RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Environmental Statement

Volume 7

Appendix 10-1 Fish and Shellfish Ecology Consultation Responses

June 2024

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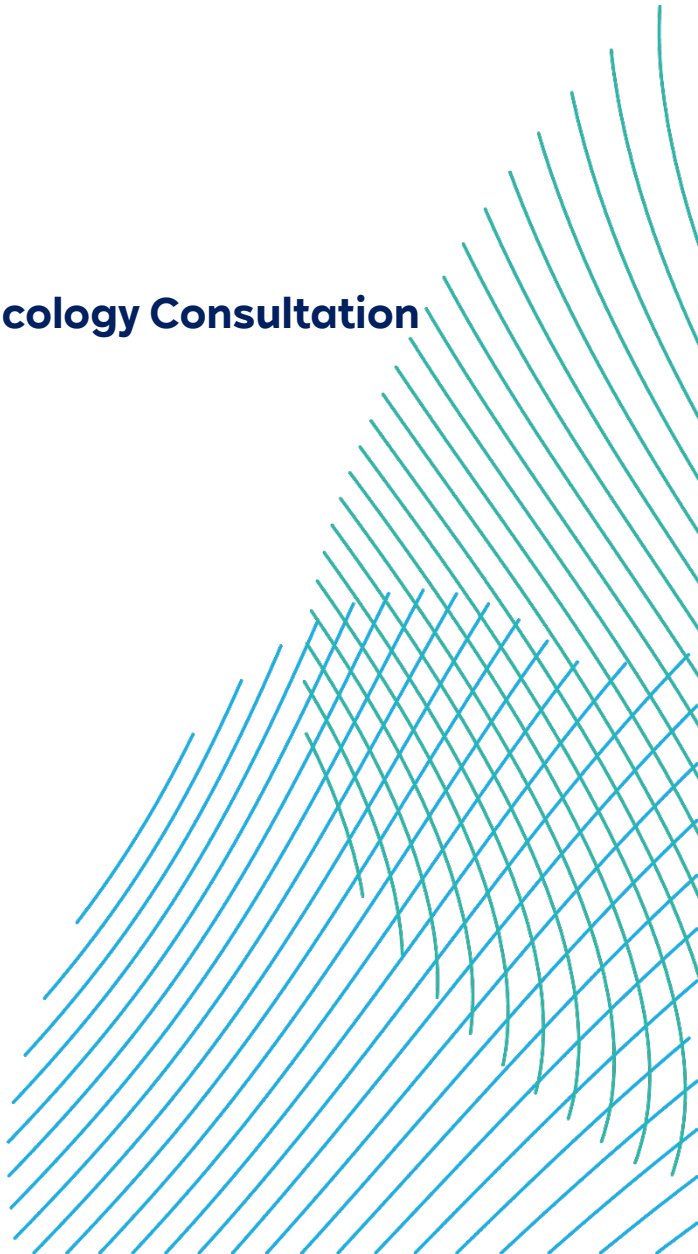

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Company:	**RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited**	Asset:	**Development**
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Glossary

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).
Baseline	The existing conditions as represented by the latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of the Projects.
Construction Buffer Zone	1km zone around the Array Areas and Offshore Export Cable Corridor, and 500m zone around the Inter-Platform Cabling Corridor. Construction vessels may occupy this zone but no permanent infrastructure would be installed within these areas.
Cumulative effects	The combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource.
Cumulative impact	The combined impact of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource.
Development Scenario	Description of how the DBS East and / or DBS West Projects would be constructed either in isolation, sequentially or concurrently.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.

Term	Definition
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).
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Fish and Shellfish Ecology Study Area	The Fish and Shellfish Ecology Study Area for the Projects is defined as 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.
Habitats Regulations Assessment (HRA)	The process that determines whether or not a plan or project may have an adverse effect on the integrity of a European Site or European Offshore Marine Site.
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.

Term	Definition
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.
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Intertidal	Area on a shore that lies between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water.
Landings	Quantitative description of amount of fish returned to port for sale – can be defined in terms of value or weight.
Mean High Water Springs (MHWS)	MHWS is the average of the heights of two successive high waters during a 24 hour period.
Mean Low Water Springs (MLWS)	MLWS is the average of the heights of two successive low waters during a 24 hour period.
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.
Scoping opinion	The report adopted by the Planning Inspectorate on behalf of the Secretary of State.
Scoping report	The report that was produced in order to request a Scoping Opinion from the Secretary of State.
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.

Term	Definition
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
CPUE	Catch per Unit Effort
DBS	Dogger Bank South
Defra	Department for Environment Food and Rural Affairs
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPP	Evidence Plan Process
ES	Environmental Statement
ESP	Electrical Switching Platform
IBTS	International Bottom Trawl Survey
ICES	International Council for the Exploration of the Sea
IFCA	Inshore Fisheries and Conservation Authorities
IHLS	International Herring Larvae Survey
JNCC	Joint Nature Conservation Committee
MMO	Marine Management Organisation
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SPL	Sound Pressure Level

Term	Definition
TTS	Temporary Threshold Shift
UXO	Unexploded Ordnance
VMS	Vessel Monitoring System

10.1. Consultation Reponses

10.1.1. Introduction

1. This appendix covers those statutory consultation responses that have been received as a response to the Scoping Report (2022), the Preliminary Environmental Information Report (PEIR) (2023) and Expect Topic Group (ETG) meetings.
2. Response from stakeholders and regard given by The Applicants have been captured in **Table 10-1-1**.

Table 10-1-1 Consultation Responses Related to Chapter 10 Fish and Shellfish Ecology

Comment	Project Response
The Planning Inspectorate, Scoping Opinion - Proposed Dogger Bank South Offshore Wind Farms Case Ref: EN010125 02/09/2022	
Direct damage (crushing) and disturbance to fish and shellfish species (all phases): The Inspectorate has considered the information in the Scoping Report and does not agree that the evidence presented is sufficient to support scoping this matter out of the ES. The Inspectorate accepts that maintenance activities are likely to be of lower impact than construction, however, in the absence of any information as to the nature, duration, frequency, and extent of these activities it is not possible to rule out significant effects. The ES should assess the likely significant effects from direct impacts to fish and shellfish populations from the Proposed Development, providing an estimate of the project-specific impacts and the resulting significance of effects on species based on their value and sensitivity.	The impact of direct damage (crushing) and disturbance to fish and shellfish species has been assessed for all phases within this chapter in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.1 and 10.6.2.2.
Release of sequestered contaminants (all phases): The Inspectorate notes the information in the Scoping Report including the location of dredge disposal sites shown on Figure 2-15. As highlighted previously, a lack of site-specific information and reasoned justification in the Scoping Report means it is not possible to exclude this matter from the ES at this stage. The ES should assess the likely significant effect or provide adequate information to demonstrate that significant effects will not occur.	The impact of release of sequestered contaminants has been assessed for all phases within this chapter in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.3 and 10.6.2.4.
Pollution events resulting from the accidental release of pollutants (all project phases): Based on the information provided on the proposed mitigation and control measures, the Inspectorate agrees that significant effects from accidental release of pollution during all project phases are unlikely. The ES should detail the proposed mitigation measures for all project phases and describe how they are to be secured.	Proposed embedded mitigation measures relating to pollution events are detailed in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.3.3.
Increase in local suspended sediment concentrations and sediment settlement (operation): The Inspectorate agrees that the potential for likely significant effects is within the construction phase, however, in the absence of more specific information on the operation and maintenance activities required it is not in a position to scope this matter out. The ES should assess any likely significant effects or provide adequate information to demonstrate that significant effects will not occur.	The impact of an increase in local suspended sediment concentrations and sediment settlement has been assessed for the operation phase within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.2.3.
Impacts on fish and shellfish species as a result of noise and vibration (operation): Paragraph 269 states that as piling and unexploded ordnance (UXO) clearances will be completed during the construction phase, no significant effects are likely. No discussion of the need for unexpected/ emergency UXO clearance during operation is provided, and no information on other operational/ maintenance activities which would be sources of underwater noise is provided. The Inspectorate advises that the ES should provide an assessment of the likely significant effects of underwater noise during operation or provide justification that significant effects are unlikely supported by the evidence highlighted above. The assessment methodology should be discussed with and agreed where possible with stakeholders, and the outcomes of any consultation (e.g., the EPP) reported in the ES.	The impact on fish and shellfish species as a result of underwater noise and vibration during the construction phase is assessed in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4, and during the operational phase in section 10.6.2.5.
Habitat loss/disturbance to spawning and nursery areas (operation): In the absence of information on the likely operational activities the Inspectorate does not agree to scope this matter out. The ES should assess the likely	The impact of habitat loss and disturbance has been assessed for the construction phase in **Volume 7, Chapter 10 Fish and Shellfish**

Comment	Project Response
significant effects associated with the disturbance/displacement to spawning/ nursery areas during operation. The Inspectorate notes that long-term change in fish and shellfish habitat due to substrate changes is proposed to be assessed for the operational phase and considers this approach to be appropriate.	**Ecology (application ref: 7.10)**, section 10.6.1.1, and for the operational phase in sections 10.6.2.1 and 10.6.2.2.
Electromagnetic Field (EMF) impacts arising from cables (construction and decommissioning): The Inspectorate agrees that this impact-effect pathway should be assessed for the operational phase only of the Proposed Development where likely significant effects could occur.	The impact of EMF from cables has been assessed for the operational phase in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.2.6.
Project specific surveys on fish and shellfish: The Scoping Report states that no project specific surveys are to be carried out. The ES must be based on sufficient information about the receiving environment to allow the scale of any impacts to be defined and understood. The ES should provide justification for the approach taken and explain to what extent this has been agreed with relevant stakeholders, for example via the EPP described in section 1.7 of the Scoping Report.	In the absence of site-specific surveys, multiple high-quality datasets (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.4.1.2) containing comprehensive information on fish and shellfish ecology within the region have been identified and used to determine the biological baseline (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2).
Potential Impacts on Shellfish in the Dogger Bank Special Area of Conservation (SAC): Table 2-27 in Scoping Report Chapter 2.9 (Commercial Fisheries) indicates that impacts on fish and shellfish species will be assessed within the fish and shellfish ecology chapter. Paragraph 371 of Scoping Report Chapter 2.9 refers to the scallop stock within the Dogger Bank SAC which experienced a large increase in scallop dredging since early 2020 and acknowledges that a large proportion of the Array Areas overlap with the SAC. A byelaw is in place within the Dogger Bank SAC to ban the use of bottom towed fishing gear, which the Scoping Report indicates could change the baseline environment. No reference is made to this within Chapter 2.6 Fish and Shellfish Ecology. The ES should assess ecological impacts on the Dogger Bank SAC scallop stock where likely significant effects could occur.	The impacts on shellfish from potential habitat loss and / or disturbance to spawning and nursery areas is assessed for the construction phase in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.1, and for the operational phase section 10.6.2.2. Further consideration is provided within **Volume 7, Chapter 11 Commercial Fisheries (application ref: 7.11)**.
The Planning Inspectorate, Scoping Opinion - Proposed Dogger Bank South Offshore Wind Farms Case Ref: EN010125 02/09/2022 Appendix 2: Respondents to Consultation and Copies of Replies	
Environment Agency	
Depending on the chosen landfall location, could the proposed activities directly affect fish within the Humber Estuary, delay or prevent fish from entering the estuary or affect fish migrating through the estuary? If yes, potential impacts to fish in the Humber will need to be scoped into the Water Environment Regulations compliance assessment and should also be considered as part of the EIA. There is the potential for disturbance during construction phase from noise and vibration.	Migratory fish, including those within and likely to enter the Humber estuary have been identified as a receptor group for this assessment within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.5. Additionally, the Humber Estuary has been included within the Fish and Shellfish Ecology Study Area as indicated in **Volume 7, Figure 10-1 (application ref: 7.10.1)**.
Marine Management Organisation	
The Marine Management Organisation (MMO) notes that section 263 states that 'Atlantic herring populations within the Fish and Shellfish study area increase during the summer and autumn, with spawning peaking between April and June (JNCC 1995a; 1995b)'. Please note that Atlantic herring spawning in the central North Sea (CNS) are from the Banks population which spawn between August and October (inclusive). See Ellis *et al.* (2012) for spawning seasons of	Information pertinent to the Banks Atlantic herring population spawning times has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.3.3.

