RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Report to Inform Appropriate Assessment

Habitats Regulations Assessment

Volume 6

Part 2 of 4 – Annex I Offshore Habitats and Annex II Migratory Fish (Revision 6) (Tracked)

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Rev No.	Date	Status/Reason for Issue	Author	Checked by	Approved by
01	February 2024	Draft for PINS / TCE submission	RHDHV	RWE	RWE
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04	April 2025	Submission at Deadline 4	RHDHV	RWE	RWE
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06	October 2025	Post-Examination Update	Haskoning	RWE	RWE

Revision Change Log			
Rev No.	**Page**	**Section**	**Description**
01	N/A	N/A	Draft for PINS / TCE submission
02	N/A	N/A	Final for DCO Application
03	66, 67, 68, 69	6.6.2.2.1	Part 2 of 4 of the RIAA has been updated at the request of Natural England following the production of the Technical Note: Comparison of Approaches using the Natural England Guidance NEA001 and JNCC Guidance, to demonstrate the changes to the Air Quality assessment conclusions.
04	22 - 31	6.3.2	Updates to worst-case parameters to reflect Project Change Request 1 and commitment to bundling of Offshore Export Cables.
04	38 - 64	6.4	Dogger Bank SAC assessment updated to reflect updated worst-case parameters and responses received during Examination.
04	65 - 69	6.5	Flamborough Head SAC assessment updated to reflect responses received during Examination.
04	69 - 71	6.6	Humber Estuary SAC assessment updated to reflect responses received during Examination.
05	19 – 22	Table 6-2	Embedded mitigation updated to reflect latest commitments for the Projects.
05	25 - 31	Table 6-2	Worst-case parameters table updated to include UXO clearance activities under disturbance total and minor amendment to habitat loss estimates.
05	55	6.4.2.6.1	Reference to **Appendix E - Ecological Halo Effects Technical Note (Revision 2)** [document reference 15.7] added.
05	67 - 68	6.4.2.3	Table 6 7 added, presenting four without prejudice scenarios for the consideration by the Secretary of State for different scenarios that could lead to AEOI following Natural England comments.

Revision Change Log			
Rev No.	**Page**	**Section**	**Description**
05	76 – 77	6.6.2.1.1	Humber Estuary SAC assessment updated with site specific modelling analysis from **Assessment of Coastal Processes at the Dogger Bank South Landfall** [REP5-040].
05	92 – 95	7.5	Section updated to refer to Humber Estuary Ramsar.
05	96 – 99	References	Reference list amended to restore deleted entries.
06	31-65	Table 6-3	Amendments to habitat loss estimates.
06	67 - 69	6.4.2.3	Halo effects scenarios updated following Natural England comments at Deadline 9.

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Appendices

Glossary

Term	Definition
Accommodation Platform	An offshore platform (situated within either the DBS East or DBS West Array Area) that would provide accommodation and mess facilities for staff when carrying out activities for the Projects.
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).
Collector Platforms (CPs)	Receive the AC power generated by the wind turbines through the array cables, collect it and transform the voltage for onward transmission to the Offshore Converter Platforms (OCPs).
Concurrent Scenario	A potential construction scenario for the Projects where DBS East and DBS West are both constructed at the same time.
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.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
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.
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.

Term	Definition
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).
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
European Site	Terminology previously used to refer to sites designated for nature conservation under the Habitats Directive and Birds Directive, prior to the UK's exit from the European Union in 2020. This included candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and was defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Export Cable Platform Search Area	The Export Cable Platform Search Area is located mid-way along the Offshore Export Cable Corridor and is the area of search for the Electrical Switching Platform (ESP).
Habitats Regulations	Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017.
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.
Horizontal Directional Drill (HDD)	HDD is a trenchless technique to bring the offshore cables ashore at the landfall and can be used for crossing other obstacles such as roads, railways and watercourses onshore.

Term	Definition
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
Inter-Platform Cable Corridor	The area where Inter-Platform Cables would route between platforms within 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.
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.
Mean Sea Level	The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events.
National Policy Statement (NPS)	A document setting out national policy against which proposals for NSIPs will be assessed and decided upon.
National Site Network	The National Site Network comprises National Site Network sites (formerly referred to as European) in the UK that already existed (i.e., were established under the Nature Directives) on 31 December 2020 (or proposed to the EC before that date) and any new sites designated under the Habitats Regulations under an amended designation process.

Term	Definition
National Site Network sites	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Nearshore	The zone which extends from the swash zone to the position marking the start of the offshore zone (~20m).
Numerical modelling	Refers to the analysis of coastal processes using computational models.
Offshore Converter Platforms (OCPs)	The OCPs are fixed structures located within the Array Areas that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the Offshore Export Cables to the Project's Onshore Grid Connection Points.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the offshore export cables (and potentially the ESP) between the Offshore Converter Platforms and Transition Joint Bays at the landfall.
Offshore Export Cables	The cables which would bring electricity from the offshore platforms to the Transition Joint Bays (TJBs).
Preliminary Environmental Information Report (PEIR)	Defined in the EIA Regulations as information referred to in part 1, Schedule 4 (information for inclusion in environmental statements) which has been compiled by the applicants and is reasonably required to assess the environmental effects of the development.
Scour protection	Protective materials to avoid sediment erosion from the base of the wind turbine foundations and offshore substation platform foundations due to water flow.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter.
Sediment transport	The movement of a mass of sediment by the forces of currents and waves.

Term	Definition
Site of Community Importance (SCI)	Sites that have been adopted by the European Commission in accordance with the Habitats Directive, but not yet formally designated by the government of each country.
Special Area of Conservation (SAC)	Strictly protected sites designated pursuant to Article 3 of the Habitats Directive (via the Habitats Regulations) for habitats listed on Annex I and species listed on Annex II of the Directive
Statutory Nature Conservation Bodies (SNCBs)	Comprised of JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage, these agencies provide advice in relation to nature conservation to government
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).
Turbine string	Term referring to a number of cables installed in series on a single cable branch forming a string (or collection) circuit.
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
AEoI	Adverse Effect on [Site] Integrity
CBRA	Cable Burial Risk Assessment
DCO	Development Consent Order
DML	Deemed Marine Licence
EGL	Eastern Green Link
EMF	Electromagnetic Field
ES	Environmental Statement
HRA	Habitats Regulations Assessment
INIS	Invasive Non-Indigenous Species
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
PAH	Polyaromatic Hydrocarbon
PEMP	Project Environmental Management Plan
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SACO	Supplementary Advice on Conservation Objectives
SSSI	Site of Special Scientific Interest
TBT	Tributyltin
THC	Total Hydrocarbon Content

Term	Definition
UXO	Unexploded Ordnance
ZOI	Zone of Influence

6 Sites Designated For Offshore Annex I Habitats

6.1 Approach to Assessment

1. This section provides information in order to determine the potential for the Project to have an adverse effect on the integrity of sites designated for Annex I habitats.

2. For each site designated for Annex I habitats screened in for further assessment, the following has been provided:

   - A summary of the relevant qualifying features of the SAC screened into the assessment;
   - An assessment of the potential effects during the construction, operation, maintenance and decommissioning phases; and
   - An assessment of the potential for in-combination effects alongside other relevant developments and projects.

6.2 Consultation

3. The key elements of consultation to date have included the HRA Screening Report (**Volume 6, Appendix A (application ref: 6.1.1)**) and the ongoing technical consultation via the DBS Seabed Expert Topic Group. The feedback received has been considered in preparing this draft RIAA. **Table 6-1** provides a summary of how the consultation responses relevant to Offshore Annex I Habitats received to date have influenced the approach that has been taken.

Table 6-1 Consultation Responses Relevant to Offshore Annex I Habitats

Comment	Applicants Response
Draft HRA Screening Report Comments, MMO (30/01/2023)	
The MMO have no comments to make in regards to the Stage 1 screening report at this moment. MMO defer to comments made by Natural England (NE) and Environment Agency (EA) as Lead Competent Authorities on matters related to nature conservation. MMO wish to be included on future HRA discussions/reports so that we can consider whether any subsequent proposed mitigation, which are to be secured in an eventual Deemed Marine Licence (DML) meet the requirements of the MMO Enforcement Team. This means they must be drafted in a way that meets the following 5 criteria: 1) The condition must be necessary. 2) The condition must relate to the activity or development for which a DCO is sought. 3) The condition must be enforceable. 4) The condition must be precise. 5) The condition must be reasonable.	Noted with thanks, the Applicants will ensure that MMO are included in all future HRA consultation and discussions.
Draft HRA Screening Report Comments, Natural England (20/02/2023)	
Natural England welcomes the opportunity to review the HRA screening report and provide feedback on it. Additional sites we feel should be screened in can be found below and our detailed comments are provided in Annex I.	Noted with thanks.
Internationally designated sites Natural England can confirm that the proposed works are located within Dogger Bank Special Area of Conservation (SAC), Southern North Sea SAC, the Greater Wash Special Protection Area (SPA) and Flamborough and Filey Coast SPA, all of which have been correctly screened into the HRA assessment. Natural England have reviewed the other adjacent (or within the zone of influence (ZOI)) sites scoped into the assessment and advise the following additional designated sites also have the potential to be impacted and should therefore be screened in	Noted with thanks.
Humber Estuary SAC Natural England advise that the Humber Estuary SAC is screened into the HRA assessment due to potential impacts on sediment transportation along the Holderness coast as a result of cable installation activities. The Annex 1 habitats of the Humber Estuary which could be impacted are: • Estuaries; • Mudflats and sandflats not covered by seawater at low tide; • Sandbanks which are slightly covered by seawater all the time; • Coastal lagoons; • Salicornia and other annuals colonising mud and sand Atlantic salt meadows (*Glauco Puccinellietalia maritimae*)	Potential effects on the Humber Estuary SAC are presented in section 6.6 of this report.

