sand	% Fines	Folk Description
ST124*	1.59	97.66	0.75	Sand
ST125	0.23	99.72	0.05	Sand
ST126	0.67	98.43	0.89	Sand
ST127	1.75	98.25	0	Sand
ST128*	0.23	99.77	0	Sand
ST129*	0.04	98.89	1.06	Sand
ST130	0.06	99.94	0	Sand
ST131	23.22	76.57	0.22	Gravelly sand
ST132	17.28	82.72	0	Gravelly sand
Offshore Export Cable Corridor				
ST133	0.29	90.39	9.32	Sand
ST134	0.43	89.52	10.05	Muddy sand
ST135	67.16	29.68	3.17	Sandy gravel
ST136	0.18	96.42	3.39	Sand
ST137	0.08	99.92	0	Sand
ST138	1.03	98.97	0	Sand
ST139	0.7	89.28	10.02	Muddy sand
ST140	0.07	89.92	10.01	Muddy sand
ST141	0	100	0	Sand
ST142	0.13	91.88	8	Sand
ST143	1.71	92.94	5.34	Sand
ST144	0.1	94.06	5.85	Sand
ST145	0.04	95.56	4.4	Sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST146	0.77	95.07	4.16	Sand
ST147	2.47	94.71	2.82	Sand
ST148*	0.08	92.76	7.16	Sand
ST149*	0.31	94.31	5.38	Sand
ST150*	2.88	91.89	5.23	Sand
ST151*	0	95.79	4.21	Sand
ST152*	0	100	0	Sand
ST153*	0.77	89.88	9.35	Sand
ST154*	0.08	95.18	4.74	Sand
ST155*	0.04	99.96	0	Sand
ST156*	0	100	0	Sand
ST157*	0.01	94.67	5.31	Sand
ST158	0.87	94.06	5.06	Sand
ST159	0.74	97.05	2.22	Sand
ST160	0.79	97.02	2.19	Sand
ST161	13.84	81.02	5.13	Gravelly sand
ST162	32.58	61.64	5.78	Sandy gravel
ST163	31.7	61.08	7.23	Muddy, sandy gravel
ST164	42.29	51.48	6.23	Muddy, sandy gravel
ST165	66.12	27	6.88	Muddy, sandy gravel
ST166	89.87	9.43	0.69	Gravel
ST167	72.78	26.58	0.63	Sandy gravel
ST168	0.07	92.78	7.15	Sand

Station	% Gravel	% Sand	% Fines	Folk Description
ST169	0.24	94.94	4.82	Sand
ST170	0.47	99.53	0	Sand
ST171	0	100	0	Sand
ST172	0.03	99.97	0	Sand
ST173	1.77	98.23	0	Sand
ST174	0.56	99.3	0.14	Sand
ST175*	0	100	0	Sand
ST176*	0	100	0	Sand
ST177	0.09	86.65	13.26	Muddy sand
ST178	0.11	96.23	3.66	Sand
ST179	0.1	99.9	0	Sand
ST180	0.05	93.1	6.86	Sand

Unsuitable Potential Supporting Habitat	Marginal Potential Supporting Habitat	Preferred Potential Supporting Habitat





Legend:

- Offshore Development Area
- Offshore Export Cable Corridor
- DBS East Array Area
- DBS West Array Area
- Inter-Platform Cable Corridor

Fractional Sediment Composition

- Gravel
- Sand
- Fines

Bathymetry (LAT)

High : 1.90336

Low : -69.8343

S2	P01	23/10/2024	Suitable for Information	SM	JH	RF
SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR

Title:

Spatial Variations of Percentage of Sand, Gravel and Fines Across the Array Areas of DBS East and DBS West

Figure: 3-7 Drawing No: PC2340-RHD-OF-ZZ-DR-Z-0902

Co-ordinate system:	Page Size:	Scale:
WGS 1984 UTM Zone 31N	A3	1:265,000

Project:	Report:
Dogger Bank South Offshore Wind Farms	Heat Mapping Report: Atlantic Herring and Sandeel

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DBS Offshore Wind

3.3 Summary – Sandeel

65. The evidence presented within section 3 represents an update to the original EIA within **Chapter 10 Fish and Shellfish Ecology** [APP-091], in accordance with MMO and Natural England's Relevant Representations documented within **The Applicants' Responses to Relevant Representations** [PDA-013] (RR-030: 5.5.2; RR-030: 5.5.4 to 5.5.11; RR-030: 5.5.13; RR-030: 5.5.21; RR-030: 5.5.38; RR-039: E2, E3, E13, and E17). The updated sandeel potential supporting habitat heat map presented in **Figure 3-1** incorporates current UK best practice in line with requests made by the MMO through their relevant representations. The subsequent analyses of **Figure 3-1** do not represent a substantial change in the baseline understanding of sandeel supporting habitat presented within **Chapter 10 Fish and Shellfish Ecology** [APP-091], by virtue of similarities in the datasets used within the Latto *et al*. (2013) and Reach *et al*. (2024) methods.