Comment	Project Response
commercially important fishes. The JNCC 1995a and 1995b citations were not included in the reference list for review and comment.	
The MMO notes that herring spawning grounds have not been depicted in Figure 2-11, only their nursery grounds have been mapped. Nonetheless, section 263 acknowledges that Atlantic herring have spawning grounds within the Projects' study area and that the species is highly sensitive to changes in their substrate composition. The MMO note that potential herring spawning habitat has been mapped further on in Figure 2-14, following the method described by MarineSpace (2013a) which the MMO support.	Spawning and nursery grounds of Atlantic herring as determined within Coull *et al.* (1998), and Ellis *et al.* (2012) are depicted within **Volume 7, Figure 10-6 (application ref: 7.10.1)**. Potential Atlantic herring spawning grounds are depicted in **Volume 7, Figure 10-7 (application ref: 7.10.1)**, following the methodology described within Reach *et al.* (2013).
The MMO notes that the commercial and ecological importance of the Dogger Bank as a sandeel habitat has been recognised in the scoping report. The report recognises that sandeel have spawning grounds within the Projects' study area and that the species is highly sensitive to changes in their substrate composition. Sandeel habitat suitability has been mapped in Figure 2-13 following the method described by MarineSpace (2013b) which the MMO support.	Potential sandeel habitat suitability is depicted in **Volume 7, Figure 10-5 (application ref: 7.10.1)** following the methodology described within Latto *et al.* (2013).
The MMO considers that for the purpose of the PEIR and ES, details of the individual data layers that make up the herring spawning habitat and sandeel habitat 'heat' maps should be provided. For example, the temporal ranges of International Herring Larvae Survey (IHLS) data and Vessel Monitoring System (VMS) data used in the maps should be specified. The MMO recommend a minimum of ten years of IHLS data is used to inform the herring spawning 'heat map'. IHLS data up to 2021 are available to download from ICES at Eggs and larvae (ices.dk).	Information on layers used inform these figures are provided within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.5.3.3.2 and 10.5.3.3.3. The IHLS layer used indicates the maximum extent of IHLS survey stations where a positive identification of age zero herring larvae have been made as per Reach *et al.* (2013). No material changes to this layer have been made following incorporation of the last 10 years of data. Therefore, this layer has considered the last 10 years of available IHLS data. This complies with current approved MMO guidance.
Similarly, the MMO considers that information on the origins and vintage of any sediment data (e.g., Particle Size Analysis (PSA)) should be discussed and mapped to provide a visual representation of data coverage. For avoidance of duplication, appropriate sign-posting can be made to the relevant section/s of the Benthic Ecology chapter where sediment data and/or maps are presented.	Information pertaining to sediment data in relation to ecological receptors can be found within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, which has been referenced throughout this chapter where appropriate.
The MMO notes that VMS data used to inform the sandeel heat map should be selected on the basis that the fishing gear is appropriate to target the species, i.e., VMS data for bottom trawled gear rather than pelagic gear. Please note that in 2022, the MMO introduced a new byelaw to protect important habitats and species within the Dogger Bank SAC. The byelaw prohibits bottom towed fishing across the whole SAC (MMO, 2022). With this in mind, it should be noted that the coverage of VMS data used to inform the PEIR and ES is likely to change compared to what has typically been observed over the years, as commercial fishing fleets using bottom towed gear targeting sandeel (and other demersal species) on the Dogger Bank will be excluded from the area. As the new byelaw has only just come into force, VMS data for fishing activity on the Dogger Bank in recent years will still be relevant to the assessment.	Demersal gear types only have been considered during the production of the sandeel heat map **Volume 7, Figure 10-6 (application ref: 7.10.1)**.
In reference to section 265, the MMO notes that the correct scientific name for cuckoo ray is *Leucoraja naevus* (rather than '*Raja naevus*'). Similarly, common skate (referred to in the scoping report as '*Leucoraja batis*') is now recognised to be two different species; the flapper skate, *Dipturus intermedius*, and the blue skate, *Dipturus batis*, see Iglésias *et al.* (2010).	Updated scientific names have been used for this chapter and the associated appendix.

Comment	Project Response
Tables 2-16 outline the list of existing data sources and literature that will be used to inform the fish ecology baseline. The sources are generally appropriate to characterise the study area, however the MMO have cited additional publications and peer reviewed papers within this advice which will help enhance the characterisation and inform the EIA.	Consideration to a greater range of data and literature sources has been given throughout this chapter when compared to the outline provided within the Scoping Report. Where appropriate, recommended publications and papers have been utilised.
The MMO considers that the PEIR and ES should recognise the limitations of the data collected for fish characterisation surveys for other wind farm projects (e.g., Dogger Bank Zone and Former Hornsea Zone) as some of the data are now in excess of ten years old. Furthermore, some of the surveys were carried out prior to the placement and operation offshore wind(OWF) infrastructure. Factors such as loss of habitat, introduction of hard substrates, and temporal and natural variations in fish assemblages may have changed over this period.	The vintage of data collected during these fish characterisation surveys has resulted in its exclusion within this chapter. The Fish and Shellfish Ecology baseline has instead been characterised using a range of more recent datasets as described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.4.1.2.
The MMO notes that when using any fisheries data collected from past surveys, it is important that the data are interpreted and presented appropriately and that all survey limitations are acknowledged. The MMO recommend that any catch data should be presented in the PEIR and ES in standardised units e.g., Catch Per Unit Effort (CPUE). The survey methods, timings and limitations of survey and gear types as well as gear selectivity should be discussed or acknowledged within the PEIR and ES, especially with regard to the influence on species and life stages captured by individual gear types/sampling methods. For example, a 2m epibenthic beam trawl will not adequately target large/adult fish, or pelagic fish; otter trawls and epibenthic beam trawls will not adequately target sandeel; and the season in which a survey is undertaken may influence species abundance in that particular area.	Fish landings data has been presented using CPUE where available (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2.2). Where CPUE data was not available within a given source, a proxy or proxies are instead presented (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2.1). Consideration for gear type and sampling method is given within each section.
The MMO note that despite the age of some data sources, we are generally content that there is no requirement for new fish characterisation surveys to be undertaken, as the various sources of data proposed to inform the desk-based assessment will be adequate to provide a general description of the fish species typically found in the Project study area. The MMO note that a site-specific benthic survey of the Project study area will be undertaken in 2022 which will include grab sampling of seabed sediments which will be used for particle size analysis (PSA). PSA data can then be used to determine sandeel habitat suitability and herring spawning habitat suitability.	Consideration has been given to site-specific benthic survey data within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.5.1., 10.5.3.2.3., and 10.5.3.3.3. Sandeel presence as identified within the 2022 benthic fauna survey is compared with modelling after Latto *et al.* (2013) within **Volume 7, Figure 10-5 (application ref: 7.10.1)**.
The MMO notes that transboundary impacts to fisheries and fish ecology have been scoped out of the EIA on the basis that the Projects are located 40km from the Exclusive Economic Zones (EEZ) boundary, and therefore it is considered that there is no pathway for transboundary impacts. The range of effect for noise and vibration generated by piling can extend over large distances, i.e., in excess of the 40km distance between the Project sites and the EEZ boundary. On this basis the MMO recommend that transboundary impacts to fish receptors arising from underwater noise and vibration are scoped into the EIA.	An assessment of Transboundary Effects is provided within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.9.
The MMO do not support scoping out of the impacts arising from direct damage and disturbance to fish species during construction, operation and decommissioning stages of the development. The justification that the impact/s will be limited in spatial and/or temporal extent cannot be supported until the spatial / temporal extent of the impact/s in relation to specific species and/or habitats has been quantified and assessed. This impact should be scoped into EIA for all stages.	This impact has been assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.1, 10.6.2.2, and 10.6.3.

Comment	Project Response
The MMO do not support the scoping out of increases in local suspended sediment concentrations and sediment settlement during the operation phase of development. As per paragraph 27, the justification that the impact/s will be limited in spatial and/or temporal extent cannot be supported until the spatial / temporal extent of the impact/s in relation to specific species and/or habitats has been quantified and assessed. This impact should be scoped into EIA for all stages.	This impact has been assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.2, 10.6.2.3, and 10.6.3.
The MMO consider that the impact of habitat loss / disturbance to spawning and nursery areas should be scoped into the EIA for the operation phase as well as the construction and decommissioning stages. Given the location of the Project arrays within an important sandeel habitat, and the ECC cable corridor which crosses the Banks herring spawning ground at Flamborough Head, there is potential for significant impacts relating to habitat loss and/or disturbance to occur to sandeel habitat and herring spawning habitat as a result of operation and maintenance activities. The magnitude and significance of impact would depend on the scale of works required and timing of the operation and maintenance (O&M) activity.	This impact has been assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.1, 10.6.2.2, and 10.6.3.
The MMO note that the term 'long term' should be changed to 'permanent' in the context of assessing loss of habitat or changes in habitat type from OWFs during the operation and decommissioning phases, unless The Applicant is able to commit that all infrastructure relating to the project will be removed from the seabed at the end of the Project's lifetime.	It is likely that offshore project infrastructure above the seabed will be removed at the decommissioning stage. A decommissioning programme will be agreed closer to the time. As such permanent has been used in the assessment for these scenarios.
The MMO are content that impacts arising from accidental pollution during the construction, operation, and decommissioning phases can be scoped out of further assessment, on the basis that an Environmental Management and Monitoring Plan (EMMP) will be implemented to manage and mitigate any pollution events.	Pollution Prevention Measures are described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10), Table 10-3**.
The MMO note that the information provided on the proposed approach to assessing the impacts of noise and vibration on fish is quite high-level, though underwater noise modelling will be included in the EIA the MMO have provided some recommendations in points a) to g) below, to inform the approach to the EIA and underwater noise modelling for fish, particularly in respect of herring. a. The MMO would expect to see an accurate description of the physiological and behavioural impacts to fish caused by noise and vibration to be included in the PEIR and ES, and fish species relevant to the development should be assigned into one of the four categories described in Popper *et al*. (2014). b. The MMO recommend that fish are treated as a stationary receptor in any modelling used to make predictions for noise propagation on fish spawning and nursery grounds. The MMO do not support the use of a fleeing animal model for fish. c. The MMO know that fish will respond to loud noise and vibration, through observed reactions including; schooling more closely; moving to the bottom of the water column; swimming away, and; burying in substrate (Popper *et al*.,2014). However, this is not the same as fleeing, which would require a fish to flee directly away from the source over the distance shown in the modelling. The MMO are not aware of scientific or empirical evidence to support the assumption that fish will flee in this manner.	a. Information on the impact of underwater noise on fish and shellfish receptors is described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3, and assessed within sections 10.6.1.4 and 10.6.2.5. Further details are provided within **Volume 7, Appendix 11-3 Underwater Noise Modelling Report (application ref: 7.11.11.3)**. Where available, the hearing groups of fish species are provided within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology (application ref: 7.10.10.2)**. b. Fish and shellfish receptors have been assessed as stationary receptors throughout this chapter. c. See above.
d. The assumption that a fish will flee from the source of noise is overly simplistic as it overlooks factors such as fish size and mobility, biological drivers, and philopatric behaviour which may cause an animal to remain/return to the area of	d. See a) and b) in the row above.

Comment	Project Response
impact. This is of particular relevance to herring, as they are benthic spawners which require a specific substrate type on which to spawn. e. Eggs and larvae have little to no mobility, which makes them vulnerable to barotrauma and developmental effects. Accordingly, they should also be assessed and modelled as a stationary receptor, as per the Popper *et al.* (2014) guidelines. f. The outputs of modelling should be presented in map-form depicting the predicted noise contours. Ten years of IHLS data should be presented in the form of a 'heat map' which should be overlaid with the mapped noise contours. This will provide a better understanding of the likely extent of noise propagation into herring spawning grounds and allow for a more robust assessment of impacts to be made. g. The Applicant should clearly state in their ES (and PEIR if applicable) whether they propose to undertake simultaneous piling, i.e., the installation of more than one pile at a time, for the installation of WTGs or other offshore platform structures. If simultaneous piling is proposed, then underwater noise modelling for impacts to fish should be based on this scenario.	e. Eggs and larvae have been assessed as stationary receptors throughout this chapter. f. **Volume 7, Figure 10-8, Figure 10-9,** and **Figure 10-10 (application ref: 7.10.1)** within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4 indicate noise contoured overlaid with herring heat maps, of which IHLS extent is a component. Use of the heat maps allows for a more comprehensive assessment of noise propagation into potential herring spawning grounds than a single attribute may allow. g. Information pertaining to piling strategy in relation to underwater noise and vibration is provided within **Table 10-2** and section 10.6.1.4 in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**.
The MMO could not find any reference to the use of 'soft start' procedures on commencement of piling within the scoping report. This form of 'best-practice' mitigation involves the gradual ramping up of hammer energy so that sensitive marine receptors have adequate time to distances themselves away from the source of impact, thus limiting a sensitive receptor's exposure to the impact. Cefas fisheries advisors recommend a 20-minute soft-start in accordance with Joint Nature Conservation Committee (JNCC) protocol for minimising the risk of injury to marine mammals and other fauna from piling noise (JNCC, 2010). Should piling cease for a period greater than 10 minutes, then the soft-start procedure must be repeated.	Information pertaining to soft-start strategy can be found in **Table 10-2** and **Table 10-17 (Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10))**.
The MMO would highlight that when assessing the impacts of noise and vibration on fish for the purpose of a CIA (Cumulative Impact Assessment), given the far-reaching effects of underwater noise, projects do not need to be adjacent to each other for cumulative effects to arise.	Cumulative impacts are assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.7, with consideration given to the potential impact of underwater noise for all projects identified with potential for cumulative effects..
The MMO note that inter-related impacts and effects on fisheries and fish ecology have not been discussed in the scoping report, so it is unclear if / how inter-related impacts will be assessed.	Inter-relationships are presented within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.11.
The MMO recommends that The Applicant use of the Fisheries Sensitivity Maps developed by Coull *et al.*, 1998 to identify spawning and nursery areas for *Nephrops*. The MMO believes *Nephrops* spawning, and nursery areas fall within the Fish and Shellfish Ecology Study Area and should be considered in the future EIA.	Coull *et al.* (1998) (and Ellis *et al.* (2012)) have been analysed to identify the presence of spawning and nursery grounds within the Fish and Shellfish Ecology Study Area. Spawning and nursery grounds are identified in the relevant receptor group subsections within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3. This includes Norway lobster *Nephrops norvegicus* which have spawning and nursery grounds within the north-eastern