Comment	Applicants Response
At present, the Project is unable to provide any information on the likely requirements for external cable protection within the nearshore zone. External cable protection (and cable crossings) in shallow water depths could potentially alter nearshore sediment transport processes. The Project's landfall location at Skipsea is south of the longshore drift divide. Thus, longshore drift, combined with residual currents, drive the southwards movement of material along the coast to Spurn Head. In addition, tidal currents flow southwards during the flood tide (northwards with the ebb tide) leading to a net southwards residual current. Fine sediments eroded from the Holderness cliffs are transported into the Humber Estuary by flood tides and these finer sediments are considered to play an important role in the sediment budgets of the Humber Estuary and the Wash. As several Projects of material consideration are due to be making landfall along this coastline there is also potential for these impacts to act in-combination. We also do not have any details of potential installation of ancillary infrastructure in the nearshore such as cofferdams, HDD exit pits etc, which could also affect longshore sediment transport. Therefore, in line with advice provided to other projects in this area, we advise that The Humber Estuary SAC be screened into the assessment.	
Consideration of in-combination effects (Section 3.3.1) Natural England note that the Project has adopted a three tier approach to rank other projects in the in-combination assessment. We highlight that NE Best Practice Guidance published in 2022 advises the use of a seven tier approach (Section 11.1, Phase III Best Practice for Data Analysis and Presentation at Examination, March 2022) which we advise is used in this assessment moving forward. We note that for several thematic areas, insufficient information has been provided regarding the approach to in-combination assessment and the Projects to be included for us to meaningfully comment at this time.	The in-combination assessment methodology has been updated to reflect the most recent version of the Phase III Best Practice for Data Analysis and Presentation at Examination guidance.
Sites designated for Annex I Habitats (Section 4.1) Natural England have concerns that the 50km in-combination search area for benthic impacts is not appropriate in all instances. We consider the HRA should take into consideration other offshore wind projects, especially those that are to be located within the Dogger Bank SAC (we note that Dogger Bank C is currently not considered). Where multiple projects impact a designated site, Natural England advise the screening area should be increased to encompass all projects impacting the features to be assessed within that site. Natural England advise that the Eastern Green Link 2 (EGL2) interconnect cable making landfall just south of Bridlington should be included in the assessment of in-combination impacts on Annex I habitats of Flamborough Head SAC. This project has submitted its licence application and is awaiting a decision so should be considered Tier 4 according to the NE Best Practice Guidance. Natural England request further evidence is provided to support the use of a 10km ZOI for suspended sediment. It is noted that the Project has based this on evidence from other offshore wind EIAs (such as the nearby Sofia and Dogger Bank C) [paragraph 92]. However, Natural England are concerned that these two projects follow a different export cable route and that this figure might not be suitable for the nearshore area where Dogger Bank South makes landfall. We highlight that recently examined offshore wind farms (OWF) such as Hornsea 4 used buffer zones 'scaled to represent the equivalent distance of tidal excursion on a mean spring tide', whereby two different values are used for tidal excursion noting the differences between the array area and offshore export cable corridor (approx. 10km for the array area and 15km for export cable corridor based on nearshore flows). We suggest a similar approach is taken for the Dogger Bank South Projects.	All offshore wind farms under planning, under construction or in operation within the Dogger Bank SAC will be considered in the in-combination assessment. The Eastern Link 2 HVDC cable, in addition to the Third Eastern Link HVDC cable (TGDC) and Fourth Eastern Link HVDC cable (E4L5) will also be considered in the in-combination assessment. The Zone of Influence (ZoI) for suspended sediment has been updated to 8km based on site specific physical processes modelling undertaken for the Projects (see **Volume 7, Appendix 8-3 (application ref: 7.8.8.3)** that accompanies this report for further information).

Comment	Applicants Response
Final HRA Screening Report Comments, MMO (17/07/2023)	
Table 4-1 states that PAH contamination is screened out for the operational phase, however as there is a possibility of fluids entering the marine environment these should be considered. For example hydraulic fluids used on the OWF, even in a 'closed' system, where top up is required may have the potential to be released into the marine environment. Whilst the risk may indicate that it is low, because there is potential for these chemicals and pollutants (from use and discharge as a result of operation and maintenance activity) reaching the marine environment this should be scoped in.	Polyaromatic hydrocarbon (PAH) contamination during the operation and maintenance phase of the Projects has been screened in for assessment for the Dogger Bank SAC in section 6.4.2.4.1.
The MMO is content that the synthetic compound contaminants have been scoped out for operation and decommissioning but are scoped in as part of the assessment for operation and maintenance. However, the table also suggest that the effects of transition elements and organo-metals like tributyl tin contamination are not relevant to the Projects activities. Many inorganic chemicals may be used offshore e.g., for cementing drilling and cleaning purposes, it is unclear here why the effects of the potential release of these chemicals in the marine environment are not relevant and the MMO suggest they are scoped in for consideration.	Potential effects of synthetic compound contaminants (including pesticides, antifoulants, pharmaceuticals) have been screened in for assessment for the Dogger Bank SAC in section 6.4.2.7.1.
Table 4-1 (and Section 4.1) has screened out seabed surface disturbance and changes in water clarity as impacts during operations and maintenance. The MMO does not consider that either can be screened out without further justification. Wakes in the lee of OWF foundations are likely to maintain sediment suspension in the water column at levels above those experienced in the absence of the OWF. However, the same table does indicate the consideration of smothering, seabed type change and siltation rate changes during operations, which would appear to be related. You should clarify how changes to siltation and smothering occur without related changes to suspension and water clarity. Based on recent evidence (e.g., Forster, 2018; Schultze *et al*.,, 2020; Christiansen *et al*.,, 2023), vertical sediment distribution changes in subsurface wakes should be considered as an impact throughout the operations phase.	Seabed surface disturbance and changes in water clarity during the operation and maintenance phase of the Projects have been assessed within sections 6.4.2.1.1 and 6.4.2.2.1 respectively.
Although Paragraph 80 provides consideration of the release of fines on water quality, and Paragraph 81 considers release of hydrocarbons as a result of the construction activity, there is mention of the quality of the sediments and potential for release of other contaminants (e.g., heavy metals) from sediment at depth (e.g., the drill arisings), this should be included for completeness. The MMO notes the comments in Paragraph 87 regarding the potential of plastic pollution as a result of paint flakes and welcome the comments on this topic.	Potential effects of heavy metal contamination are assessed in section 6.4.2.4.1.
The document scoped out the inclusion of hydrocarbons during operation activities. This, as well as all chemicals used and or discharged that may come into to contact the marine environment – should be considered within the assessment for all stages of the OWF lifetime.	Potential effects of hydrocarbon contamination during all phases of the Projects lifespan are assessed in section 6.4.2.4.1.
Final HRA Screening Report Comments, Natural England (17/07/2023)	
Natural England disagrees with abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids, and penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion being screened out for the operations and maintenance phase. We advise that these impacts are screened in for assessment.	The effects of abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids, and penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion have been assessed across all phases of the Projects lifespan in section 6.4.2.1.