66. Given the evidence presented within this report, it has been determined that the majority of the Array Areas and the Offshore Export Cable Corridor are located within the preferred potential supporting habitat for sandeel that is characteristic of the Dogger Bank and wider Humber region.

67. When considered alongside the records of sandeel presence sampled on behalf of the Projects (Fugro, 2023), it is concluded that sandeel are present within the DBS West Array Area. Caution must be applied for areas lacking sandeel presence within samples due to limitations in sandeel sampling techniques (Reach *et al*., 2024). As such, sandeel are considered potentially present within the DBS East Array Area and the Offshore Export Cable Corridor, but that the DBS West Array Area is likely of greater importance to potentially support sandeel.

68. Activities associated with the Array Areas and the Offshore Export Cable Corridor cable-laying activities within the defined Offshore Export Cable Corridor assessed within the ES were determined as having **no likely significant effect on sandeel**, primarily as a result of the extensive potential habitat available to sandeel outside of the footprint of the Projects' infrastructure or footprint of temporary construction impacts. The updated sandeel heat map presented above represents a refinement in understanding of the likelihood of sandeel presence within the DBS Array Area or Offshore Export Cable Corridor, and satisfies the requests for updated methodologies documented within **The Applicants' Responses to Relevant Representations** [PDA-013].

69. As sandeel habitat was assumed as present within the ES, and updated figures do not result in a notable change in the understanding of potential habitat distribution used to inform potential impacts within the ES, it **<u>does not alter the conclusions within the EIA</u>** for Fish and Shellfish Ecology (**Chapter 10 Fish and Shellfish Ecology** [APP-091])

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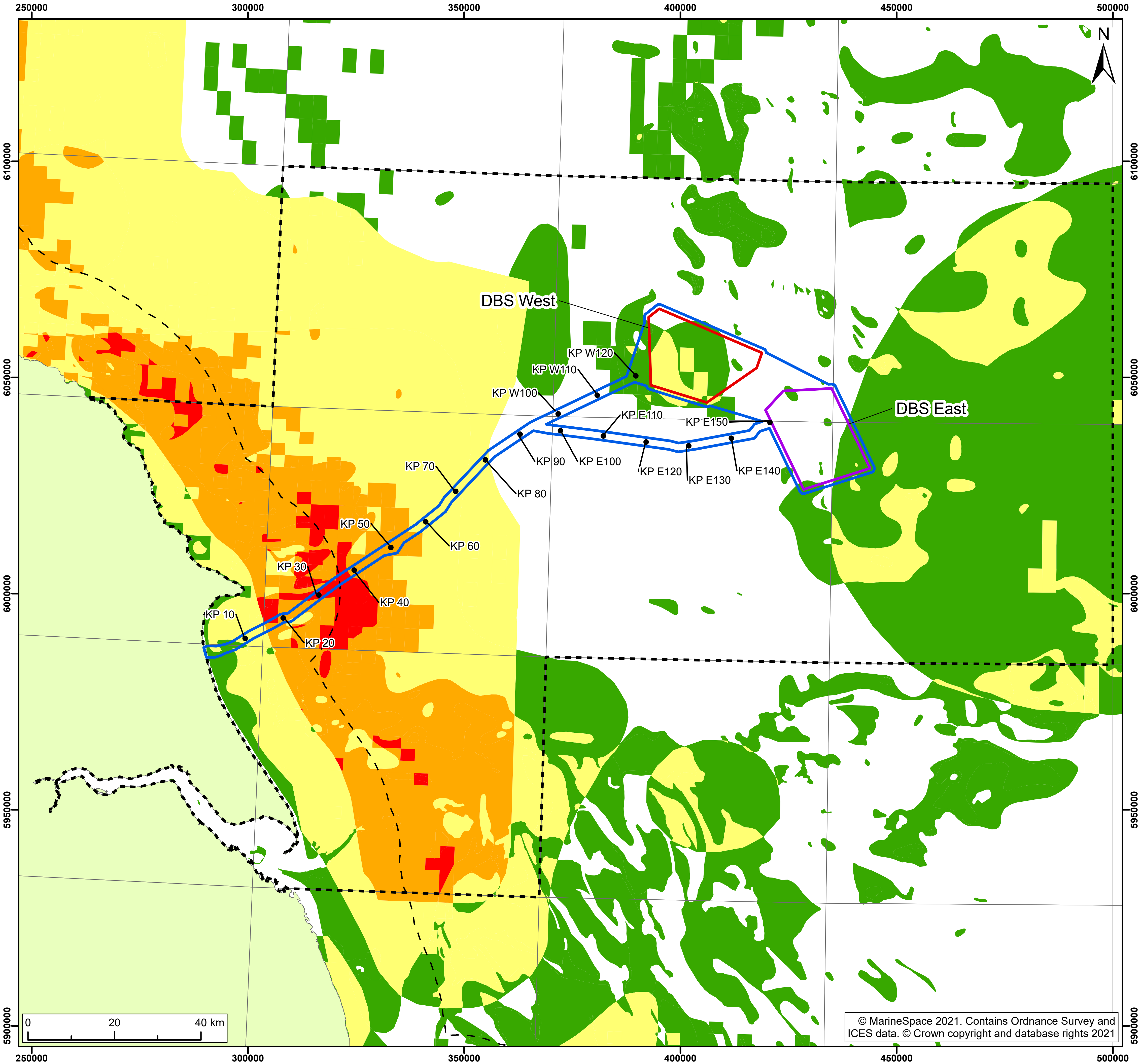
Appendix 1