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	corner ICES rectangle 36F1 as per Coull *et al.* (1998) (and Ellis *et al.* (2012)).
The Applicant has identified a range of suitable data sources of various timescales. The MMO would expect to see data collected within the last five years as the primary data source used as this data will provide the most accurate view of current baseline conditions. This should be updated in the ES.	Data used in this chapter are outlined in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.4.1.2 and consideration of data identified within **Volume 7, Chapter 13 Commercial Fisheries (application ref: 7.13)** has been given where appropriate. The majority of datasets used to inform this chapter encompass the last 5-year period.
The MMO notes that at this stage The Applicant has not fully described the potential cumulative and inter-related impacts and effects on the physical and biological environment related to shellfisheries. The MMO agrees with The Applicant 's intention to include habitat loss and disturbance and noise impacts in conjunction with adjacent projects and cumulative changes to seabed habitat caused by changes in physical processes.	Potential cumulative and inter-related impacts and effects are considered in full within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.7 and 10.11.
PEIR Consultation, Lincolnshire Wildlife Trust 17/07/23	
As The Applicant will be aware, the Dogger Bank is the largest sandbank in UK waters and is home to a variety of species which live both on and within the sand sediment. Among these, sandeel species, predominately lesser sandeel *Ammodytes marinus*, are a key component of this marine ecosystem and is an important prey species for many seabirds and marine mammals. While little is known about their distribution beyond fishing grounds, statistical models have been used to predict the distribution of seabed habitat that is suitable for buried *A. marinus* in only two main areas: 1) the northern part of the North Sea (including Dogger Bank) and 2) the northern parts of the Celtic Seas region around the west coast of Scotland, Northern Ireland and Republic of Ireland.	Sandeel have been included within the assessment of all impacts throughout the chapter, and are included within the 'Demersal Fish' receptor group (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.2.). The distribution of the species has been established using the methodology described within Latto *et al.* (2014). Sandeel presence within the region has been verified via drop down video.
It has been well-documented that declines in sandeel populations have negative consequences on several seabird and marine mammal species due to loss of prey. Moreover, the importance of the North Sea sandeel stock has been recognised by the UK Government, as demonstrated by the MMO's Bottom Towed Fishing Gear Byelaw in 2022, recent sandeel consultation on management practices (March–May 2023), and Defra's request for advice on the ecosystem risks and benefits of full prohibition of industrial sandeel fishing in UK waters of the North Sea (ICES Area IV). In a press release published today, the government has announced that it is: 'Publishing a summary of responses to a consultation on spatial management of sandeels, with a majority of respondents being in favour of the option to fully close industrial sandeel fishing in English waters of the North Sea.' (Marine Management Organisation (2022). Decision document: Dogger Bank SAC. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1069134/Dogger_Bank_SAC_Decision_Document.pdf 3 Department for Environment, Food & Rural Affairs and The Rt Hon Thérèse Coffee MP (2023). UK Government seizes post-Brexit freedoms for fishing industry. https://www.gov.uk/government/news/uk-government-seizes-post-brexit-freedoms-for-fishing-industry)	Information provided is acknowledged, noting that the approach to sandeel fisheries management falls outside the scope of this EIA chapter.
Crucially, the JNCC raised clear concerns for the health and status of the Dogger Bank SAC, and its dependent communities, in their Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation: 'The sandbank communities are not expected to be fully recovered yet from the impacts from historic bottom trawling, but are expected to start recovering following removal of this pressure. Full recovery is based on the resilience of the feature (medium for subtidal sand) and would not be expected for 2-10 years and only where it is not	The assessment of Temporary Habitat Disturbance (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.1.) has been revised to include a recovery period for the receptor group including sandeel of 2-10 years as described within the Joint Nature Conservation Committee (2022)

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hindered by other pressures.' (Joint Nature Conservation Committee (2022). Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation. https://data.jncc.gov.uk/data/26659f8d-271e-403d-8a6b-300defcabcb1/dogger-bank-saco-v2.pdf)	Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation referenced.
While the Dogger Bank sandeel population (sandeel stock 1r) is technically sufficiently abundant to support a fishery, stock 1r has repeatedly fallen below biological reference points (mainly recruitment) since 2004, indicating that the Dogger Bank sandeel stock is in poor condition. The MMO attributes this to the short-lived nature and high variability of recruitment patterns driven by several natural factors. Consequently, the UK Government and Defra are considering the closure of commercial sandeel fisheries. While focus has remained on fishing gear and practice, management and regulatory bodies have also identified wind turbine development in the area as a negative impact on the Dogger Bank sandeel population. The in-combination impacts of these various practices is only now being considered in a holistic manner through the assessment of zoned and/or adaptive management approaches. However, given the vulnerability and importance of the Dogger Bank sandeel stock 1r, LWT hopes that the appropriate management strategies can be implemented before irreparable damage occurs.	Information provided is acknowledged, noting that the approach to sandeel fisheries management falls outside the scope of this EIA chapter.
According to the PEIR documents, roughly the entire DBS West array (estimated at 95.3% in Table 10-15) rests within areas that The Applicant has identified as high spawning potential for sandeel (Figure 10-5). Worst-case scenario estimates (Table 11-2) place the direct habitat loss within the DBS West array around 3,813,562m2, which would equate to a loss of roughly 3,634,324m2 of high-spawning-potential habitat. In Volume 7, Chapter 10 Fish and Shellfish Ecology, section 104 of Chapter 10, The Applicant claims that 'these are a species of national importance that are anticipated to recover to baseline levels within 1 – 7 years'. Unfortunately, this claim was not referenced in the PEIR documents. Upon examining the literature, LWT found reference to a similar timeframe in van Deurs et al. (2012) (i.e., 1–7 years). However, the context of that study and these Projects are completely different. Van Deurs et al. (2012) states that the study area was 'a sink rather than a source for A. marinus'. In contrast, these Projects are expected to negatively impact an important source—as outlined by the 95.3% overlap of DBS West and estimated loss of roughly 3,634,324m2 of habitat considered to have high spawning potential—for A. marinus recruitment. We could not find reference for the short- and long-term impacts of offshore development on sandeel spawning and/or nursery habitat (i.e., source habitat). Therefore, the assumption and claim of recovery within 1–7 years following these Projects (Volume 7, Chapter 10 Fish and Shellfish Ecology, section 104) is misleading and unsubstantiated.	The assessment of Temporary Habitat Disturbance (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.1.) has been revised to include a recovery period for the benthic fish receptor group, which includes sandeel, of 2-10 years as described within the Joint Nature Conservation Committee (2022) Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation referenced.
LWT would refer to the information above, and strongly disagrees with this claim and justification for the lowering of appraised sensitivity to habitat disturbance by The Applicant , as outlined in Section 202 of Chapter 10: 'The low magnitude of impact for DBS West (as the worst case scenario footprint assigned to both DBS East and DBS West, as well as the worst case for sandeel and Atlantic herring spawning), combined with the medium sensitivity of effect for the demersal fish, and pelagic fish receptor groups with demersal spawning, results in the assessment that permanent loss of habitat and / or change in habitat type as a result of changes in substrate has a minor adverse effect, and is therefore not significant in EIA terms.'	The assessment of Permanent Loss of Habitat (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.2.1.) has been revised to include a recovery period for the receptor group including sandeel of 2-10 years as described within the Joint Nature Conservation Committee (2022) Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation referenced.
Characteristics of this species, including short lifespan, high site-fidelity, and high variability of recruitment, suggest that an impedance of this length and magnitude to an important source habitat (i.e., habitat with high spawning potential) could have serious consequences on the health and resilience of the Dogger Bank sandeel population. LWT would therefore advise careful consideration for the direct and cumulative impacts of this development on this ecologically and economically important fish species. Furthermore, LWT would recommend that any assessments and/or decisions should factor-in ongoing measures aimed at improving population health and resilience for sandeel	Consideration as to the sensitivity of the species as well as related economic and ecological importance has been given for each relevant impact throughout the chapter, as defined within **Table 10-6**.

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(e.g., Defra's ongoing consultation on spatial management measures for industrial sandeel fishing). Lastly, LWT would expect that any perceived and/or anticipated impacts to the Dogger Bank sandeel population will be carefully considered within the mitigation hierarchy, and that proper due diligence is given to each level of the hierarchy (i.e., avoidance first, then embedded mitigation measures, and compensation only as a last resort).	
Given the above concerns for direct impact and loss of important spawning habitat for sandeel, LWT would recommend minimising the need for dredging within the Dogger Bank SAC (avoidance) and mitigating the disposal of dredged material either outside of the SAC or outside of important spawning seasons for both sandeel and Atlantic herring. We anticipate a full evaluation of the impacts of dredging and sediment redeposition on these and other receptors in the ES, as well as due diligence towards the mitigation hierarchy for any projected impacts.	Impacts on dredging and sediment redeposition are included within the assessments of Temporary Habitat Disturbance (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.1.) which includes the total footprint of seabed disturbance during Project Construction and total volume of sediment to be dredged and relocated, and the assessment of Increase in Local Suspended Sediment Concentrations and Sediment Settlement (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.2.).
PEIR Consultation, National Federation of Fishermen's Organisations 17/07/23	
The following comments are in reference to the Fish and Shellfish Ecology chapter of the PEIR, Chapter 11, Volume I and the Fish and Shellfish Ecology Technical Report, Appendix 11.1, Volume III.	Acknowledged.
We welcome the approach taken within this chapter to assess impacts for all of the potential construction scenarios for both developments.	Acknowledged.
We are concerned with many of the data sources used to characterise the baseline environment within this chapter, however. Landings data have been presented to aid in characterising the fish and shellfish baseline environment, but only from the UK fleet. The Dogger Bank region supports a significant number of vessels from the EU fleet and inclusion of their data within the PEIR would further enhance the characterisation of the baseline environment.	UK fleet landings data have been investigated within this chapter alongside International Bottom Trawl Data and the Project specific benthic survey data in order to establish species present within the region. As non-UK fleet data is not considered likely to identify additional common species within the region these data are not considered within this chapter, but have been investigated in detail within **Volume7, Chapter 13 Commercial Fisheries (application ref: 7.13)**.
The decision to aggregate the landings data for the reference period into a total value/tonnage does not accurately represent the inter-annual variation in these fisheries. Fisheries Dependent Data are also strongly influenced by factors outside of stock dynamics (eg spatial and legislative restrictions) and should be treated with caution. As these data are a primary source used to characterise the fish and shellfish baseline environment in the PEIR, we would expect to see a more precautionary approach taken when assessing potential impacts to the receptors identified.	When establishing a baseline for Fish and Shellfish Ecology exact tonnage and value of individual fisheries. the identification of specific species present is the primary extract of the landings data datasets. To avoid confusion landings values have been excluded from **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2. Further consideration as to tonnage and value of fisheries is given in **Volume7, Chapter 13 Commercial Fisheries (application ref: 7.13)**.
There are no site-specific surveys undertaken to aid in characterising the fish and shellfish baseline environment here. A desk-based study should address the pedigree of data being used, including the specific spatial and temporal characteristics of the examples cited. For example, more caution is needed in using Roach et al., (2022) with regard to	A number of fish and shellfish species were identified during the site-specific benthic ecology surveys. All fish and shellfish species identified within these surveys have been included within their receptor groups,

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impacts on lobster, since the habitat found in the study site in that paper is very different from that observed at the Dogger bank region.	as presented within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology Technical Appendix (application ref: 7.10.10.2)**. Findings made within Roach *et al.* (2022) have not been used in the determination of impact throughout the report, however acknowledgement of the differences in habitat type have been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.4.2.
The reliance of offshore wind impact assessments on Coull et al., (1998) and Ellis et al., (2012) has been called into question in nearly all our responses to offshore development licensing and planning reports. These data are 25 and 12 years old respectively, but seem to be used as a 'gold standard' to assess impacts on spawning and nursery grounds. We would expect to see a more precautionary use of these data, based on those papers' well described limitations.	Both Coull *et al.*, 1998, and Ellis *et al.*, 2012 are the most informative studies published to date on spawning extent of fish species in UK waters, however additional text has been added to **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2. to acknowledge time since publication. Through this report they have been complimented by baseline data from additional sources, and the modelling of herring and sandeel habitat and spawning grounds as described within Reach *et al.*, 2014. The use of these papers has been complimented by the MMO in received comments.
There is minimal site-specific and contemporary data here that can support the assessments made within this chapter and few precautions taken when assessing impacts and drawing conclusions, suggesting an insufficiently robust approach.	Fish and shellfish species identified within the site-specific benthic ecology surveys have been included within the Fish and Shellfish Ecology baseline, with information on these species provided within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology Technical Appendix (application ref: 7.10.10.2)**.
Minimal data has been presented in the PEIR with regards to potential impacts to fish and shellfish (excluding elasmobranch) receptors, yet any proposed impacts have been assessed as being 'negligible'/'minor adverse' in all cases, with no mitigation proposed. A paucity of data and evidence should lead to caution when assessing impacts to the described receptors. Acknowledging the limitations of the data but subsequently ignoring them and treating that data as concrete evidence, with no caveats, misinforms the assessment of the impacts and calls into question their validity.	Additional data relevant to fish and shellfish species identified within the site-specific benthic ecology surveys have been included within the Fish and Shellfish Ecology baseline, with information on these species provided within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology Appendix (application ref: 7.10.10.2)**. Assessment of impacts have been made using available data and established approaches, as defined within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.4.2.
Projects scoped into the cumulative assessment did not include the Hornsea Four project. The construction period for Dogger Bank South is likely to overlap with pre-construction and construction of Hornsea Four, so cumulative impacts with this development should be scoped in.	Hornsea 4 has been included within the cumulative assessment within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.7.2.
The assessment of the impacts of fisheries exclusion and potential increased effort in surrounding areas is welcome. There is very little evidence presented to support the conclusions drawn in this section, however. Spill-over and fishing the line effects needs to be assessed correctly, with supporting examples relevant to what is likely to be observed at this particular site, if the assessment is to have validity.	As the array falls within the Dogger Bank SAC Bylaw (bottom-towed fishing gear) area, it is not possible for fishing the line to occur. A full assessment of impacts on commercial fisheries is considered within the Commercial Fisheries chapter.