Comment	Applicants Response
Natural England disagree with the introduction or spread of INNS being screened out for the construction and decommissioning phases, as this is when vessel traffic and material introduction will be at its highest. We advise that INNS are screened in for all phases of the project.	Introduction or spread of invasive non-indigenous species (INIS) have been assessed across all phases of the Projects lifespan in section 6.4.2.5.1.
A ZOI of 10km has been used for sediment plumes based on evidence from the Teesside A&B EIA. NE advise that a tidal ellipse is used to estimate the zone of greatest influence for sediment plumes for the array area and export cable corridor. We understand that the Applicant intends to provide new, site-specific modelling which may address this point. We request that the new modelling is provided for review during the Evidence Plan Process.	The ZoI for suspended sediment has been updated to 8km based on site specific physical processes modelling undertaken for the Projects (see **Volume 7, Appendix 8-3 (application ref: 7.8.8.3)** that accompanies this application for further information).
Final HRA Screening Report Comments, Lincolnshire Wildlife Trust (17/07/2023)	
4. Cumulative Impacts on the Dogger Bank SAC While the Applicant outlines the need and methodology for a Cumulative Effects Assessment (CEA) in Chapter 6, Subsection 7.4., LWT would like to flag concern for the level of detail and consideration given to the CEA within the PEIR and so far throughout the pre-application process. Within the Planning Inspectorate's Advice Note Seventeen, Paragraph 2.1 clearly outlines that, '*The scale and nature of NSIPs will typically dictate a broad spatial and temporal zone of influence (ZOI)*'. Furthermore, Paragraph 2.2 states that, '*Stages 1-2 should be ideally undertaken early in the pre-application phase and ideally before requesting a Scoping Opinion. Applicants should make use of the EIA scoping process to provide information on the CEA and ensure that it is appropriate, focussed and proportionate.*' While LWT understands that Advice Note Seventeen does leave some contingency for open interpretation on appropriate CEA timelines, we nonetheless interpret the wording from Paragraphs 2.1 and 2.2 as impetus on developers to begin a broad CEA process early to ensure due diligence and best practice. Therefore, we are disappointed with the decision taken by the Applicant to wait until the later stages of the EIA and ES to appropriately conduct a CEA, as stated in Section 6.7.4.3, Paragraph 80: '*The available information regarding many other projects is continually changing as they move through the development process, for example, the Outer Dowsing PEIR (by Q2 2023), the decision on Hornsea Project Four (Q3 2023), and the Sheringham Shoal and Dudgeon Extension Projects examination (Q3 2023). The information that is made public from these and other relevant projects will alter the details presented in the CEA for the Projects. As such, a final CEA will be included in the later stages of the EIA and completed and reported on in the ES, when the main assessments of the DBS East and/or DBS West proposals have been undertaken and the extent to which other plans, programmes or projects might lead to cumulative effects can be fully considered.*'	Noted. A full Cumulative Effects Assessment with regard to the Dogger Bank SAC is included within section 6.4.2 of this report.

6.3 Assessment of Potential Effects

6.3.1 Embedded and Standard Mitigation Measures

4. **Table 6-2** outlines the embedded and standard mitigation measures incorporated into the design of the Projects relevant to the assessment for Annex I habitats.

Table 6-2 Embedded Mitigation Measures Relevant for Annex I Habitats

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Offshore Export Cable Corridor	The offshore cable corridor was selected in consultation with key stakeholders to select route options which minimised impacts on designated sites, such as minimising its length within the Dogger Bank Special Area of Conservation (SAC), avoiding permanent overlaps with the Annex I Smithic Bank sandbank, as well as avoiding overlaps with the Flamborough Head SAC. See **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)**.	DCO Schedule 1
Minimise use of scour and external cable protection	Following industry best-practice the Applicants will seek to minimise the use of scour protection and external cable protection for any stretches of unburied cables and cable crossings. This is presented in two Cable Burial Risk Assessments and secured in Cable Protection Plans, produced in line with the detail outlined in the **Cable Statement (application ref: 8.20)** that has been submitted with the DCO application, and which will be updated in accordance with conditions attached to the Deemed Marine Licences (DMLs) in the **Draft DCO (application ref: 3.1)**. In addition, the Applicants will seek to minimise the use of foundation scour protection. This is presented in the **Outline Scour Protection Plan (application ref: 8.27)** that has been submitted with the DCO application, and which will be updated in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1)**.	Scour Protection Plan Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Cable Burial Risk Assessment (CBRA)	Final Cable Burial Risk Assessments and Cable Protection Plans will be produced in line with the detail provided in the **Cable Statement (application ref: 8.20)** that has been submitted with the DCO application, and in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1)**. This will aid in determining where shallow areas of glacial till may be located within the Offshore Development Area. If required, the use of micro-siting is required to avoid any such features will be discussed and agreed with the MMO in consultation with Natural England post-consent.	DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11
Electromagnetic Fields (EMF)	The Applicants are committed to burying offshore export cables to 0.5-1.5m (depending on cable location) where practicable (subject to a cable burial risk assessment (see **Volume 8, Cable Statement (application ref: 8.20)**). This will increase the distance between the offshore export cables and the seabed surface, resulting in a lower field strength and area affected by EMF at the seabed surface (see **Volume 8, Cable Statement (application ref: 8.20)**).	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 – Condition 11
Employ biosecurity measures	The risk of spreading INNS will be reduced by employing biosecurity measures in accordance with the following requirements: • International Convention for the Prevention of Pollution from Ships (MARPOL); • The Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations 2022); and • The Environmental Damage (Prevention and Remediation (England) Regulations 2015.	Project Environmental Management Plan (PEMP) Marine Pollution Contingency Plan (MPCP) DML 1 &2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Cable and Scour Protection	Any offshore export cables associated with the Projects will be buried within the intertidal zone at landfall, and 350m seaward of Mean Low Water Springs (MLWS). No surface cable protection will be used within these areas. Cable protection will be limited to 10% of the cumulative length of all cables laid between 350m seaward of MLWS and the 10m depth contour as measured against the lowest astronomical tide before the commencement of construction. If cable or scour protection is to be derived from plastic materials then their use will be further assessed prior to construction.	Cable Statement Outline Scour Protection Plan DML 3 & 4 - Condition 3
Cable bundling	Offshore Export Cables from DBS East and DBS West will be respectively bundled together in individual trenches comprising one trench per Project.	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 – Condition 13 DML 5 - Condition 11
Pollution Prevention Measures	Due to the presence and movements of construction and operation and maintenance vessels / equipment there is the potential for spills and leaks which could result in changes to water quality. All vessels involved will be required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. The production of one or more Project Environmental Management Plans (PEMPs) is a Condition of the five Deemed Marine Licences (DMLs). The final PEMP(s) would be in accordance with the **Outline PEMP (application ref: 8.21)** and would detail all procedures and measures (in the form of a Marine Pollution	PEMP MPCP DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
	Contingency Plan (MPCP)) to be followed during the different phases of the Projects to minimise the risk of, and effects in, the event of an accidental spill. The final PEMP will identify all potential sources and types of accidental pollution for the relevant project phase and set out the proposed mitigation measures and will be developed in consultation with key stakeholders for approval by the MMO. The individual Projects and phases may require separate final PEMP(s). In addition separate PEMPs may also be produced for individual packages.	
Sediment Removal	Any sediment removed from within the Dogger Bank Special Area of Conservation during construction of the authorised scheme must be disposed of within that part of the Dogger Bank Special Area of Conservation which falls within the Order limits.	DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11
Dredging	Detail relating to sand wave levelling, deposition and sandbank recovery will be provided in the form of a plan provided as an Appendix to the Final Cable Statement(s) should sand wave levelling be required as part of the Projects Dredging will be minimised where possible. Dredged material will be disposed of on like sediments for both withing and beyond the boundary of the Dogger Bank Special Area of Conservation.	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 – Condition 11
Sandwave Crossing	Where sandwaves need to be crossed, they will be crossed where conditions allow, at an angle as close to 90 degrees as possible to minimise dredge volumes. Cable installation will occur as soon as is reasonably practicable after sandwave levelling to reduce the need for additional preparation work and minimise disturbance timeframes	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 – Condition 11

5. Although not considered mitigation, the following commitments have been made by the Applicants in line with the conclusions of The Crown Estate's Round 4 Plan Level HRA (The Crown Estate, 2022):

- The use of gravity base structures and suction caisson monopile foundations have been removed as foundation options within the boundary of the Dogger Bank SAC.
- A maximum 10% of cable length within the Dogger Bank SAC may use remedial protection measures.

6.3.2 Worst Case Scenario

6. The Projects final design will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects that may arise. These are presented in **Table 6-3**.

6.3.2.1 Worst Case Scenario Updates

7. In January 2025, the Applicants submitted the **Project Change Request 1 - Offshore & Intertidal Works** [AS-141] into Examination, which had previously been issued for consultation with stakeholders in November – December 2024. This document presented the following proposed changes to the Projects' design envelope:

- Change 1: Removal of Gravity Based Structure (GBS) foundations;
- Change 2: Removal of Electrical Switching Platform (ESP) from the Projects' Design Envelope;
- Change 3: Reduction in number of offshore platforms in the Projects' Design Envelope, from eight to three within the Array Areas, including reductions of associated seabed preparation and scour protection;
- Change 4: Reduction of cabling within the Array Areas, plus associated seabed preparation and cable protection; and
- Change 5: Removal of the short trenchless crossing at landfall.

8. Following submission of **Project Change Request 1 - Offshore & Intertidal Works** [AS-141] in January 2025, the proposed changes were subsequently accepted into Examination by the Examining Authority (ExA) in the **Rule 9 and 17 letter - Procedural Decision and Request for further information dated 21 January 2025** [PD-012].

9. In addition, following comments received from Natural England in their Relevant Representations (see RR-039: C23 of **Response to Natural England's Relevant Representations (including Appendices A - F, and I)** [AS-048] the Applicants committed to the bundling of Offshore Export Cables in pairs, reducing the number of Offshore Export Cable trenches to one per Project. This commitment was later included within the **Cable Statement (Revision 4)** [document reference: 8.20], which is itself secured within in the **Draft Development Consent Order (DCO) (Revision 7)** [document reference: 3.1] under Condition 15 of Deemed Marine Licences (DMLs) 1 and 2, Condition 13 of DMLs 3 and 4 and Condition 11 of DML 5.