70. This appendix displays the original Atlantic herring and sandeel heat maps produced to support **Chapter 10 Fish and Shellfish Ecology** [APP-091] of the Environmental Statement submitted as part of the DCO application (submitted June 2024).

71. The original Atlantic herring heat map (**Figure A-1**) was produced in accordance with previous guidance by Reach *et al.* (2013).

72. The original sandeel heat map (**Figure A-2**) was produced in accordance with previous guidance by Latto *et al.* (2013).



Legend:

- DBS East Array Area
- DBS West Array Area
- Offshore Development Area
- Fish and Shellfish Ecology Study Area
- Kilometer Point
- UK 12 nm limit
- ICES Rectangles

Herring spawning potential

- Low spawning potential
- Medium spawning potential
- High spawning potential
- Very High spawning potential

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S4	PO4	09/01/24	PB2340-MAR-OF-ZZ-DR-Z-0007	AN	IW	TM
S3	P03	22/03/23	PB2340-MAR-OF-ZZ-DR-Z-0007	NB	IW	TM
S2	P02	21/04/22	PB2340-MAR-OF-ZZ-DR-Z-0005	BO	IW	TM

Title:

Herring spawning potential across the Fish and Shellfish Study Area

Figure: A-1 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0007

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:880,336

Project: Dogger Bank South Offshore Wind Farms

Report: Heat Mapping Report: Atlantic Herring and Sandeel

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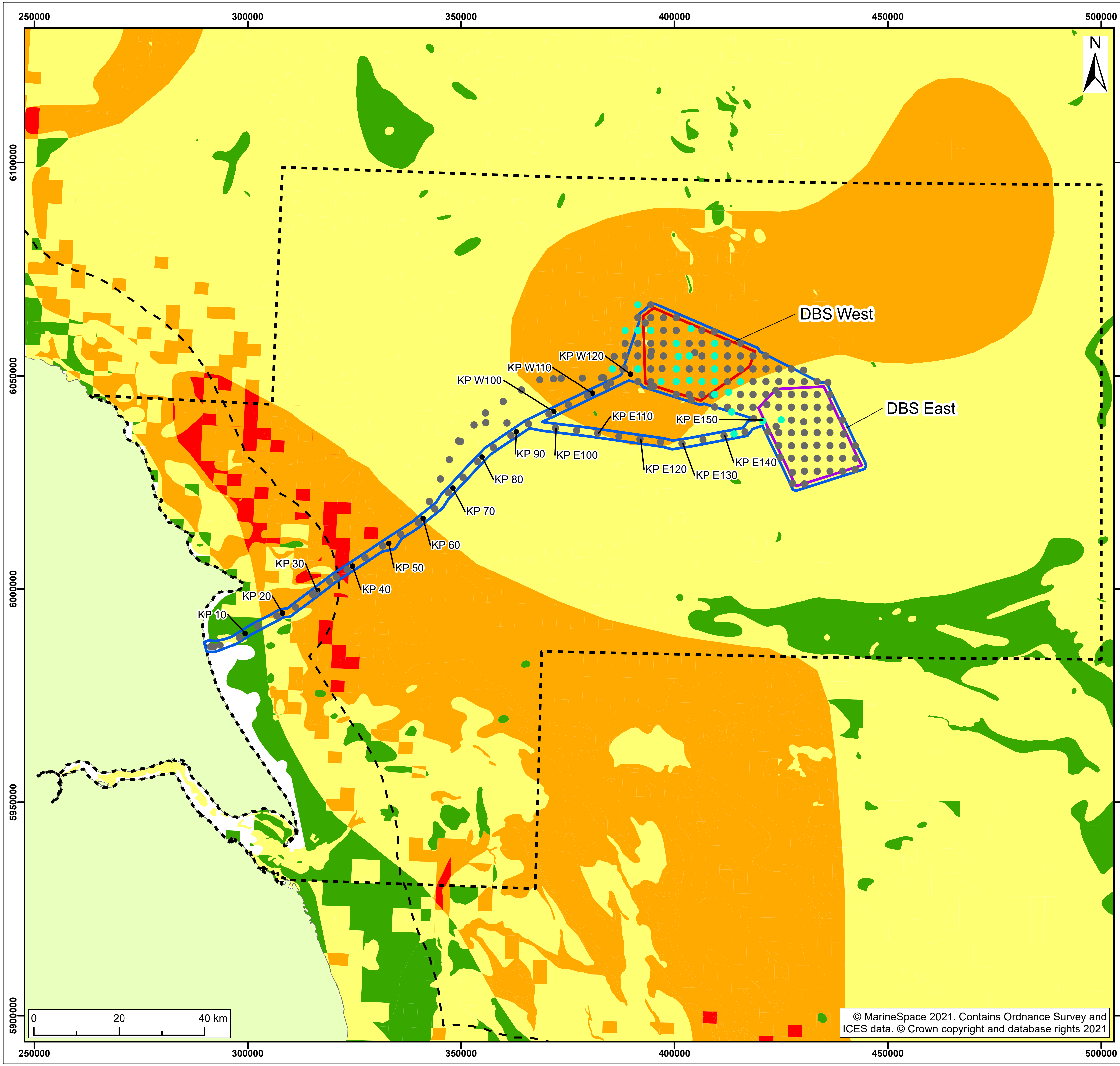

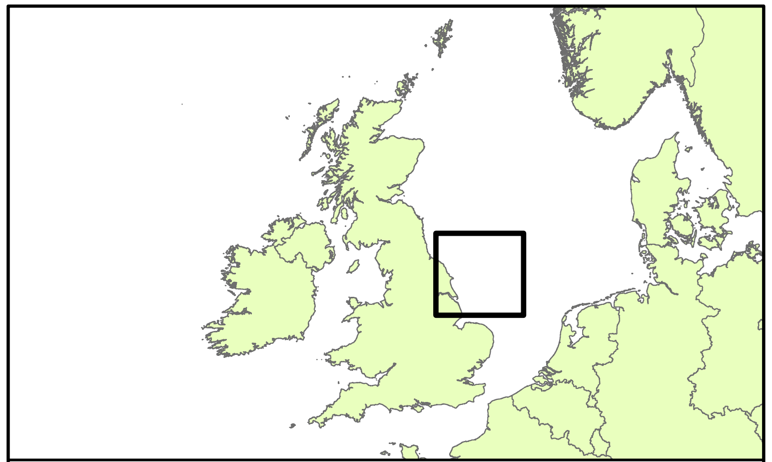

Legend:

- DBS East Array Area
- DBS West Array Area
- Offshore Development Area
- Fish and Shellfish Ecology Study Area
- Kilometer Point
- UK 12nm limit

Sandeel Presence

- Not Present
- Present

Sandeel habitat potential

- Low habitat potential
- Medium habitat potential
- High habitat potential
- Very High habitat potential

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S4	PO4	09/01/24	PB2340-MAR-OF-ZZ-DR-Z-0006	AN	IW	TM
S3	P03	22/03/23	PB2340-MAR-OF-ZZ-DR-Z-0006	NB	IW	TM
S2	P02	21/04/22	PB2340-MAR-OF-ZZ-DR-Z-0004	BO	IW	TM

Title:

Sandeel habitat potential across the Fish and Shellfish Study Area

Figure: A-2 Drawing No: PB2340-MAR-OF-ZZ-DR-Z-0006

Co-ordinate system: WGS 1984 UTM Zone 31N | Page Size: A3 | Scale: 1:880,336

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