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We are concerned with the lack of fish and shellfish species monitoring proposed. The justification given is that landings data will highlight any impacts of the development on the populations in the region. As described earlier, fisheries dependent data is influenced by many factors and should be interpreted with caution when used solely to assess impacts at a site/stock level. Additionally, the spatial restriction on fisheries in the region from other developments and legislative restrictions will influence these data and may mask a signal of an impact/effect from the development. The proposed development completely overlaps key spawning and nursery grounds for several key species, yet impacts to these receptors has been assessed as minor adverse at worse due to the impact being a localised effect. The evidence does not support this assumption.	A requirement for Fish and Shellfish monitoring was not determined as being necessary during the scoping stage of the Projects following public consultation. IBTS data, and fish and shellfish observations made during the site specific benthic monitoring surveys, have been used to supplement fisheries landings data to ensure that non-commercial species are included within this assessment. The overlap with spawning grounds is considered minor at a population level, as is determined within the assessment of Permanent Loss of Habitat. Whilst the array may be located within spawning/nursery grounds of a given species, it does not encroach across any spawning/nursery grounds as a whole. The footprint of the Projects (where there is direct interaction with the seabed) comprises only a portion of the overall Offshore Development Area as a whole, further reducing interaction with spawning/nursery grounds. As impacts on fish and shellfish are determined to be negligible or minor, no further monitoring it proposed during or following construction.
The PEIR highlights the importance of the region to shellfish species (crab, lobster and scallop), however no evidence as to their distribution in the region is presented. We would expect to see this information included in the analysis.	The presence of these species is noted within the region, and they have been included within the Shellfish receptor group as presented within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology Technical Appendix (application ref: 7.10.10.2)**.
We acknowledge the difficulties with the lack of site-specific, contemporary data, but we would expect to see some element of precaution taken when assessing impacts on fish and shellfish ecology, especially when that assessment is informed by studies which employed methodologies inappropriate to this task.	Additional site-specific and contemporary data relevant to fish and shellfish species identified within the benthic ecology surveys have been included within the Fish and Shellfish Ecology baseline, with information on these species provided within **Volume 7, Appendix 10-2 Fish and Shellfish Ecology Technical Appendix (application ref: 7.10.10.2)**. The assessment of impact is described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.4. To ensure a precautionary approach, a worse case scenario is assessed for all impacts, as described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.3.2.
PEIR Consultation, Marine Management Organisation 17/07/23	
The Applicant has defined a broad study area for the characterisation of fish and shellfish ecology and the key demersal, pelagic and migratory species, as well as several important elasmobranch species, have been generally well characterised. Generally, appropriate data sources have been used to characterise fish receptors in the region including the use of spawning and nursery ground data from Coull et al., (1998) and Ellis et al., (2012). The MMO welcomes this and has split up comments on this chapter in to general comments, habitat suitability assessments, including herring and sandeel, temporary habitat loss/disturbance, underwater noise, unexploded ordnance (UXO), mitigation and cumulative effects.	Acknowledged.

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In PEIRs for projects of this nature and scale, it is helpful to present a summary table within the fish ecology chapter which clearly outlines which impacts have been scoped in/out of further assessment for each stage of the development (construction, operation and decommissioning), since the scoping stage consultation. Doing so provides a concise way of determining whether likely impacts to fish receptors have been appropriately scoped in/out. It would be helpful if this information could be provided in the ES.	A table indicating the scoping of impacts has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.
The overall presentation of the fish and shellfish ecology chapter is somewhat fragmented. The supporting information and evidence is not always clearly signposted in the main chapter.	Formatting of the chapter has been updated since the PEIR, with signposting added where appropriate.
From the information presented in Table 10-2, in which likely impacts are presented in the context of the 'realistic worst case design parameters', it is the MMO's understanding that the following impacts have been scoped into the construction and operation phases:	Acknowledged.
Likely impacts to fish and fish ecology arising during decommissioning should be included in the impact assessment. Table 10-2 sets out the reason for a full assessment not being included. While the MMO appreciates that the full extent of decommissioning works will not be finalised until much closer to the time, it is important that potential likely impacts be assessed, nonetheless.	It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase, as stated within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.3.2. and section 10.6.3. The impact assessment for the construction phase should therefore be used for the decommissioning phase.
An outline of the works anticipated during the decommissioning phase, and the likely impacts thus arising, have been provided within PEIRs for other wind farm projects of a similar size. It is understood that this information is indicative given that the period of decommissioning will not occur for 30+ years, however this information is necessary for a complete assessment. The MMO expects amendments to be made within the ES, incorporating a table which clearly outlines the likely impacts to fish at each stage of the development, and whether these have been scoped into/ or out of further assessment. Such a table is necessary to outline the information presented in Table 10-2 more clearly.	A table indicating the scoping of impacts has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase, as stated within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.3.2. and section 10.6.3. The impact assessment for the construction phase should therefore be used for the decommissioning phase.
The assessment of the significance of impacts for the DBS OWFs in Volume 7, Chapter 10 Fish and Shellfish Ecology, section 10.6 presents assessments based on two Development Scenarios; one where DBS East and West are developed concurrently, and the second where DBS East and West are developed 'in isolation'. The scenario where DBS East and West are developed 'in isolation' simply refers to a staggered implementation of the two projects, where construction of the first begins two years prior to construction commencing on the second. In terms of assessing the significance of impacts to fish receptors, the MMO does not agree that the impacts can be considered less severe as a result of this two-year staggered-start approach, as there will still be up to three years where both projects are being developed simultaneously. This should be stated clearly in the assessment of impacts to fish ecology.	The 'in isolation' scenarios assessed refers to a scenario where only a single windfarm is developed. The 'together' scenario refers to a scenario where both sites are developed (either sequentially, or concurrently, with the worst case of the two assessed on an impact by impact basis), as is described within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.3.2.3. Where the potential advantages of a sequential approach have been discussed when compared to a concurrent construction programme, additional text has been added to the impact assessment to highlighting the requirement for an overlap of a minimum of 3 years.

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Tables within the Fish and Shellfish Ecology Appendix have been provided which detail the ecology of fish and elasmobranch species identified as being potentially present within the Fish and Shellfish Ecology Study Area. Figures indicating the presence of spawning and nursery grounds (as per Ellis et al., (2012)) have also been provided in the volume of figures. For ease of interpretation given the volume of information provided, it would be useful to have a table presented within the main Fish and Shellfish Ecology chapter, which presents a list of species as per Ellis et al., (2012), and indicates via tick boxes whether the spawning and/or nursery grounds of each species overlaps with the Fish and Shellfish Ecology Study Area. A column in this table indicating the periods of spawning activity for fish species identified would also be helpful, and in doing so would draw this information together in one place in the main Fish and Shellfish Ecology chapter.	A table has been added to **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.2. presenting the requested information.
Although this doesn't change the outcome of the impact assessment, the MMO would not anticipate albacore tuna (*Thunnus alalunga*) to be a significant species scoped into an assessment in the central North Sea, as this does not normally form part of their distribution. Bluefin tuna (*Thunnus thynnus*) have also been identified as seasonal visitors to the North Sea.	Acknowledged.
Habitat suitability assessments for herring and sandeel are presented within Chapter 10. For herring and sandeel, a 'heat' map output has been provided to indicate areas of seabed with the potential to provide sandeel habitat or herring spawning habitat, following the MarineSpace (2013a and 2013b for herring and sandeel respectively) methodologies. This is appropriate.	Acknowledged.
Tables 10-15 and 10-16 display the calculated total areas in km² of potential habitat for sandeel and potential spawning habitat for herring, which overlap with the project boundaries. Please note that the MMO does not support the calculation of quantified areas of potential sandeel habitat and potential herring spawning habitat. Doing so likely over- or under-represents the area of suitable habitat available, as well as assumes that; a) The total area of suitable habitat is explicitly known and that sandeel populations will remain at comparable densities. b) Herring populations will spawn across the same area every year, within in a reduced area. When in fact herring will return to a broad area to spawn annually but will not spawn over the whole spawning ground each year. This means the relative importance of a particular spawning area to the overall reproductive success of the population will vary between years and therefore calculations of total area (or percentage area) of spawning habitat should be treated with caution as they are not truly reflective of the potential impacted area.	Additional text has been added to the paragraphs preceding these tables to provide additional context surrounding the caveats that must be considered when utilising the quantification of modelled extents. Further, these values have been included within the baseline only, and have not been used directly to draw conclusions regarding impact significance.
A 'heat' map of potential herring spawning habitat has been provided in Figure 10-7. The MMO notes from Table 10-5, that ICES International Herring Larvae Survey (IHLS) data for the years 2010-2022 has been used to inform the 'heat' map and agrees this is appropriate.	Acknowledged.
Given the extent of the noise-generating activities proposed and noting that the ECC passes through the Banks herring spawning ground at Flamborough Head, it will be helpful if the individual data layers (e.g. sediment data, 10 years of amalgamated IHLS data) are presented in mapped form in the ES. This information will be necessary to refine any temporal or spatial restrictions placed on the Projects to protect spawning herring from disturbance by the Projects works.	Layers can be found within **Figures 10-7a** to **10-7g** of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**.
The Applicant 's heat map of potential herring spawning habitat (Figure 10-7) clearly demonstrates that the ECC is set to be laid directly through an area of seabed with high and very high potential as herring spawning habitat. With this in	This preliminary recommendation has been acknowledged, and no piling works along the ECC during the Banks herring population

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mind, I have made a preliminary recommendation that a temporal restriction on construction activities which interact with the seabed along the ECC (including seabed preparatory works, cable trenching etc) is necessary during the herring spawning season (which for the Banks herring population is August – October inclusive). Please see the mitigation section for further comments.	spawning season (August-October) has been included as embedded mitigation throughout this assessment. Following completion of sediment plume modelling and quantification of seabed disturbance, and the assessment of the impacts related to these components of the construction phase of the Projects within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6 determining no significant effect, and so restrictions on construction activities as a whole has not been included within embedded mitigation.
The sandeel habitat suitability assessment refers to both sandeel spawning habitat, and sandeel supporting habitat interchangeably. Figure 10-5 is labelled 'Sandeel spawning potential across the fish and shellfish study area'. The method described by Latto et al., (2013) for assessing sandeel habitat suitability was used to produce Figure 10-5, which is appropriate. The 'heat' map output, which is based on a suite of data, indicates areas of seabed with higher or lower suitability to support sandeel habitat, not spawning potential.	Acknowledged and revised.
Sandeel are demersal spawners and their eggs form batches which attach to the seabed, sandeel larvae are planktonic for approximately 3-months, before settling down into the seabed. Sandeel display a high level of site fidelity and so importance is placed on maintaining suitable habitat, as sandeel spawn in and within the vicinity of the sediments which they inhabit.	This additional context has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.2.3.
Paragraph 66 states: 'the DBS West Array Area is predominantly classed as having a high potential for sandeel spawning, with a number of localised areas of medium potential – the largest of which is located in the south-eastern corner of the Array Area. The DBS East array is predominantly of a medium potential for sandeel spawning, with the exception of the north-western corner which is classed as high potential' This paragraph and Figure 10-5 should be amended within the ES to describe suitable areas as sandeel habitat and sandeel spawning.	Acknowledged and revised to state that this is referring to sandeel habitat, in line with the Latto *et al.* (2014) methodology.
The sources used to inform the sandeel habitat suitability assessment are generally suitable for contributing to the formation of the potential habitat 'heat' map (Figure 10-5). British Geological Survey (BGS) sediment data, vessel monitoring system (VMS) fishing data, and Inshore Fisheries and Conservation Authorities (IFCA) data for the east coast indicating fishing catch are suitable for use in the formation of sandeel habitat suitability 'heat' map, as per the MarineSpace (2013a) methodology. However, the limitations associated with some of these data sources should be acknowledged.	Additional text has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.2.3. to note these limitations.
For example, VMS data used to inform the sandeel heat map should be selected on the basis that the fishing gear is appropriate to target the species, i.e., VMS data for bottom trawled gear rather than pelagic gear. Further, in 2022, the MMO introduced a byelaw to protect important habitats and species within the Dogger Bank Special Area of Conservation (SAC) which prohibits bottom towed fishing across the whole SAC (MMO, 2022). With this in mind, it should be noted that the coverage of VMS data used in the 'heat' map, is likely to change compared to what has typically been observed over the years because commercial fishing fleets using bottom towed gear targeting sandeel (and other demersal species) on the Dogger Bank will be excluded from the area. As the new byelaw has only just come into force, VMS data for fishing activity on the Dogger Bank in recent years will still be relevant to the assessment. The	VMS data used in this assessment is limited to demersal gear types. Additional text has been included within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.2.3. to note these limitations.