10. As a result of the changes and commitments detailed above, the worst-case design parameters relevant to the assessment of Annex I habitats have been significantly reduced from those included in the original revision of this assessment. **Table 6-3** has been updated to reflect these updated parameters.

Table 6-3 Worst-Case Scenario for Annex I Habitats Assessment

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Construction **In the instance of sequential development of the two Projects, up to a two-year lag between construction activities is possible, final overall area would be identical to the concurrent design scenario.**				
Abrasion/disturbance of the substrate on the surface of the seabed **Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion** **Habitat structure changes – removal of substratum (extraction)** **Physical change (to another seabed or sediment type)**	**Total area of disturbance within Dogger Bank SAC – 11,8120,141m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 8,392,500m²** Array cable trench area (350,000m x 20m boulder plough width) – 7,000,000m² Inter-platform cable trench area (23,000m x 20m disturbance width) – 460,000m² Maximum seabed area disturbed by sandwave levelling – 932,500m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,278,583m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for two offshore platforms (monopile foundations), including scour protection – 12,445m² Area of seabed contact for vessel jack-up assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 100 small turbines) - 660,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m² combined leg area x five operations per	**Total area of disturbance within Dogger Bank SAC – 10,600,677m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 8,392,500m²** Array cable trench area (350,000m x 20m boulder plough width) – 7,000,000m² Inter-platform cable trench area (23,000m x 20m disturbance width) – 460,000m² Maximum seabed area disturbed by sandwave levelling – 932,500m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,278,583m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for two offshore platforms (monopile foundations), including scour protection – 12,445m² Area of seabed contact for vessel jack-up – assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 100 small turbines) – 660,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m² combined	**Total area of disturbance within Dogger Bank SAC – 25,018,524m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 19,372,500m²** Array cable trench area (700,000m x 20m boulder plough width) – 14,000,000m² Inter-platform cable trench area (161,000m x 20m disturbance width) – 3,220,000m² Maximum seabed area disturbed by sandwave levelling – 2,152,500m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 2,543,094m²** Seabed preparation area for 200 small turbine monopile foundations (including scour protection) – 716,966m² Seabed preparation area for three offshore platforms (monopile foundations), including scour protection – 18,668m² Area of seabed contact for vessel jack-up vessel jack-up assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 200 small turbines) – 1,320,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m² combined leg area x five operations per	Total area of disturbance includes array cable, inter-platform cable and offshore export cable trenching, sandwave levelling, foundation installation and vessel jack-up and anchoring impacts, Figure totals include a mix of large and small turbine parameters to represent an absolute worst-case situation. As such covers for a scenario where a mix of small and large turbines are utilised in the build-out of the Projects. Pre-lay grapnel run (PLGR) activities will fall within the area of the cable trench disturbance width of 20m. In situations where a number does not divide into an integer between DBS East and DBS West (e.g.113 large turbines), the numbers presented in this table have been rounded up to higher number (e.g. 57 large turbines as opposed to 56.5). Anchoring events assumes four activities per turbine

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	platform x two offshore platforms) – 11,000m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + two offshore platforms) – 236,640m² <u>Offshore Export Cable Corridor</u> **Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 2,148,238m²** Maximum number of cables required – Two Total offshore cable length of bundled cables within the Dogger Bank SAC – 40.7km Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 814,000m² (based on 40,700m distance x 20m width of temporary disturbance) Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 1,329,462m² Maximum estimated area impacted by anchoring – 4,776m² <u>UXO Clearance Activities</u> Worst case number of UXO requiring clearance – 41 Worst-case crater area – 20m² Total footprint of UXO clearance activities – 820m²	leg area x five operations per platform x two offshore platforms) – 11,000m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + two offshore platforms) – 236,640m² <u>Offshore Export Cable Corridor</u> **Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 928,774m²** Maximum number of cables required – Two Total offshore cable length of bundled cables within the Dogger Bank SAC – 16.72km Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 334,400m² (based on 16,720m distance x 20m width of temporary disturbance) Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 591,966m² Maximum estimated total impacted by anchoring – 2,408m² <u>UXO Clearance Activities</u> Worst case number of UXO requiring clearance – 41 Worst-case crater area – 20m² Total footprint of UXO clearance activities – 820m²	platform x three offshore platforms) – 16,500m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 200 small turbines + three offshore platforms) – 470,960m² <u>Offshore Export Cable Corridor</u> **Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 3,102,110m²** Maximum number of cables required – Four Total offshore cable length of bundled cables within Dogger Bank SAC – 40.7km for DBS East, 16.72km for DBS West Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 1,148,400m² (based on 57,420m distance x 20m width of temporary disturbance) Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 1,946,205m² Maximum estimated area impacted by anchoring – 7,505m² <u>UXO Clearance Activities</u> Worst case number of UXO requiring clearance – 41 Worst-case crater area – 20m² Total footprint of UXO clearance activities – 820m²	foundation installation + one activity for topside installation per turbine. In some instances the projects in sequence / concurrently are not double those of the projects in isolation. For example, there is only ever one accommodation platform under any design scenario. To ensure the WCS has been assessed, however, such platforms are accounted for in each possible scenario. Final totals are based on the unrounded figures of the above parameters. As such there is a small variation in the total figures stated in the table compared to the figure reached when adding the rounded figures of each parameter. Offshore export cables will be bundled together in pairs, resulting in a maximum of one cable trench per Project in isolation or two cable trenches for both Projects built concurrently and / or in sequence. Sandwaves were divided into three categories: small bedforms (maximum height <0.4m); medium bedforms (maximum height <0.4m to 0.75m); and large or very

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
				large bedforms (maximum height 5m), as per the Ashley (1990) bedform classification. The total sandwave levelling volumes were calculated by estimating the profile area of a trenched sandwave (separately for small, medium and large or very large) and multiplying this figure by the estimated worst-case length of each export cable route where bedforms of each classification may be encountered. The separate figures for small, medium and large or very large bedforms were then added together and multiplied by the maximum number of offshore export cables for that particular scenario to give the final estimated volume of sediment disturbed by sandwave levelling activities.
Changes in suspended solids (water clarity) **Smothering and siltation rate changes (Light and Heavy)**	**Total displaced sediment within Dogger Bank SAC – 6,640,604m³** **Total displaced sediment by array and inter-platform cable installation – 2,684,663m³** Array cable – 2,100,000m³ (350,000m length x 6m width x 1m depth) Inter-Platform Cables – 207,000m³ (23,000m length x 6m width x 1.5m depth)	**Total displaced sediment within Dogger Bank SAC – 4,470,651m³** **Total displaced sediment by array and inter-platform cable installation – 2,684,663m³** Array cable – 2,100,000m³ (350,000m length x 6m width x 1m depth) Inter-Platform Cables – 207,000m³ (23,000m length x 6m width x 1.5m depth)	**Total displaced sediment within Dogger Bank SAC – 12,361,460m³** **Total displaced sediment by array and inter-platform cable installation – 6,520,763m³** Array cable – 4,200,000m³ (700,000m length x 6m width x 1m depth) Inter-Platform Cables – 1,449,000m³ (161,000m length x 6m width x 1.5m depth)	Maximum burial depth for array and inter-platform cables is 1m. Maximum burial depth for offshore export cables is 1.5m. These depths has been assumed across the entire length of the each cable type to determine the worst-case volume of sediment disturbed.

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination **Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)** **Transition elements & organo-metal (e.g. TBT) contamination**	Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 377,663m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 3,921,559m³** Export cable – 336,300m³ (40,700m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 3,585,259m³ **Maximum volume of drill arisings (57 turbines) – 34,382m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 377,663m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 1,751,606m³** Export cable – 150,480m³ (16,720m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 1,601,126m³ **Maximum volume of drill arisings (57 turbines) – 34,382m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 871,763m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 5,772,537m³** Export cable – 516,780m³ (57,420m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 5,255,757m³ **Maximum volume of drill arisings (113 turbines) – 68,160m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	6m disturbance width based on worst-case pre-lay ploughing width
Introduction or spread of invasive non-indigenous species (INIS)	Up to 80 construction vessels within the Dogger Bank SAC simultaneously and up to 3,857 round trips to port.	Up to 80 construction vessels within the Dogger Bank SAC simultaneously and up to 3,857 round trips to port.	Up to 134 construction vessels within the Dogger Bank SAC simultaneously and up to 7,510 round trips to port.	
Operation				
Abrasion/disturbance of the substrate on the	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan)	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan)	**Array Areas and Inter-Platform Cable Corridor**	N/A