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full utility and limitations of the data which underpin this assessment should be acknowledged within the Fish Ecology chapter.	
Whilst the MMO supports the approach to mapping sandeel habitat suitability using the MarineSpace (2013b) method, it should be recognised that this method only shows habitat suitability but does not provide any indication of the distribution or abundance of sandeels across the Dogger Bank or the Projects Array Areas. Some additional data sources that should be used to enhance the characterisation of sandeel habitat in the array area are: • Sandeel dredge surveys of the former Dogger Bank Zone undertaken to inform the Dogger Bank Creyke Beck OWF ES (now referred to as Dogger Bank A & B OWFs). These have some potential to support the discussion on sandeel habitat for the ES (please see Figures 1-3 in Annex 1) as the data contain catch rates for Raitts, smooth and lesser sandeels and demonstrated that high abundances were found around particular areas (and potentially features) of the Dogger Bank. The MMO caveat to this by acknowledging the vintage of this data. • International Bottom Trawl Survey (IBTS) catch data for sandeels from the Q1 and Q3 surveys. These should be used to better inform the environment for sandeels at the DBS array sites. Whilst the gear type is not intended to target sandeels, the data often show larger catch rates of sandeel around Dogger Bank. The surveys are undertaken annually and form part of a long time series, so long-term and recent data are available to download from ICES' data portal 'DATRAS': https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx	Project specific data has been incorporated into the sandeel heatmap. These data indicate the locations across the Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested. Consideration of IBTS data has been given throughout the chapter via its incorporation into the baseline. However, the spatial resolution of these data when compared to that provided by the project specific data is not determined as likely to provide additional value.
Given the high conservation importance of sandeel due to their sensitivity to seabed disturbance, and their importance as prey species for bird species within the region, coupled with the high spawning potential in the DBS West array site, the MMO believes it would be prudent to consider pursuing other data that are available to provide a more detailed picture of sandeel abundance around Dogger Bank, for example by identifying those areas or seabed features where sandeel catch rates have historically been more prevalent.	Consideration has been given to site-specific benthic survey data within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.5.1., 10.5.3.2.3., and 10.5.3.3.3. Sandeel presence as identified within the 2022 benthic fauna survey is compared with modelling after Latto *et al.* (2013) within **Volume 7, Figure 10-5 (application ref: 7.10.1)**.
Impacts from 'Temporary Habitat Disturbance' have been considered as likely to occur during seabed preparation works and/or installation of Projects infrastructure, but 'specifically during wind turbine or offshore platform foundation, scour protection, and transmission cable installation, along with rock placement activities as part of any cable stabilisation work' (Volume 7, Chapter 10 Fish and Shellfish Ecology, section 10.6.1.1). Whilst it is appropriate to scope in Temporary Habitat Disturbance as an impact pathway from activities such as cable trenching, whereby the disturbance caused is indeed temporary, it is not appropriate for activities such as the placement of foundations or rock/scour protection.	The worst case scenario table and subsequent assessment of this impact has been adapted to ensure that only temporary impacts are assessed within this section, with the impact of foundations and rock/scour protection being assessed within Permanent Habitat Loss.
The MMO notes that in the assessment of impacts to fish during the operational phase, the presence of foundations and scour and cable protection have been considered to cause permanent habitat loss. The MMO would highlight that from the moment turbine and OSP foundations and sour protection are installed, the habitat lost under their footprint cannot be recovered unless commitment is made to fully removing such infrastructure during decommissioning. Therefore, during construction, the placement of foundations or rock/scour protection causes permanent habitat loss, and as foundations remain present during the operational phase, impacts from permanent habitat loss persist.	Additional text has been added to both **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.1. (Temporary Habitat Disturbance) and 10.6.2.1. (Permanent Loss of Habitat) to clarify that that this impact will occur from the moment of installation. Assessment of this impact remains within the Operational phase of the chapter, alongside this signposting, as impacts may last throughout the lifetime of the Projects.
The definitions of what activities may cause temporary and permanent habitat loss should be amended within the ES, and permanent loss of habitat should be scoped in as an impact arising from the construction phase. The MMO also recommends that impacts to fish arising from temporary habitat loss be scoped into the operational stage, as there is	Definitions of activities causing temporary habitat disturbance and permanent habitat loss have been revised in line with other comments received. Permanent Habitat Loss remains within the operations

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potential that cable maintenance activities (such as repair and reburial) will create habitat loss and/or disturbance temporarily.	section of the chapter for consistency across the industry, however additional paragraphs have been added to both **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.6.1.1. (Temporary Habitat Disturbance) and 10.6.2.1. (Permanent Loss of Habitat) to clarify that that this impact will occur from the moment of installation. Temporary habitat disturbance has been scoped into the operational phase of the project, and is assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.2.2. (Temporary Habitat Disturbance to Fish and Shellfish Species and Spawning and / or Nursery Grounds, Including Direct Damage from Repair and Maintenance)
In providing UWN comments relating to fish the MMO has reviewed 'Appendix 11-2 - Underwater Noise Modelling Report (Volume III)', further general comments on this report can be found in Section 14 of this document.	Acknowledged.
The Applicant has acknowledged that installation of foundations within the DBS OWFs may lead to injury and/or disturbance to fish species due to underwater noise during pile driving. UWN modelling has been presented based on worst-case scenarios of a 17m diameter monopile installed with a maximum hammer energy of 7000 kilojoules (kJ) over a maximum duration of 5 hours and 20 minutes for a single pile, and for a 4.2m diameter pin pile installed with maximum hammer energy of up to 3,000kJ over a maximum duration of 3 hours and 20 minutes for a single pile. Scenarios covering a single pile installation, multiple sequential pile installations, and simultaneous multiple location installation have been considered.	Acknowledged.
In Section 4.2.2 of the Modelling Report The Applicant has outlined two concurrent piling scenarios. These are as follows: • Monopile foundation concurrent piling scenario: o Two sequentially installed piles at DBS East: South location, o Two sequentially installed piles at DBS West: West location, o A single pile installed at the DBS East/West: Centre location. • Pin pile jacket foundation concurrent piling scenario: o Four sequentially installed piles at DBS East: South location, o Four sequentially installed piles at DBS West: West location, o Four sequentially installed at the DBS East/West: Centre location.	Acknowledged.
These scenarios are somewhat open to misinterpretation and additional clarification as to how piling will be undertaken under each scenario would be helpful. For example, the MMO understands the concurrent monopile scenario to mean that piling will be undertaken at each of the three locations concurrently, where one pile is installed at each location and then a second pile is installed at the DBS East, South and DBS West, West locations after the first piles are installed. In this sense, the maximum number of monopiles being installed at once is three. This should be clarified in Section 4.2.2 of the UWN modelling report, and be restated clearly in the fish ecology chapter, as on first read it appears that five monopiles would be installed concurrently.	Additional clarification has been added within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4.

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Both fleeing and stationary fish receptors have been included in the underwater noise (UWN) modelling. As standard, the MMO does not support the use of a fleeing receptor for fish in underwater noise modelling as it is overly simplistic and assumes that all fish will flee from the source of impact. This overlooks factors such as fish size and mobility, philopatric behaviours (foraging, reproductive or migratory) which may cause an animal to remain/return to the area of impact.	Although both fleeing and stationary fish receptors are included in the UWN modelling, the assessment of impacts of UWN on fish and shellfish receptors assumes a stationary receptor.
Appropriate thresholds for mortality and potential mortal injury, recoverable injury, and temporary threshold shift (TTS) for fish in each hearing group have been used in the underwater noise (UWN) modelling, as per the pile driving threshold guidelines described by Popper et al. (2014). The Applicant states that the worst-case scenario for the assessment of impacts from impulsive UWN has been based on stationary fish with a swim bladder used in hearing (highest hearing sensitivity).	Acknowledged.
A key aspect of the UWN modelling for the Projects will be whether the predicted range of effect overlaps the herring spawning ground near Flamborough Head. Given the specific spawning habitat requirements of herring and their sensitivity to underwater noise, the MMO recommends that you model and present (in mapped form) additional noise modelling for the received levels of single strike sound exposure levels (SELss) at the Flamborough Head herring spawning ground based on the 135 decibels (dB) (SELss) startle response (as per Hawkins et al. (2014)), in order to predict the range of effect for behavioural responses in herring. This is particularly important as UWN propagating from the location of the Projects in the central North Sea has potential to create an acoustic barrier to herring as they follow their migration clockwise through the central North Sea (Cushing, 2001).	Modelling of the 135 dB SELss contour has been performed and added to **Volume 7, Figure 10-8** and **Figure 10-9 (application ref: 7.10.1)**. It is described in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3 and assessed in section 10.6.1.4.
The MMO notes from Figures 10-8 and 10-9 (Chapter 10), that the UWN contour for 186 dB cumulative sound exposure level (SELcum) (indicating the likely range of effect for Temporary Threshold Shift (TTS) in fish with high hearing sensitivity as per Popper et al., (2014)) shows overlap with areas of medium potential for herring spawning. With this in mind, it may be necessary to temporally restrict piling activities to periods outside of the herring spawning season (which for the Banks herring is August – October, inclusive).	Acknowledged.
The 135-dB threshold is based on research by Hawkins et al., (2014a), who exposed wild schooling sprat to short sequences of repeated impulsive playback sounds at different sound pressure levels, to resemble that of a percussive pile driver. The MMO recognises that this may be a conservative threshold as the Hawkins study was carried out in Lough Hyne, which is an enclosed, quiet coastal sea loch, where fish were not accustomed to heavy disturbance from shipping and other sounds (Hawkins et al., 2014a). However, given an absence of other peer-reviewed empirical evidence of behavioural responses in clupeid fishes to support an alternative threshold for impulsive noise, Hawkins et al., (2014a) is currently considered the best available scientific evidence by the MMO, and as such 135dB is deemed an appropriate threshold for modelling behavioural responses.	This impact has been assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4.
However, further UWN modelling is needed to predict the range of behavioural effects for hearing-sensitive fish, as well as additional modelling of the range of effect for piling at the OSP on the ECC and to determine whether such restrictions are needed.	This impact has been assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4.
The MMO notes that the Projects design includes an offshore platform (OSP) along the export cable. The location of this OSP is not indicated on any Figures in the PEIR. The MMO expects to see UWN modelling to predict the range of	Additional modelling and consideration has been given to piling associated with the OSP along the export cable route within **Volume**

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effect from piling at the OSP location to be presented for review in the ES, taking into account the need for modelling of the 135dB threshold for behavioural responses in herring.	**7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.1.4.
Please note – even if this modelling is provided a threshold approach may not be agreed for the Projects and noise abatement and/or mitigation in the form of a seasonal restriction will likely still be required.	Acknowledged.
The MMO notes in Figures 10-8 and 10-9, that the legend for hearing thresholds in fish is expressed as 'decibel hearing threshold (dBht) Level'. However, the UWN modelling report does state that the modelling has been undertaken using unweighted metrics (rather than dBht). Therefore, the thresholds levels in Figures 10-8 and 10-9 should be corrected to 'dB Level'.	The reference to dB_{ht} has been removed in **Volume 7, Figure 10-8** and **Figure 10-9 (application ref: 7.10.1)**. It is confirmed that UWN modelling for Fish & Shellfish is unweighted and does not use the dB_{ht} approach. Full units have been added to the legends for clarity.
The MMO notes clearance of any UXO (if required) will likely be the subject of a separate marine licence application. The MMO would highlight that there may be a requirement for UXO surveys and UXO detonation to be two separate licences, to provide further detail in an UXO detonation application. In a UXO detonation licence the MMO expects to see supporting evidence and an appropriate assessment of impacts to fish from UXO to be presented for review when this application is submitted.	Acknowledged.
Given the ECC route passes through areas of 'high' and 'very high' potential spawning habitat for herring, the MMO considers it necessary for a temporal restriction to be placed on construction activities which interact with the seabed along the ECC route (including seabed preparatory works, cable trenching etc) during the Banks herring spawning season (August – October, inclusive). Activities such as trenching and cable burial cause direct disturbance to the seabed and are likely to cause direct harm to adult herring engaged in spawning, as well as herring eggs and early developmental stage (yolk-sac) larvae.	This preliminary recommendation has been acknowledged, and no piling works along the ECC during the Banks herring population spawning season (August-October) has been included as embedded mitigation throughout this assessment. Following completion of sediment plume modelling and quantification of seabed disturbance, and the assessment of the impacts related to these components of the construction phase of the Projects within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6 determining no significant effect, and so restrictions on construction activities as a whole has not been included within embedded mitigation.
There is potential for this restriction to be applied spatially as well as temporally, given that the areas of the cable route offshore are not situated in the herring spawning ground. The MMO requests site of the individual data layers used in the 'heat' map for herring which will enable us to interrogate data on sediment suitability and larvae abundance in more detail for use when applying a restriction spatially. With this in mind, it would be useful if to indicate kilometre point distances along the ECC on the maps so that any potential restriction could be applied to specific points along the cable.	KP points have been added to **Volume 7, Figure 10-5** and **Figures 10-7a-g (application ref: 7.10.1)**, relating to potential habitat and spawning potential for sandeel and herring respectively.
An outline of likely cumulative effects associated with the Projects has been presented in Volume 7, Chapter 10 Fish and Shellfish Ecology, section 10.7 of chapter 10. A high-level list of other projects which have been screened into further assessment is provided in Table 10-23, however no preliminary assessment for fish receptors giving magnitude and significant of cumulative effect (for example, cumulative underwater noise (UWN) arising the various Dogger Bank OWF projects) has been provided. For Projects of this size and scale, at this stage in the consenting process, the MMO expects a more detailed assessment than has been provided and this should be updated in the ES.	An assessment of cumulative effects relating to Fish and Shellfish Ecology is presented within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.7.

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PEIR Consultation, Dutch Reaction - Netherlands, with inputs provided by the Dutch Ministry of Infrastructure and Water Management, the Ministry of Economic Affairs and Climate Policy, and the Ministry of Agriculture, Nature and Food Quality – 15/09/2023	
It is mentioned that there may be temporary and permanent loss of spawning and nursery grounds of several vulnerable and endangered species, including shark species (see OSPAR List of Threatened and/or Declining Species & Habitats). We would appreciate additional mitigation and compensation plans for these species, as the loss of spawning and nursery grounds for vulnerable species seems more substantial than the minor adverse effects that are described.	It is acknowledged that temporary and permanent habitat loss associated with the Projects has the potential to occur in regions where spawning and nursery grounds of fish and shellfish species are present. However, it should be noted that the assessment made within the EIA gives consideration to impacts on receptor groups at a population level scale, and not at an individual scale. The assessments undertaken within sections 10.6.1.1; 10.6.2.1. and 10.6.2.6 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** determine that the scale of this disturbance is not considered to have an adverse effect beyond minor, which is not significant in EIA terms. This determination is based on both the limited scale of habitat loss when compared to the wider availability of suitable habitat across the study area and the wider North Sea, combined with the mobility of Fish and Shellfish species allowing for the utilisation of alternate suitable spawning and nursery grounds beyond the footprint of the Projects. Due to the determination of no significant impact, mitigation and compensation is not considered further within this assessment.
Dogger Bank South Offshore Windfarm – Seabed ETG 21/09/2023	
MMO considers that the potential impacts of underwater noise on spawning herring will need to be further considered and discussed in upcoming meetings. For further comments regarding the impacts of underwater noise on Herring see Annex A.	**Volume 7**Acknowledged.
Following review of the underwater noise memo, MMO requests that the most appropriate approach is to model and provide the unweighted sound level contours, specifically the received levels of the single strike sound exposure level (SELss) and overlay these contours onto appropriate herring spawning ground data.	Popper et al. (2014) guidelines have been used as thresholds for physical injuries. Behavioural impacts have been modelled using the quantitative 135 dB (SELss) threshold.
MMO considers the use of the injury thresholds presented in Popper et al. (2014) is currently the best available, peer reviewed criteria for fish species and requests their application in noise impact assessments. These criteria provide quantitative thresholds for Temporary Threshold Shift (TTS), recoverable injury, and death in fish in response to pile driving. The thresholds are formulated using the peak sound pressure level (decibel (dB) peak) and the cumulative sound exposure level (SELcum). The Popper criteria, however, do not provide quantitative thresholds for behavioural responses to noise. Instead, where sufficient data exist to make a recommendation for guidelines, a subjective approach is adopted in which the relative risk of an effect is placed in order of rank at three distances from the source – near, intermediate, and far (where “near” might be considered to be in the tens of metres from the source “intermediate” in the hundreds of metres, and “far” in the thousands of metres). MMO recommend that the most appropriate approach is to model and provide the unweighted sound level contours, specifically the received levels of	Popper et al. (2014) guidelines have been used as thresholds for physical injuries. Behavioural impacts have been modelled using the quantitative 135 dB (SELss) threshold.

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the single strike sound exposure level (SELss) and overlay these contours onto appropriate herring spawning ground data.	
Behavioural effects are particularly difficult to assess, since they are highly dependent on behavioural context (Ellison et al., 2012; Popper et al., 2014) and responses may not scale with received sound level (Gomez et al., 2016). Furthermore, the effect of a particular response is often unclear. A startle or reflex response to the onset of a noise source, for instance, does not necessarily lead to displacement from the ensonified area. Consequently, there is considerable uncertainty in assessing the risk of behavioural responses. This uncertainty is further compounded by the limitations of observing fish behavioural responses in a natural context: few studies have conducted behavioural field experiments with wild fish (Popper and Hastings, 2009), and lab-based experiments may not give a realistic measure of how fish will respond in their natural environment (Kastelein et al., 2008).	The 135 dB (SELss) threshold has been incorporated into **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** as a behavioural response threshold throughout this assessment.
For these reasons, quantitative assessments (in the form of simplistic thresholds) for behavioural responses are currently not feasible as such. Recent studies have considered more sophisticated approaches to quantify the risk of behavioural responses, for example through dual criteria based on dose-response curves for proximity to the sound source and received sound level (Dunlop et al., 2017). Approaches based directly on the "distance of effect" reported for in situ behavioural studies (e.g., Merchant et al., 2017) can also be used as an empirical estimate of the risk of behavioural responses (Gomez et al., 2016), provided that the sound level of the noise source in the cited study is not substantially exceeded in the assessment scenario.	
In the absence of any fixed behavioural threshold one approach could be to provide unweighted sound level contours, specifically the received levels of the single strike sound exposure level (SELss) and overlay these contours onto appropriate herring spawning ground data. An assessment can then be made on Schools of sprat were observed to disperse or change depth on 50% of presentations. the potential for behavioural responses, with reference to peer-reviewed literature. Hawkins and Popper (2014) reported startle responses of schools of wild sprat at a single-pulse sound exposure level of 135 dB re 1 μPa^2s and 142 dB re 1 μPa^2s for mackerel shoals. Sprats are a clupeid species, closely related and anatomically similar to herring, and similarly sensitive to underwater sound (sprats also possess a swim bladder involved in hearing). Thus, these single-pulse sound exposure levels can be applied to estimate potential behavioural response ranges.	
The limitations of this approach must be recognised, and caveats must be applied. Sound playback experiments (not a real pile driver) were carried out in an enclosed, quiet, coastal sea lough, where fish were not accustomed to heavy disturbance from shipping and other intense sound sources. The authors note in the paper that these data cannot yet be used to define the sound exposure criteria. On the other hand, the paper does present data on the levels of impulsive sound to which wild sprat and mackerel respond. The thresholds, which are based on the best available evidence, could be taken to be a conservative indicator for the risk of behavioural responses and potential displacement.	
Overall, and in the absence of fixed thresholds and limited data, one should draw on the best available evidence that we do currently have, in order to conduct a meaningful impact assessment. If The Applicant were to propose a more appropriate threshold derived from the peer-reviewed literature, then MMO could consider this.	Popper et al. (2014) guidelines have been used as thresholds for physical injuries. Behavioural impacts have been modelled using the quantitative 135 dB (SELss) threshold.

Comment	Project Response
MMO refers to comments made in advice provided on the Preliminary Environmental Information Report (PEIR), in relation to the impacts to fish and fish ecology receptors identified and request that these comments are actioned for the environmental statement (ES). These include that no likely impacts have been scoped into the decommissioning phase, and that the definitions of what activities may cause 'temporary' and permanent habitat loss should be amended, and scope in permanent loss of habitat as an impact arising from the construction phase.	Each of these changes have been addressed within the ES, with further details provided against specific comments made at the PEIR stage.
Comments on taxa identified in Slide 13 of ETG slides: a: Slide 13 presents observations of potentially sensitive taxa/ habitats within the DBS OWF Array areas. It is noted that the figure presented observations of sandeels being present at the sample sites throughout the array. A suitable discussion on the relevant data underpinning the figure in Slide 13 should be included in the fish ecology baseline characterisation for the DBS OWF array area ES.	Observations of sandeel made in the site specific survey data have been included within **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**, and discussed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.5.3.2.
Response to applicant's question: 'Do you consider the quantification of herring and sandeel habitat assessment should be removed from the ES and only a qualitative approach should be taken?': Yes. MMO considers that you should present habitat suitability assessments for herring and sandeel with supporting visualisations (heatmaps, herring larval densities or sandeel presence) and an appropriate supporting discussion of the site-specific data (e.g., particle size analyses of sediment samples and observations of sandeels in site-specific samples, as per Annex 2, etc.), but without quantifying areas of higher or lower potential habitat for sandeel or potential spawning habitat for herring.	Additional text has been added to the paragraphs preceding these tables (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.5.3.2 and 10.5.3.3. to provide additional context surrounding the caveats that must be considered when utilising the quantification of modelled extents. Further, these values have been included within the baseline only, and have not been used directly to draw conclusions regarding impact significance within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.
MMO does not support the calculation of quantified areas of potential sandeel habitat or potential herring spawning habitat because defining explicit areas of habitat is likely to over- or under-represent the area of suitable habitat available. The 'heat' mapping exercise developed by MarineSpace (2013a and 2013b for herring and sandeel respectively) use multiple sets of data which are methodically layered and scored to generate a single 'heatmap' output. Areas of 'heat' are representative of areas with potential herring spawning habitat, or potential sandeel habitat and the heatmap output provides a visual indication of this. Calculating defined, discrete areas of high, medium or low potential habitat in kilometres squared (km^2), assumes that the total area of suitable habitat is explicitly known and uniformly used. This approach does not account for possible changes in sediment composition resulting from natural environmental fluctuations (e.g., increases mud or silt content) which would affect the suitability of the sediment for herring and sandeel, but may not be captured in the broadscale seabed sediment data used to generate the heatmap. In addition, a quantified approach assumes that sandeel populations will remain at comparable densities each year, or that herring populations will spawn across the same exact area every year. In fact, whilst herring will return to a broad area to spawn annually, they will not spawn over the whole spawning ground each year and may not spawn in the exact same area. The relative importance of a particular area of seabed to the overall reproductive success of the population (for both herring and sandeel) will vary slightly between years and therefore calculations of total area (or percentage area) of habitat should be treated with caution. Therefore, MMO considers that a qualitative approach is the most appropriate way interpret and present the habitat suitability assessments.	Additional text has been added to the paragraphs preceding these tables (**Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sections 10.5.3.2 and 10.5.3.3. to provide additional context surrounding the caveats that must be considered when utilising the quantification of modelled extents. Further, these values have been included within the baseline only, and have not been used directly to draw conclusions regarding impact significance within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6.