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
surface of the seabed	Area of seabed disturbance from array cable repairs over Projects lifetime – **54,000m²** (Nine events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **12,000m²** (Two events x 6,000m² per event) **Offshore Export Cable Corridor** Area of export cable repairs - seabed disturbance over Projects lifetime – **18,000m²** (Three events x 6,000m² per event)	Area of seabed disturbance from array cable repairs over Projects lifetime – **54,000m²** Nine events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **12,000m²** (Two events x 6,000m² per event) **Offshore Export Cable Corridor** Area of export cable repairs - seabed disturbance over Projects lifetime – **18,000m²** (Three events x 6,000m² per event)	Area of seabed disturbance from jacking-up activities over Projects lifetime – **613,800m²** (20,460m² per year x 30 year lifespan) Area of seabed disturbance from array cable repairs over Projects lifetime – **102,000m²** (17 events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **36,000m²** (Six events x 6,000m² per event) **Offshore Export Cable Corridor** Area of export cable repairs - seabed disturbance over Projects lifetime – **36,000m²** (Six events x 6,000m² per event)	
Changes in suspended solids (water clarity) **Smothering and siltation rate changes (Light and Heavy)** **Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contaminatio n** **Synthetic compound contaminant (including pesticides, antifoulants,**	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 1,666,500m³** Volume of displaced sediment from array cable repairs over Projects lifetime – 108,000m³ (Nine events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 24,000m³ (Two events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 1,534,500m³ (51,150m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 36,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime –	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 1,666,500m³** Volume of displaced sediment from array cable repairs r Projects lifetime – 108,000m³ (Nine events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 24,000m³ (Two events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 1,534,500m³ (51,150m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 36,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime – 36,000m³ (Three events x 12,000m² per event)	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 3,345,000m³** Volume of displaced sediment from array cable repairs over Projects lifetime – 204,000m³ (17 events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 72,000m³ (Six events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 3,069,000m³ (102,300m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 72,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime – 72,000m³ (Six events x 12,000m² per event)	Jack-up vessel footprint assumes a maximum penetration depth of 5m Cable repairs assume a maximum depth of 2m. The cable is buried 0.5-1.5 but repairs also account for potential additional mobile sand coverage.

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
pharmaceuticals) **Transition elements & organo-metal (e.g. TBT) contamination**	36,000m³ (Three events x 12,000m² per event)			
Physical change (to another seabed or sediment type)	**Total area of habitat loss within the Dogger Bank SAC from Array Area and Offshore Export Cable Corridor footprints combined – ~~809,495~~711,083m²** **Array Area** **Total area of habitat loss within the Dogger Bank SAC in relation to the Array Area (foundations, scour protection, cable protection and cable crossings) – ~~741,535~~624,835m²** Total worst case turbine foundation area, including scour protection – 311,725m² (100 small turbines x 3,117m² total area per turbine) Total worst case offshore platforms foundation area, including scour protection– 10,822m² (2 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – ~~363,788~~247,088m² (~~326,70~~210,0000m² array cable protection + 37,088m² inter-platform cable protection)	**Total area of habitat loss within the Dogger Bank SAC from Array Area and Offshore Export Cable Corridor footprints combined – ~~766,949~~662,441m²** **Array Area** **Total area of habitat loss within the Array Area (foundations, scour protection, cable protection and cable crossings) – ~~741,535~~624,835m²** Total worst case turbine foundation area, including scour protection - 311,725m² (100 small turbines x 3,117m² total area per turbine) Total worst case offshore platforms foundation area, including scour protection– 10,822m² (2 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – ~~362,625~~247,088m² (~~326,700~~210,000m² array cable protection + 37,088m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 21	**Total area of habitat loss within the Dogger Bank SAC from Array Areas and Offshore Export Cable Corridor footprints combined – 1,~~815,352~~606,336m²** **Array Areas and Inter Platform Cable Corridor** **Total area of habitat loss within the Array Areas and Inter Platform Cable Corridor (foundations, scour protection, cable protection and cable crossings) – 1,~~715,882~~482,482m²** Total worst case turbine foundation area, including scour protection – 623,449m² (200 small turbines x 3,117m² total area per turbine) Total worst case offshore platforms foundation area, including scour protection – 16,233m² (3 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – ~~901,160~~667,760m² (420,000m² array cable protection +	Offshore Export Cable Corridor trench length within DBS East – 40,700m Offshore Export Cable Corridor trench length within DBS West – 16,720m Indicative worst-case width of Offshore Export Cable protection measures – 15.2m Maximum 10% length of Offshore Export Cable permitted to utilise cable protection measures within the Dogger Bank SAC.

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	Estimated number of array/inter-platform cable pipeline/cable crossings - 21 Total area of pipeline / cable crossing material (array + inter–platform cables) – 55,200m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – ~~67,960~~86,248m²** Total area of export cable protection – 61,864m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - ~~1~~4 Total area of pipeline / cable crossing material – ~~6,096~~24,384m²	Total area of pipeline / cable crossing material (array + inter–platform cables) –55,200m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – ~~25,414~~37,606m²** Total area of export cable protection – 25,414m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings ~~-~~– ~~0~~2 Total area of pipeline / cable crossing material – 12,192m²	247,760m² inter-platform cable protection~~87,278m²~~) Estimated number of array/inter-platform cable pipeline/cable crossings - 53 Total area of pipeline / cable crossing material (array + inter–platform cables) – 175,040m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – ~~99,470~~123,854m²** Total area of export cable protection – 87,278m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - ~~2~~6 Total area of pipeline / cable crossing material – ~~12,192~~36,576m²	
Electromagnetic Changes	Minimum target burial depth – **0.5m** *Note - In exceptional circumstances, there may be lengths of cable where it will not be possible to achieve the minimum target burial depth.* N/A			
Introduction or spread of invasive non-indigenous species (INIS)	**Vessels** Maximum number of operation & maintenance (O&M) vessels on site at any one time – **20** (See long-term habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **20** (See long-term habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **21** (See long-term habitat loss row for infrastructure that could be colonised)	The risk of introducing INNS during construction is primarily related to vessel activities should vessels come from other marine bioregions. Based on simultaneous presence of jack-up vessels, service operations vessels, accommodation vessels, small CTV vessels, lift vessels, cable maintenance vessels and auxiliary vessels.

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Decommissioning				
No final decision regarding the final decommissioning policy for the offshore project infrastructure including landfall, has yet been made. It is also recognised that legislation and industry best practice change over time. It is likely that offshore project infrastructure will be removed above the seabed and reused or recycled where practicable. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase. A decommissioning plan for the offshore works would be submitted prior to any decommissioning commencing.				

6.4 Dogger Bank SAC

6.4.1 Site Description

11. This section relates to Annex I habitats designated for the Dogger Bank SAC. The Dogger Bank is an extensive sublittoral sandbank in the southern North Sea formed by glacial processes and submergence through sea-level rise. A large part of the southern area of the bank is covered by water seldom deeper than 20m below chart datum (JNCC, 2024).

12. Characteristic communities of the SAC are not explicitly defined by JNCC (2022). However, key macrofaunal communities and fish have been identified. In terms of macrofaunal communities, evidence from surveys in 2008 and 2014 (Diesing *et al.*,, 2009; Eggleton *et al.*,, 2017) supported the existence of the four related biological communities previously identified by Wieking and Kröncke (2003):

- the "*Bank*" community was the predominant one and straddled across the bank from north to southeast. It is characterised by a *Bathyporeia-Tellina* community of amphipods and small clams;
- the "*North-Eastern*" community had lower densities but the highest number of species. The tube-inhabiting velvet anemone *Cerianthus lloydii* and the small sea urchin *Echinocyamus pusillus* occured at high densities in the shallower part. The brittlestar *Amphiura filiformis*, the clam *Abra prismatica* and the polychaete *Scoloplos armiger* were more common in the deeper part;
- the "*South-West Patch*" community was a sub-group of the Bank community in the shallow western side. The amphipod *Bathyporeia elegans* is the most abundant species with the clam *Donax vittatus* and the polychaete *Nephtys cirrosa* at their highest abundances in this sub-area of the Bank community; and
- the "*Southern Amphiura*" community in the deeper southern part of the bank. The polychaete *Spiophanes bombyx* was abundant, but here the brittlestar *Amphiura filiformis* and its commensal bivalve *Kurtiella bidentata* dominated in numbers.

13. Sandeel are included in the characteristic communities discussion by JNCC (2022). Further information on the presence of sandeel within the SAC is presented in **Volume 6, Appendix B (application ref: 6.1.2)**. Sandeel are also considered in relation to the function of the sandbank feature through provision of nutrition to predator species (see Section 6.4.1.2.3).

6.4.1.1 Qualifying Features

14. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time.

6.4.1.2 Conservation Objectives

15. The conservation objectives set for the designated sandbank feature and sub-features of Dogger Bank are (JNCC, 2022a):

16. For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by seawater all the time. This contribution would be achieved by maintaining or restoring, subject to natural change:

- The extent and distribution of the qualifying habitat in the site;
- The structure and function of the qualifying habitat in the site; and
- The supporting processes on which the qualifying habitat relies.

6.4.1.3 Condition Assessment

17. In the most recent condition assessment of the Dogger Bank SAC, it was determined that the Annex I sandbank feature is currently in unfavourable condition (JNCC, 2022c), with a restore objective being advised for two of the above conservation objective attributes:

- The extent and distribution of the qualifying habitat in the site; and
- The structure and function of the qualifying habitat in the site.