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MMO requires a sandeel habitat suitability (heatmap) assessment to be carried out as described in MarineSpace (2013b). No further data sets need to be incorporated into the heat map assessment. However additional data sources which were recommended in the PEIR response should be presented and discussed alongside the sandeel habitat suitability (heatmap assessment).	Project specific data has been incorporated into the sandeel heatmap **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**. These data indicate the locations across the Offshore Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested.
The MarineSpace (2013b) method provides a visual indication of sandeel habitat suitability but does not provide an indication of the distribution or abundance of sandeels. With this in mind, additional data sources are suggested which could be used to enhance the characterisation of sandeel habitat in the array area:	Project specific data has been incorporated into the sandeel heatmap **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**. These data indicate the locations across the Offshore Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested. Consideration of IBTS data has been given throughout the chapter via its incorporation into the baseline. However, the spatial resolution of these data when compared to that provided by the project specific data is not determined as likely to provide additional value.
A: International Bottom Trawl Survey (IBTS) catch data for sandeels could be used to better inform the environment for sandeels at the DBS array sites. The surveys are undertaken annually and form part of a long time series. As was outlined in advice provided on the PEIR, recent data are available to download from International Council for the Exploration of the Sea (ICES) data portal 'DATRAS' (https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx). MMO recommends that a minimum of 10 years of the most recently available data is used to inform the assessment. However, the limitations associated with this data must be recognised because the GOV trawl used in the International Bottom Trawl Survey (IBTS) does not target sandeels.	
b: MMO recommends that you supplement your sandeel habitat assessment with data from the North Sea Sandeel Survey (NSSS) carried out in Sandeel Area 1 in December each year. This is a targeted sandeel dredge survey that has been carried out since December 2004 and includes a number of stations in and around the DBS OWFs (see Annex 3). The NSSS data can be downloaded from ICES at 'DATRAS'. As above its recommended that a minimum of 10 years of the most recently available data is used to inform the assessment.	Project specific data has been incorporated into the sandeel heatmap **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**. These data indicate the locations across the Offshore Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested. The spatial resolution of these data when compared to that provided by the project specific data is not determined as likely to provide additional value.
c: The sandeel dredge surveys of the former Dogger Bank Zone undertaken to inform the Dogger Bank Creyke Beck OWF ES (now referred to as Dogger Bank A & B OWFs) have some potential to support the discussion on sandeel habitat for the ES. The surveys were conducted by Brown & May Marine Ltd and collected catch rate data for Raitts, lesser and smooth sandeel around Dogger Bank (Forewind, 2013). To the MMO's knowledge, this is the only sandeel dredge survey carried out around the Dogger Bank for any of the OWFs in the vicinity. There is some potential for the data to be used in the assessment for the DBS OWFs, however there are limitations with its use. The survey was completed in 2012, so is quite old, and was carried out before much of the construction activity associated with the various OWFs took place. With this in mind, you should recognise that the distribution and density of sandeels across the Dogger Bank may have changed. For this reason, although the Dogger Bank Zone sandeel dredge surveys have some utility to the DBS OWFs, the NSSS data would provide a more up to date source of data.	Project specific data has been incorporated into the sandeel heatmap **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**. These data indicate the locations across the Offshore Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested. The relevance and quality of these data when compared to that provided by the project specific data is not determined as likely to provide additional value.

Comment	Project Response
d: VMS data for bottom trawled gear is a further source of data that could be used in the assessment to identify areas where high intensity fishing may be occurring in the project study area. However, given the introduction of a byelaw on bottom towed fishing gear within the Dogger Bank SAC in 2022, some areas of the Dogger Bank may be data deficient for recent years.	Project specific data has been incorporated into the sandeel heatmap **Volume 7**, **Figure 10-5 (application ref: 7.10.1)**. These data indicate the locations across the Offshore Development Area where sandeel were identified within drop-down video transects. Collected in 2022, these data are of high spatial and temporal resolution, and enhance the characterisation of sandeel habitat in the area as requested. Consideration to landings data from throughout the Fish and Shellfish Ecology Study Area has been given throughout the chapter via its incorporation into the baseline. However, when compared to the project specific data it is not determined as likely to provide additional value in this context.
A minimum of 10 years of the most recently available International Herring Larval Survey (IHLS) data should be used to inform assessments.	The IHLS layer used indicates the maximum extent of IHLS survey stations where a positive identification of age zero herring larvae have been made as per Reach et al. (2013). No material changes to this layer have been made following incorporation of the last 10 years of data. Therefore, this layer has considered the last 10 years of available IHLS data. This complies with current approved MMO guidance.
MMO is content with the habitat suitability assessment for herring which was presented in the PEIR however given the extent of the noise-generating activities proposed for the project and noting that the export cable corridor (ECC) passes through the Banks herring spawning ground at Flamborough Head, it would be beneficial if the individual data layers (e.g. sediment data, 10 years of amalgamated IHLS data) are presented in mapped form in the ES, alongside the final heatmap. This information will be necessary to refine any temporal or spatial restrictions placed on the project to protect spawning herring from disturbance by project works.	Individual layers can be found within **Volume 7, Figures 10-7a** to **10-7g (application ref: 7.10)**.
You have made reference to a licence condition for the Scotland to England Green Link 1(SEGL1) subsea cable (licence ref. L/2023/00212/1) relating to the herring spawning season. You have noted the potential inclusion of a licence condition for DBS that could restrict works between August and October, which differs from the timing of the condition for SEGL1. MMO recommended the following condition for the SEGL1 works: a: No cable laying works are permitted to take place on the seabed between KP60 and KP120 between 1st August and 30th September (inclusive). Reason: to protect herring spawning habitat during the herring spawning season, and to ensure eggs and newly hatched larvae remain undisturbed during their development period. b: KP (Kilometre Point) along the SEGL1 The timing of conditions are based on the timing of the herring spawning season for that particular location.	This preliminary recommendation has been acknowledged, and no piling works along the ECC during the Banks herring population spawning season (August-October) has been included as embedded mitigation throughout this assessment. Following completion of sediment plume modelling and quantification of seabed disturbance, and the assessment of the impacts related to these components of the construction phase of the Projects within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, section 10.6 determining no significant effect, and so restrictions on construction activities as a whole has not been included within embedded mitigation.

Comment	Project Response
Herring migrate in a north to south direction during their spawning period, with spawning occurring earlier in the season, further north. As the herring migrate south, the spawning season progresses through September and October. Herring spawning off the Northeast of England is understood to take place between 1st August – 30th September, but further south, i.e., off Flamborough Head, the season extends from 1st August to 31st October.	
The purpose of a seasonal restriction is to prevent disturbance or disruption to adult herring migrating to the spawning ground, and to prevent direct harm to adult herring engaged in spawning, as well as herring eggs and early developmental stage (yolk-sac) larvae during the spawning season. For this reason, the period of the restriction is defined to allow time for suspended sediment to settle following the cessation of activities which disturb the seabed, and for maturing adult herring to move into areas of chosen spawning habitat. Herring eggs are laid in mats and egg development and hatching occurs after between 7 to 49 days depending on water temperature at the seabed (the warmer the water the less time hatching takes to occur), (Table 1, Russell, 1976). After this, newly hatched larvae undergo a period where they remain close to the seabed while the yolk sac is absorbed (Table 2). Again, the length of this period depends on temperature of the water at the seabed. Russell (1976) describes that the yolk-sac is usually completely absorbed when larvae have reached lengths of 8-10mm. After this, post-larvae are typically carried by currents to the northeast margin of the North Sea where they continue to develop towards metamorphosis (Dickey-Collas et al., 2009). Therefore, it is recommended a seasonal restriction is from 1st August to 31 October inclusive.	
With regard to the Skaret et al., 2003 herring spawning dataset used, MMO has concerns due to the study being based on Norwegian spring-spawning herring that spawn along the coast from Lofoten to Lista, whereas Banks herring are autumn spawners. There is no reference in the paper to a 'herring spawning observer', there are also no definitive references in the paper that dropdown video (DDV), or other imaging equipment was routinely used in the data collection protocols to observe herring eggs on the seabed. There is a single reference to the spawning substrate being examined using a remotely operated vehicle (ROV), but it is not clear whether this was part of the methodology used in the data collection for this study. Data on herring spawning schools was gathered using acoustic recordings and biological sampling. To surmise, it is not clear from the information provided how this study, or its data, would inform a herring monitoring protocol if proposed. Further clarifications of the purpose of including this study are needed.	The proposition of a herring spawning observer is no longer being perused following integration of embedded mitigation referencing no piling works along the ECC during the Banks herring population spawning season (August-October).
The herring spawning observer process is outlined however, the MMO has concerns about how effectively and accurately a 'herring spawning observer' would be able to monitor herring spawning activity and the development of eggs across the Banks herring spawning ground. MMO requests a detailed methodology of the herring spawning observer process is submitted for further discussion including the scale that the monitoring will be carried out.	
Please note it is likely that spawning activity will not follow a neat north-south sequence but rather will be somewhat sporadic and variable depending on the environmental conditions present in respective areas. For example, during the spawning period, spawning activity may occur simultaneously at various locations across the spawning ground with unsynchronized timing. Therefore studies such as Skaret et al., 2002 may not be applicable at wider spatial scales.	

Comment	Project Response
MMO needs to understand how you intend to identify herring spawn. Any approach which attempts to establish a threshold for the concentration of herring eggs above which a work-halt is required, would be limited by the quality of the images provided by the DDV and subjective according to what The Applicant considers a sufficient concentration of eggs. Similarly, a presence / absence exercise will also have limitations related to image quality and clarity, and both approaches will require regular (potentially daily or bi-daily) surveys to ensure that eggs are not laid in the vicinity of the site after the work-halt has been removed.	
The MMO would highlight that consideration should be taken on whether the potential for rolling work-halts and a stop-start-stop-start work schedule will be more disruptive to the project than a seasonal restriction on the relevant activities. In addition, the MMO would need to agree a defined list of works which could be carried out during the spawning season under this approach. Some activities, for example impulsive piling of turbine foundations, will still require a seasonal restriction during the spawning season due to the dispersive nature of UWN pressures and the presence of adult herring in the vicinity of the spawning grounds during the spawning season. Therefore, it would be beneficial to have early consideration of techniques for minimising the range of impact for UWN e.g., noise abatement measures. Given the availability of effective alternatives to unmitigated piling (such as measures to reduce noise at source, a.k.a. noise abatement), unmitigated pile driving cannot be justified on the basis that there are no realistic alternatives. Therefore, noise abatement measures should be explored for this project, in order to reduce the risk of potential impact on marine receptors.	
MMO can confirm that in the absence of an alternative you should present modelling for the received levels of single strike sound exposure levels (SELss) at the Flamborough Head herring spawning ground based on the 135dB (SELss) startle response (as per Hawkins et al. (2014)). This advice is consistent and proportionate to offshore developments where piling noise has potential to impact herring migrating to their spawning grounds and engaging in spawning activity.	The 135 dB (SELss) threshold has been incorporated into **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** as a behavioural response threshold throughout this assessment.
The recommended threshold for predicting behavioural responses in clupeid fishes (135 dB) is lower than that at which physical injuries occur (TTS 186dB), therefore we can expect behavioural responses caused by underwater noise to occur over much greater distances. With this in mind, a key aspect of the UWN modelling for Dogger Bank South will be to establish whether the range of effect is likely to overlap the herring spawning ground surrounding Flamborough Head, causing disturbance and disruption to herring which are migrating towards and engaging in spawning.	The 135 dB (SELss) threshold has been incorporated into **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** as a behavioural response threshold throughout this assessment, with data and figures on overlap with potential herring spawning grounds clearly presented.
In relation to modelling of physical injuries to fish (for mortality and potential mortal injury (207 SELcum), recoverable injury (203 SELcum), and TTS (186 SELcum)) as per the pile driving threshold guidelines described by Popper et al. (2014), this is appropriate, and the MMO would expect to see these UWN contours for these thresholds presented as standard. However, the criteria for behavioural responses included in the Popper et al., (2014) guidelines are qualitative and broad by nature, owing to the inherent difficulties in quantifying the various ecological and behavioural responses of fish species to underwater noise at varying distances. As a result, given that these criteria can only be broadly defined (as 'near', 'intermediate', and 'far' distances), they can neither be considered conservative or unconservative. Furthermore, the qualitative behavioural criteria of Popper et al., (2014) are subjective and cannot be easily mathematically modelled to illustrate a range of impact. Accordingly, determining the maximum spatial extent of likely behavioural impacts can only be achieved by modelling a suitable quantitative threshold, based on the best available evidence.	Popper et al. (2014) guidelines have been used as thresholds for physical injuries. Behavioural impacts have been modelled using the quantitative 135 dB (SELss) threshold.

Comment	Project Response
MMO recommends that a threshold of 135dB (SELss) is used for the purpose of modelling behavioural responses in herring in their spawning ground. This 135dB threshold is based on research by Hawkins et al., (2014), who exposed wild schooling sprat to short sequences of repeated impulsive playback sounds at different sound pressure levels, to resemble that of a percussive pile driver. Observed behavioural responses included the break-up of fish schools. The sound pressure levels to which the fish schools responded on 50% of the presentations were 163.2 and 163 dB re 1 µPa (peak-to-peak), and as a result the concluded single strike sound exposure level was 135 dB re 1 µPa²s.	The 135 dB (SELss) threshold has been incorporated into **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** as a behavioural response threshold throughout this assessment.
Given an absence of other peer-reviewed empirical evidence of behavioural responses in clupeid fishes to support an alternative threshold for impulsive noise, Hawkins et al., (2014) is currently considered the best available scientific evidence by the MMO and Cefas Fisheries and Underwater Noise specialists, and as such 135dB is deemed an appropriate threshold for modelling behavioural responses. However, the MMO would consider the use of an alternative quantitative threshold for modelling behavioural responses in herring (or a similar clupeid fish), should The Applicant be able to provide one which is based on suitable, peer-reviewed literature.	
With regard to the comment within the underwater noise memo 02.11.23 the habituation of fish to anthropogenic noise, context is important. Fish may become habituated to low-level continuous noise (for example from shipping traffic), however, this is not comparable to impulsive noise which will be generated as a result of impact piling (which can cause greater physiological harm and disturbance over much larger areas). It is accurate that the 135dB SELSS threshold was determined based on sprat schooling in the water column of a quiet loch, rather than sprat (or herring) engaged in spawning in the wild. However, there is little empirical evidence to indicate how herring (or sprat) engaged in spawning activity in the wild may respond to impulsive piling noise.	
In the absence of appropriate, empirical evidence indicating that herring will continue to spawn when subjected to significant UWN disturbance, a precautionary approach, based on the best available, peer-reviewed evidence, should be adopted (International Council for the Exportation of the Sea (ICES), 2003, 2015, 2018). For the reasons given above, unless you can provide an alternative threshold or another approach (such as the “distance of effect” reported for in-situ behavioural studies), which is based on suitable, peer-reviewed literature, the MMO considers that the 135dB (as per Hawkins et al., 2014) is a precautionary but appropriate threshold for the purpose of modelling behavioural responses in herring at their spawning ground.	
The criteria for behavioural responses included in the Popper et al., (2014) guidelines are qualitative and cannot be sufficiently modelled to quantify the spatial extend of impact. As such, we support UWN modelling using the quantitative thresholds as per Popper et al., for mortality (207 dB SELcum), recoverable injury (203 dB SELcum) and TTS (186 dB SELcum), accompanied by modelling of the 135 dB, as per Hawkins et al., 2014, to indicate the spatial extent of likely behavioural impacts.	
Within the UWN memo it is stated that the approach (to model the quantitative criteria in Popper et al., (2014)) is “in line with industry standard and has been used and consented across a significant number of offshore renewables developments both within the region and nationally. These developments include, but not limited to, Hornsea Project Three, Hornsea Project Four, East Anglia ONE North, and Seagreen Alpha and Bravo”. The MMO recommends that modelling of the 135 dB, as per Hawkins et al., 2014, should be carried out to indicate the spatial extent of likely behavioural impacts of clupeid fishes such as herring. This recommendation was made in relation to each of the developments you have listed, with the exception of Seagreen Alpha and Bravo as this development is located in	