6.4.1.1.3 Extent, distribution and structure

18. With regard to physical change (to another seabed/sediment type, the restore objective for 'Attribute: Extent and Distribution' in the Supplementary Advice on Conservation Objectives (SACO) for Dogger Bank Special Area of Conservation (JNCC, 2022c) states that:

"*JNCC understands that the site continues to be subjected to activities that have resulted in a change to the extent and distribution of the feature within the site, noting bottom trawling no longer occurs within the site. Installation and/or removal of infrastructure will have a continuing effect on extent and distribution. As such, JNCC continues to advise a restore objective which is based on expert judgement; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. offshore wind farms, cabling and oil and gas industry activities….*

…These industries [offshore wind farms, cabling and oil and gas industry] have placed infrastructure i.e. gas platforms, pipelines, wind turbines, cables and protective materials (e.g. rock dump and mattresses), in or on the seabed throughout the site; although it is not possible to quantify the amount of material introduced….

…Whilst JNCC does not consider it likely that the human activities taking place within the site have the potential to permanently impact on the large-scale topography of the sandbank feature, JNCC continues to advise that the ***extent of the sandbank feature in terms of its sedimentary composition and biological assemblages*** *has been reduced and it continues to be reduced by ongoing activities; albeit by an unquantifiable amount.*"

19. The restore objective for 'Attribute: Structure and Function' (JNCC, 2022c) states that:

"*JNCC understands that the site continues to be subjected to some activities that have resulted in a change to the finer topography, sediment composition and distribution, and characteristic communities of the feature within the site, noting bottom trawling no longer occurs within the site….As such, JNCC continues to advise a restore objective, which is based on expert judgement; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. offshore wind farms, cabling and oil and gas industry activities.*"

20. JNCC (2022) states that with regard to the physical structure the restore objectives relates to **finer scale topography** and **sediment composition and distribution**. With regard to biological structure the restore objective relates to the **key and influential species** and **characteristic communities** present.

21. JNCC note that it is not possible to quantify the amount of material introduced (and does not quantify the extent of historic fishing activity) and therefore by extension it is also not possible from the above statements to understand at what magnitude/footprint the effects on Extent and Distribution and Structure and Function led to unfavourable condition. However, referring to the original draft conservation objectives for the candidate SAC (JNCC, 2012 cited in DECC, 2015) the sandbank feature was already considered to be in unfavourable condition (i.e. before any offshore wind farms were consented).

22. Although the SACO (JNCC, 2022c) states that it is not possible to quantify the spatial effects on the Dogger Bank SAC, it is important to understand what these are in order to undertake any form of assessment. In order to understand the likely quantum of effect which has led to the unfavourable condition, there are some estimates available.

23. BEIS (2019) state that should all four consented offshore wind farms within the Dogger Bank SAC (Dogger Bank A, B and C and Sofia (formerly Creyke Beck A and B and Teesside A and B)) be constructed an estimated 3.0km^2 of seabed may be physically lost to the presence of infrastructure. A further 15km^2 is estimated for cabling, totalling 18km^2 of habitat loss for these projects. The Applicants own calculations (based on consented parameters and publicly available information on final designs) are that 11.71km^2 of habitat loss was consented, with the final refined designs estimated to result in 5.71km^2 of habitat loss[1]. BEIS (2019) estimated that other infrastructure (cables and oil and gas infrastructure) accounted for approximately 1.7km^2 of habitat loss. In total, the habitat loss based on the BEIS estimates, equates to 0.16% of the area of the SAC. Using the Applicants revised figures the habitat loss would be 7.41km^2, approximately 0.06% of the area of the SAC.

24. By comparison, fisheries impacts were considered to have affected 8,700km^2 of the SAC (70.5% of the SAC) based upon VMS data from 2016 alone (BEIS, 2019). The area of this impact is three orders of magnitude greater than that of habitat loss. This is not a permanent effect, although some areas would have been subject to repeated disturbance akin to a permanent effect.

[1] This demonstrates the 'headroom' between the worst case consented footprint and the actual build-out scenario, in other words a reduction in effect since consent

25. At the time of the Round 3 Dogger Bank consents the Secretary of State (DECC, 2015) ruled out an adverse effect on site integrity from those projects, in spite of the unfavourable condition, because habitat loss would not be permanent provided there was comprehensive decommissioning in the future. This was effectively a position that the operational phase of the wind farm could be considered as a temporary impact. However, more recent precedent is available from the decision for Hornsea Three (BEIS, 2020) where the Secretary of State concluded that "*cable protection measures are likely to impede the restoration of the Annex 1 habitats for the duration that they are in place*". It can therefore be inferred that although a negligible area of the SAC (a worst case of 0.16% based on BEIS (2019)) is affected by (existing and consented) habitat loss, a different conclusion on AEoI for the Round 3 projects may be made if that decision was made now.

26. It is worth noting that although the SACO (JNCC, 2022c) refers to impacts from offshore wind, the SACO was published (December 2022) at a time when no offshore wind farms were operational, with construction within the SAC only having started on Dogger Bank A (formerly Dogger Bank Creyke Beck A) that year. Piling at Dogger Bank A was completed in September 2023. Sofia (formerly Dogger Bank Teesside A) commenced works within the SAC in 2023. In April 2024, installation of the Dogger Bank B offshore substation took place (OffshoreWIND.Biz, 2024b), with installation of the Dogger Bank C offshore export cable commencing also commencing in April 2024 (OffshoreWIND.Biz, 2024a).

27. The Dogger Bank SAC (Specified Area) Bottom Towed Fishing Gear Byelaw 2022 came into force on the 13th June 2022 and was enacted to protect the entirety of the Dogger Bank SAC from the impacts of bottom-towed fishing gear. Therefore, impacts from fishing will be significantly reduced as long as the byelaw remains in place. In addition, in January 2024 Defra announced that the UK government had decided to prohibit the fishing of sandeels within English waters of ICES Area 4 (North Sea) effective from March 2024 (Defra, 2024). This includes the Dogger Bank SAC. Therefore, since 2022, there will have been recovery from bottom-towed fisheries effects on the Dogger Bank SAC.

6.4.1.2.3 Function

28. The SACO (JNCC, 2002) list three ecosystem services which "*may be provided by the sandbank feature*";

- Nutrition – the site provides a feeding ground where prey is made available for a variety of species of commercial importance.

- Bird and whale watching – the site provides some supporting function provision for wider marine bird and mammal populations.
- Climate regulation – the range of sedimentary habitats and associated communities in the site perform ecological processes common to sandbanks such as deposition and burial of carbon in seabed sediments through bioturbation, living biomass and calcification of benthic organisms

29. The SACO goes on to state that:

"*…there is evidence to indicate that the biological communities within the site would continue to be impacted by activities associated with the oil and gas industry, cabling and historic bottom trawling and historic aggregate dredging. Effects from historic activities, including aggregates and bottom-trawling, may continue to impact the carbon storage function of Dogger Bank through their disturbances to subsurface peat (Diesing et al., 2009). The significance of any impact on the health of the sandbank feature and/or its provision of ecosystem services to the wider marine environment is unclear, but it is likely impacted.*

***A restore objective continues to be advised for function within the site based on impacts to the characterising communities** and peat deposits from ongoing and historical activities i.e., wind farm, demersal fishing, aggregates, cabling and oil and gas industry activities.*"

30. In terms of practical advice, the SACO (JNCC, 2022) states that:

"*Activities must look to minimise, as far as is practicable, disturbance and changes to the biological communities and the abiotic component of the Dogger Bank to conserve the functions that it provides to the wider marine environment.*"

31. The Applicants note that although peat deposits are discussed in the SACO (JNCC, 2022) in relation to climate regulation, such deposits are geological, not ecological, features and do not feature within the SAC selection documentation (JNCC, 2011). Geology underlying sandbanks is not considered within the Interpretation Manual of European Union Habitats (EC, 2013).

32. As noted above, the cessation of bottom-towed fishing within the SAC since 2022 should lead to recovery.

6.4.2 Assessment

33. **Table 6-4** below lists the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects screened into the assessment. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022). Note that in the assessment effects have been grouped where relevant and assessed together to avoid repetition. Any operational and decommissioning impacts, where not explicitly mentioned, are at worst the same as impacts during the construction phase. Therefore where no AEOI is determined for construction impacts, the same is assessed for operation and decommissioning.

Table 6-4 Potential effects identified for the Dogger Bank SAC (screened in (✓) and screened out(×)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Abrasion / disturbance of the substrate on the surface of the seabed	✓	✓	✓
Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion	✓	✓	✓
Habitat structure changes – removal of substratum (extraction)	✓	×	×
Changes in suspended solids (water clarity)	✓	✓	✓
Smothering and siltation rate changes (Heavy)	✓	✓	✓
Smothering and siltation rate changes (Light)	✓	✓	✓
Electromagnetic changes	×	✓	×
Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination	✓	✓	✓

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Physical change (to another seabed type)	✓	✓	✓
Physical change (to another sediment type)	✓	✓	✓
Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)	×	✓	×
Transition elements & organo-metal (e.g. TBT) contamination	✓	✓	✓

6.4.2.1 Assessment of potential effects of the Projects alone

34. Any effects relating to the Projects activities within the Offshore Development Area that overlap with the Dogger Bank SAC occur within the Annex I sandbank habitat for which the SAC is designated. As such, there exists limited differences in footprint within the SAC for DBS East or DBS West in isolation (as detailed in section 6.3.2), with impacts for each effect being broadly similar across both Projects. Therefore, to reduce repetition, only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

35. Note that this assessment has been updated to incorporate the changes in the worst case scenario and responses to stakeholder representations during the Examination phase.

6.4.2.1.1 Abrasion/disturbance of the substrate on the surface of the seabed / Penetration and/or disturbance of the substratum below the surface of the seabed / Habitat structure changes – removal of substratum (extraction)

36. Construction, operation and maintenance and decommissioning activities will result in abrasion / disturbance of the substrate on the surface of the seabed / penetration and / or disturbance of the substratum below the surface of the seabed. In addition, dredging or sandwave clearance could result in habitat structure changes – removal of substratum (extraction). These effects are considered together as 'abrasion/disturbance of the seabed'.

37. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, the biotopes found within the Projects Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are characteristic of highly disturbed environments, and typically have medium to high recoverability and will recover rapidly from disturbance[2]. The biotopes are all stated to have high (full recovery within two years) or medium (full recovery within 2 – 10 years) recovery rates, using the MarESA sensitivity criteria as presented in Annex A of Appendix C - Review of evidence on recovery of sandbank habitat following habitat damage[3] to this report. The only exception is the 'piddock' biotopes associated with a small area of DBS East.

38. For the most common biotope within the Array Areas (MB5233 *Nephtys cirrosa* and *Bathyporeia* spp. in Atlantic infralittoral sand), MarESA states (emphasis added):

> *As a consequence of the dynamic nature of the habitat the faunal component of the biotope is very sparse and low in species richness. Therefore, the community might be considered 'mature' only a few days or weeks after the last storm event, as the mobile species displaced from the biotope and those from adjacent area colonize the substratum via the surf plankton.* ***Even following severe disturbances recovery would be expected to occur within a year****; biotope resilience is therefore assessed as 'High' for any level of impact*

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[2] All conclusions on sensitivity within this assessment are based upon the evidence within the Marine Evidence based Sensitivity Assessment (MarESA) (MarLIN, 2021).

[3] Previously submitted into Examination as **Review of evidence on recovery of sandbank habitat following habitat damage (Revision 2)** [REP3-021]

39. **Volume 6, Appendix B (application ref: 6.1.2)** presents information on the presence of sandeel within the SAC. The presence of sandeels, and consequently characteristic predator species, show that the Dogger Bank supports species of wider importance across the North Sea and is an important area for connectively across the MPA network (JNCC, 2022). Other fish species, such as cod, plaice, dab, sole are important to Dogger Bank as discussed in the SACO (JNCC, 2022), although sandeel are described as being 'more resident'. **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, considers fish in relation to the Fish and Shellfish study are and concludes that the area affected by the Projects is limited when compared to wider seabed available across the North Sea.

40. The Array Areas are of medium to high habitat potential for sandeel (see **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** for habitat modelling methodology and discussion) and sandeel were observed at 26 out of 104 stations investigated, with sightings largely falling within the area of high habitat potential identified within the DBS West Array Area. **Volume 6, Appendix B (application ref: 6.1.2)** shows that the Array Areas cover 5.7% of the medium to high potential habitat for sandeel of the SAC. Historically, sandeel fishing grounds overlapped the sites. A byelaw has been place since 2022 and bottom trawling has been banned in Dogger Bank SAC. In addition, from April 2024 there will be a permanent ban on sandeel fishing in the English North Sea.

41. 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 (see **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**).

42. The worst case for footprint activities that may result in abrasion / disturbance of the seabed will be during construction and are estimated to impact approximately 25km² within DBS East and DBS West combined, representing 0.2% of the area of the Dogger Bank SAC and 0.2% of the medium to high potential habitat for sandeel of the SAC. This disturbance would be episodic, associated with discrete locations across the Offshore Development Area at any one time and occur over the five-year duration of construction (assuming a worst case of concurrent construction), not as a single event. Although there is potential for repeated disturbance for the vast majority of locations across the Offshore Development Area there will only be a single disturbance event during construction. In the case of cables for example, once the cable is installed physical recovery will commence at that location. There is no need for repeat disturbance at that location unless remedial work is required, either during construction or for the operational lifetime. Likewise for turbine foundations whilst the initial disturbance footprint is large (especially if seabed preparation is required) subsequent construction disturbance is limited to the jack-up / anchoring footprint in the worst case (and if dynamic positioning for installation vessels is possible this would not impact the seabed). Sediments would settle rapidly, the majority in close proximity to the disturbance (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8))** so there would be limited indirect effect outwith the activity footprint.

43. RPS (2019) reviews monitoring data from numerous offshore wind farms in UK waters (e.g. Barrow, Burbo Bank, Sheringham Shoal and Robin Rigg) and collates information on how the seabed has recovered from various different impacts in various different marine conditions. The report demonstrates that areas with sandy seabed types usually recover rapidly and in full following seabed levelling and trenching. Where evidence of sandwave levelling or cable trenching does remain following cable installation this occurs in areas with higher fine sediment content (muds and silts). RPS (2019) also demonstrates that where recovery has not occurred completely in sandy habitats, these examples were limited to areas with low levels of sediment transport (i.e. less dynamic areas with low seabed mobility). Notwithstanding the fact that the Dogger Bank sandbank is a geological feature rather than the sandbank areas considered in RPS (2019) (which are formed by hydrological processes), the Dogger Bank is subject to 'frequent natural disturbance' (Eggleton *et al.*, 2017) and has predominantly coarse sediments, suggesting that these findings would be relevant to the Projects.

44. There is limited direct evidence of recovery from offshore wind activities within the Dogger Bank itself. As such, the Applicants commissioned a geophysical survey to look at potential recovery of the seabed following the installation and removal of two met masts (monopiles on 15m diameter suction caissons) which were located in the Dogger Bank Wind Farm zone between 2013 and 2017 in the Dogger Bank B and Dogger Bank C wind farms (see **Volume 7, Appendix 8-2 Met Mast Survey Analysis (application ref: 7.8.8.2)**). A comparison of pre-installation and post-removal geophysical survey data was undertaken. The analysis showed no significant seabed features resulting from the presence of met masts across four years and showed that trawl marks and localised depressions visible in the pre-installation surveys had infilled over the 10 year period since installation of the met masts in March / September 2013. In addition, Dogger Bank B undertook monitoring of craters caused by high-order UXO clearance in 2023 (Dogger Bank B, 2023 see in Annex B of Appendix C - Review of evidence on recovery of sandbank habitat following habitat damage[4] to this report). The UXO clearance campaign was completed in February-March 2023, with a survey of the craters in June 2023 at five of six clearance locations. Survey showed that in all cases the craters had infilled rapidly, in some cases infilling was largely complete, and even where there was the least recovery in (DBB_027) a 0.8m crater infilled to approximately 0.4m depth.

[4] Previously submitted into Examination as **Review of evidence on recovery of sandbank habitat following habitat damage (Revision 2)** [REP3-021]

45. These two site specific examples provide some evidence of physical recovery of the seabed at Dogger Bank. In terms of ecological recovery of disturbed areas, Eggleton *et al.*, (2017) note that sandy habitats such as those characteristic of the Dogger Bank are typified by fauna that are adapted to high rates of mortality and natural disturbance. Diesing *et al.*, (2013) indicated that modelled natural disturbance on the Dogger Bank exceeds that attributed to fishing disturbance, which would be similar to some of the construction effects of the Projects. In a study of the effects of fishing activity on the Dogger Bank, Eggleton *et al.*, (2017) found that faunal communities did not noticeably differ along an abrasion pressure gradient. This may have been a result of methodological artefacts, but the authors suggest could also have been attributed community resilience. Given recovery of the physical structure of the sandbank (as evidenced by the met mast example above) and the absence of physical barriers to communities re-establishing post-construction (other than in locations of above-surface infrastructure), ecological recovery is likely from 'abrasion/disturbance of the seabed' caused by the Projects.

46. As detailed within **Volume 8, Disposal Site Characterisation Report (application ref: 8.18)**, any sediment removed from within the Dogger Bank SAC during construction activities will be disposed of within the Offshore Development Area located within the SAC boundary, ensuring no sediment is lost from the sandbank habitat. While any removed sediment may result in a change to the underlying habitat, as detailed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** due to the dynamic nature of the underlying sediment and strong tidal currents within the Array Areas, such areas of sediment removal would be expected to be filled in with sediment from the surrounding area within a matter of days (Tillin *et al.*,, 2022).

47. In addition, by the time of construction, the seabed will have been in recovery from the effects of bottom-towed fishing for at least four years, which, as described in section 6.4.1.3, had extensive impacts across the majority of the SAC.