Comment	Project Response
Scottish waters and therefore not under MMO jurisdiction. In relation to the other developments listed: a: EA One North: This is not a wholly appropriate comparison as this project is located in the southern North Sea, some distance away from the DBS OWFs, and in closer proximity to the Downs herring spawning grounds than the Banks spawning grounds. For reference Downs herring spawning occurs between November – January, inclusive. b:Hornsea Project Three: For this project The Applicant provided adequate modelling which addressed our concerns around spawning herring by demonstrating that the range of likely behavioural impacts did not overlap with the Banks herring spawning ground. The Applicant presented modelling based on "the absolute maximum hammer energy at the location closest to the spawning ground (i.e., the most conservative assumptions)" and took into account both single and concurrent monotiling scenarios. This modelling presented UWN noise contours for zero-peak sound pressure level (SPLpeak) radiating from the array under both scenarios and The Applicant was able to conclude that "in the worst case scenario, whereby two piles are installed adjacent to one another and these pulses combine, this will cause a maximum 3 dB increase in the noise level, leading to 142 dB SPLpeak at the edge of Flamborough Head spawning ground,". Lippert et al., (2015) provide an empirical estimation of the peak sound pressure level from the sound exposure level for impact pile driving noise. Using this conversion, for a SELss of 140 dB, there will be a difference of 16 dB (deriving a SPLpeak value of 156 dB). For a SELss of 150 dB, there will be a difference of 20 dB, and so on. Thus, a SELss of 135 dB is equivalent to a SPLpeak value of approximately 149 dB. Therefore, although Hornsea Project 3 did not explicitly model the 135dB (SELss) as per Hawkins et al. (2014), the project did comply with our recommendations and demonstrated that the main Banks herring spawning grounds off Flamborough Head were outside the extent of noise disturbance.	
Dogger Bank Offshore Windfarm – Fish and Shellfish ETG 223/02/2024	

Comment	Project Response
Cefas and Natural England stated that UWN modelling indicates that piling undertaken across the Offshore Development Area will result in exposure of 135dB to potential herring spawning areas off Flamborough Head. The embedded mitigation restricting piling activities along the Offshore Export Cable Corridor during herring spawning periods (August-October) will not prevent the potential impact of disturbance from 135dB exposure associated with piling in the Array Areas.	The 135 dB (SELss) threshold has been incorporated into **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** as a behavioural response threshold throughout this assessment and is not considered to represent a realistic area of likely significant effects. The 135dB threshold proposed is based on a 50% response rate where the response was a change in schooling density/change in orientation of the fish. Therefore, it should not be considered a line within which 100% of fish will exhibit a fleeing response, and there is no evidence of barrier effects at this level. While the Hawkins *et al.* (2014) threshold has been used in the assessment, there are differences in baseline noise levels and study species. The Dogger Bank is likely to have higher levels of background noise when compared to a quiet coastal loch, such that exposure to high ambient noise may have a habituating effect leading to a weaker or lack of response compared to the received levels alone, as observed in fish in Chapman and Hawkins (1969), and in Peña et al. (2013). Whilst it is acknowledged that impulsive noise at the 135dB threshold may result in behavioural responses in 50% of exposed fish, information within Hawkins *et al.* (2014) strongly indicates that this threshold is not likely to cause impacts at a population level.
Cefas stated there is a concern of herring disturbance along the ECC, especially during the spawning period (August – October inclusive). Cefas feel that this is a hotspot for herring during spawning and suggest that there is a review of the modelling. Cefas recommended no works (e.g., sand wave levelling, seabed clearance) during the spawning season in the cable corridor.	The impact of these effects is considered within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**. The full footprint for all works is 38.2km^2, with only discrete areas of high and very high herring spawning potential available along the export cable corridors. Trenching and cable burial operations within these regions will be restricted to a maximum disturbance corridor of 20m. Further, in regions where herring are likely to spawn, sediment composition will comprise mainly gravel and sandy gravel which will greatly reduce potential impacts of smothering, also assessed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**.
ETG Response, Natural England 21/03/2024 (DAS/464371)	
Summary Whilst Natural England welcome the draft impact assessment outputs being provided during the meeting, we are unable to confirm agreement with them as method statements for the modelling and analyses have not been provided for review. Further, as a RIAA and MCZ assessment have not been provided, conclusions have only been presented in relation to EIA. Given the location of this project, it is essential that full consideration is given in the RIAA to the indirect effects of impacts on forage fish to designated site features.	Noted, fish and shellfish are included in **Volume 6, RIAA (application ref: 6.1)** submitted alongside the ES. The MCZ assessment is detailed in **Volume 8, Stage 1 Marine Conservation Zones Assessment (application ref: 8.17)** also submitted alongside the ES.

Comment	Project Response
Revised Sandeel Modelling Natural England understand the methodology relating to the site-specific benthic survey will be outlined in the Benthic chapter, however we recommend this is also included in the Fish and Shellfish chapter for completeness or is signposted to within the Fish and Shellfish chapter, as a minimum. Further, as Drop-Down Video (DDV) is not a commonly used survey technique for sandeels and it was not a sandeel specific survey, the efficacy, limitations, and benefits of this approach with respect to sandeel should be included in the Fish and Shellfish chapter. Natural England consider that this method will likely only provide anecdotal/qualitative evidence of sandeel presence and/or habitat suitability. We would also advise to include details relating to the survey such as dates, visibility, conditions, frequency, and specific locations of sampling. This is due to the high interannual variability that has been observed in other sandeel areas. Natural England advise that the data sources used for the sandeel (and herring) habitat suitability "heat" maps are clearly stated in the Environmental Statement (ES).	Modelling the potential habitat for sandeel is discussed within section 10.5.3 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** with the data presented in **Volume 7, Appendix 9-3 (application ref: 7.9.9.3)**. Sandeel habitat suitability "heat" maps are provided in **Volume 7, Figure 10-5 (application ref: 7.10.1)**.
Revision to Underwater Noise Modelling Natural England notes the inclusion of the 135dB SELss noise contour from Hawkins et al., (2014) as suggested by Cefas. Natural England agree with the concerns raised by Cefas regarding the suitability of the embedded mitigation measures proposed and welcome being part of further discussions on additional noise abatement/seasonal restrictions for herring. A figure showing the modelled noise contours for concurrent pin piling in the array areas only (i.e. excluding the ECC) has not been presented so the range of effect for this scenario is currently unknown. Natural England request this figure is included in the application.	Underwater noise is discussed within section 10.6.1.4 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** and the modelling presented in **Volume 7, Appendix 11-3 (application ref: 7.11.11.3)**. As the worse case, concurrent pin pilling at three locations (one in DBS East Array Area, one in DBS West Array Area, and one in the Offshore Export Cable Corridor) has been modelled. (see **Volume 7, Figure 10-10 (application ref: 7.10.1)**). Further discussions with Natural England on this topic will be held post-application.
Additional impact pathways In the Benthic ETG meeting (Monday 29th January) it was stated that up to 25% of the cable corridor may need levelling. Natural England advise that the potential impacts of this on sandeel and herring should be assessed in the Fish and Shellfish chapter of the ES.	Sand wave levelling is discussed within the impacts of temporary habitat disturbance and increases in local suspended sediments concentrations and sediment settlement (section 10.6.1.1 and 10.6.1.2 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**
Cumulative Effects Assessment (CEA) In relation to the current list of screened in cable projects, Natural England advise that the Eastern Green Link 3 and 4 interconnector cables have recently consulted on an EIA scoping with MMO and are in the public domain. A Marine License Application has also been submitted (and/or consented) for up to two gravity base artificial nest structures for the Hornsea 4 OWF. We advise that these projects will now be a material consideration in the CEA. Natural England cannot confirm agreement with the draft conclusions presented as we have not been provided with methodologies for the assessment to review. However, with respect to underwater noise we advise that the assessment should be based on the Worst-Case Scenario for other activities occurring in the area rather than an assumption that concurrent piling will be 'extremely low'. Evidence should also be included to demonstrate how the Project has reached the conclusion that recoverability to TTS and behavioural disturbance will be high. Further clarification is also needed on how the area of long-term habitat loss has been calculated.	Noted. The worse case scenarios for underwater noise modelling has been discussed within the ES chapter (section 10.6.1.4 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** and the modelling presented in **Volume 7, Appendix 11-3 (application ref: 7.11.11.3)**. Clarification on how permanent loss of habitat has been calculated is presented in section 10.7.4.2 of **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10).**

Comment	Project Response
<u>Monitoring</u> Natural England advise that sandeel monitoring will likely be needed for this project to validate the predictions made in the ES. Natural England welcome further discussion on monitoring including review of draft method statements. An example of sandeel monitoring could include e.g. presence/absence habitat surveys before and after construction, especially for the south-west array area. For Herring, we welcome further discussion on mitigation measures (as noted above). An example of herring monitoring could include underwater noise monitoring to validate predictions in the ES.	Sandeel monitoring is detailed in **Volume 8, In Principle Monitoring Plan (application ref: 8.23)**. Grab samples would be taken at locations agreed with the MMO post-consent with subsequent Particle Size Analysis of the samples used to determine a likely preference or avoidance of the area by sandeels.
<u>Indirect effects assessment</u> Natural England advise that further consideration needs to be given to how impacts on Fish and Shellfish populations will interact with other receptors, principally with respect to Benthic, Ornithology and Marine Mammals, and how this will be included in the ES. We highlight that the results presented in the ETG largely focussed on population level effects on sandeel and herring in EIA terms. We acknowledge that it is common in ES applications for this to remain the case, and for an assessment of indirect effects within other thematic chapters to assume that there will be no impact on dependent receptors if impacts on prey at a population level are concluded to be minor. However, this does not consider the role of prey in HRA terms or the scale of localised impacts on prey that could negatively affect designated features. Given the location of Dogger Bank South in both designated sites and important foraging areas for designated species, we advise that indirect effects should be considered as a distinct impact pathway within the RIAA and relevant ES chapters in relation to the role of forage fish as a prey species for designated ornithological and marine mammal features, and as part of the ecological structure and function of benthic habitats, in line with site Conservation Advice. Consideration should be given to how the Project will affect site conservation objectives both during and post construction. For Dogger Bank SAC, Natural England highlights the current restore objective for structure and function within the Supplementary Advice on Conservation Objectives[1] (SACO), which includes '*Biological structure: characteristic communities of the feature within the site*'. Within this objective, Sandeels are specifically included as a key prey resource which along with the characteristic predator species, show that Dogger Bank supports species of wider importance across the North Sea and is a key area for connectivity across the MPA Network. The Project also overlaps with the Southern North Sea SAC, which is designated for harbour porpoise and has a conservation objective that prey availability (i.e. forage fish) is maintained (objective 3). Potential impacts on designated ornithological features should also be assessed, for example based on known foraging ranges/behaviours, and particularly for features from the Flamborough and Filey Coast SPA which have restore objectives and are dependent on sandeel during the breeding season. Natural England suggest it would also be useful to consider the impacts on herring against the context of the Banks spawning component of the North Sea stock. Given the predator-prey links mentioned above, assessment of potential impacts on sub-populations is recommended e.g., potential localised depletion and/or reduced resilience of the wider stock.	**Volume 6, Appendix B Sandeel Habitat Potential in the Digger Bank SAC and Southern North Sea SAC (application ref: 6.1.2)** provides provides baseline information on the presence and distribution of sandeel species within the Dogger Bank Special Area of Conservation (SAC) and Southern North Sea SAC. This information is then referenced in **Volume 6, Report to Inform Appropriate Assessment (application ref: 6.1)** where the potential impacts on sandeel are discussed with regards to the sites designated for benthic, offshore ornithological and marine mammal features. Further discussions with Natural England on this topic will be held post-application.

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