48. Given the low sensitivity of the biotopes within the SAC (in particular due to their high recoverability (see Annex A of Appendix C - Review of evidence on recovery of sandbank habitat following habitat damage[5] to this report); the relatively small footprint; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that abrasion / disturbance of the seabed for the Projects together would not significantly affect:

- The **extent** of the sandbank feature in terms of its sedimentary composition or biological assemblages;
- The **physical structure and function** in terms finer scale topography and sediment composition and distribution; and.
- The **biological structure and function** in terms of the key and influential species and characteristic communities present.

49. Given the minimal understanding of ecosystem services as defined in the SACO (JNCC, 2022) and based on the advice that "*activities must look to minimise, as far as is practicable, disturbance and changes to the biological communities and the abiotic component of the Dogger Bank to conserve the functions that it provides*" effects on sandbank feature function are also considered in terms the physical effects listed above. This methodology is applied to all effects throughout this assessment. Given the low sensitivity of the biotopes within the SAC; the small area of effect in relation to available sandeel habitat; and the episodic nature of the effect it is considered that abrasion/disturbance of the seabed for the Projects together would not significantly affect:

- The **function of the feature within the site**.

50. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to abrasion / disturbance of the seabed from the Projects together.

51. Whilst the Plan Level HRA (The Crown Estate, 2022) considers 'direct physical damage' as contributing to its conclusion of AEoI for the Projects, the Applicants do not consider that this is evidenced in that assessment. In addition, the Applicants consider that conclusion to be out of step with the Hornsea Project Three decision (BEIS, 2020) which only relates to permanent effects impeding restoration and is in line with the earlier Round 3 decisions (DECC, 2015).

[5] Previously submitted into Examination as **Review of evidence on recovery of sandbank habitat following habitat damage (Revision 2)** [REP3-021]

6.4.2.2.1 Changes in suspended solids (water clarity) / Smothering and siltation rate changes (Heavy and Light)

52. Construction, operation and maintenance and decommissioning activities will lead to the dispersal of sediments within the SAC, resulting in changes in suspended solids within the water column and deposition of those sediments potentially causing smothering.

53. Project-specific marine physical processes modelling (**Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**) shows that in the worst case (trenching activities within the Offshore Export Cable Corridor) suspended sediment concentrations of up to 5mg/l occur within 1km of the point of disturbance, with values returning to background levels within 5-7km of the cable corridor. The maximum predicted deposition will be up to 5cm within, and immediately adjacent to, the area of trenching, with a maximum change of up to 0.25m occurring in localised hotspots. During foundation installation suspended sediment concentrations may increase by over 5mg/l and typically return to baseline conditions within 5km of the area of disturbance and would be suspended in the water column for up to 1.5 hours. It is expected that the maximum predicted deposition resulting from a sediment plume will be <0.5cm in localised areas immediately adjacent to the foundation installation area.

54. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, the biotopes found within the Projects Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC have low sensitivity to changes in suspended sediment. JNCC and Natural England (2013) note that communities associated with sandbank habitats are adapted to high levels of sediment disturbance, owing to these habitats high-energy nature.

55. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** the short-term and localised nature of changes in suspended sediment are unlikely to cause any population-level effects to sandeel due to an increase in individual energy expenditure. Whilst some evidence suggests sandeel are tolerant to changes in suspended sediment (Messieh *et al.*, 1981; Kiørboe *et al.*, 1981; Utne-Palm, 2004), sediment settlement is likely to represent a greater risk to these species. **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** predicts no material effects on any other species across the Fish and Shellfish Ecology study area which includes the Dogger Bank SAC.

56. Given the low sensitivity of the biotopes within the SAC (in particular due to their high recoverability; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that changes to suspended solids would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

57. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to changes to suspended solids from the Projects alone.

6.4.2.3.1 Electromagnetic changes

58. There is potential for array cables, inter-platform cables and offshore export cables to produce electromagnetic fields (EMFs) that interfere with the behaviour of benthic species. EMFs are produced when electricity passes through a conductor (e.g. subsea cables). EMF have the potential to cause barrier / attraction effects dependent on the species and the spatial scale of EMF. EMF comprises both an electric field (E field) and a magnetic field (B field). The E field is confined within the cable itself through the use of insulating and shielding layers whilst the B field penetrates most materials, and, therefore, is emitted into the marine environment.

59. The strength of the EMFs produced by underwater cables is dependent on a variety of factors including distance from the cable, whether the cable is in sediment or sea water, speed and direction of water flow, and strength of the magnetic field. EMF strength dissipates rapidly with increasing distance from the source; for example, the average windfarm array cable buried 1m below the seabed will decrease from 7.85 μT directly next to the cable (0m) to 1.47 μT at 4m distance (Normandeau *et al.*,, 2011). Given the worst case burial depth of 0.5m or use of external cable protection, therefore, no receptor species would be exposed to EMFs within 0.5 m of the source.

60. For unburied cables, work conducted for the Moray offshore wind farms found that changes to EMF above that of the Earth's magnetic field were detectable up to 5m in the worst case (Moray Offshore Renewables Ltd, 2019),

61. The effects of EMF on benthic communities are not well understood, although studies (e.g. Sherwood *et al.*., 2016) suggest that benthic communities growing along offshore export cables routes are similar to those in nearby areas beyond the likely reach of EMF. It is important to note, any observed changes could be the result of the physical presence of the cable and surface properties, rather than an EMF effect (Gill and Desender, 2020).

62. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, the biotopes within the SAC are not sensitive to the effects of EMF. In addition, the Advice on Operations for the Dogger Bank SAC (JNCC, 2022) does not list electromagnetic changes as a pressure.

63. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** demersal (including sandeel), pelagic, and migratory fish species have a high level of adaptability and tolerance to EMF effects.

64. Given lack of sensitivity of the biotopes within the SAC; low sensitivity of sandeel and small footprint of effect; it is considered that electromagnetic changes would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present;
- The **function of the feature within the site**.

65. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to electromagnetic changes from the Projects alone.

6.4.2.4.1 Hydrocarbon and Polyaromatic Hydrocarbon (PAH) and Transition elements and organo-metal (e.g. TBT) contamination

66. Construction, operation and maintenance and decommissioning activities may lead to the disturbance of contaminated sediments within the Annex I sandbank habitat, resulting in an adverse effect on the existing communities.

67. Sediment data collected for the Projects **(Volume 7, Appendix 9-3 (application ref: 7.9.9.3)** indicates that for all parameters, sediment contaminant concentrations are low within the Offshore Development Area. All stations sampled within the Array Areas were found to feature Total Hydrocarbon Content (THC) or poly-aromatic hydrocarbons (PAH) levels below marine sediment quality guidelines. As noted in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**, any instances of contaminated sediment would be rapidly dispersed from the water column, settling within close proximity of its source.

68. As detailed in **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)** the biotopes within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are not considered sensitive to chemical or heavy metal contamination.

69. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** sandeel are considered to have a low sensitivity to chemical or heavy metal contamination.

70. Given lack of sensitivity of the biotopes within the SAC (in particular due to their high recoverability); low sensitivity of sandeel; and low levels of contaminants found to be present; it is considered that contamination from hydrocarbon and PAH and transition elements and organo-metal contamination would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present;
- The **function of the feature within the site**.

71. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to contamination from hydrocarbon and PAH and transition elements and organo-metal contamination from the Projects alone.

6.4.2.5.1 Introduction or spread of invasive non-indigenous species (INIS)

72. Hard substrate introduced via infrastructure such as foundations, scour and cable protection could act as potential ‘stepping stones’ or vectors for INIS.

73. The colonisation of marine fauna on introduced hard substrate has been widely recognised across the southern North Sea. Schrieken *et al.*, (2013) found that new species were colonising wrecks around the Dogger Bank and Cleaver Bank regions. Twenty-nine species were identified on the wrecks that had not been previously known to reside in the Dogger Bank area.

74. Of the biotopes identified within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor **(Volume 7, Appendix 9-3 (application ref: 7.9.9.3)**, three biotopes[6] are considered to be highly sensitive to INIS. Key INIS species which are of concern are the slipper limpet *Crepidula fornicata*, colonial ascidian *Didemnum vexillum* and the whelk *Rapana venosa*, all species which may be able to establish themselves within these biotopes and lead to a reduction in the characteristic bivalve populations or, in the case of *D. vexillum,* smother the existing habitat (Tillin, 2022a; 2022b; Tillin and Budd, 2023).

75. Due to the embedded and standard mitigation measures outlined in section 6.3, the risk of spreading INIS during all phases of the Projects will be reduced by employing a range of industry standard biosecurity measures. As such, the risk of introduction of INIS from is limited, with any potential spread of INIS arising from those already within the Dogger Bank and wider North Sea, such as those found in the site-specific surveys for the Projects.

76. Given the mitigation measures that will be employed during the Projects lifespan, it is considered that introduction or spread of invasive INIS would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present;
- The **function of the feature within the site**.

77. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to the introduction or spread of invasive INIS from the Projects alone.

6.4.2.6.1 Physical change (to another seabed / sediment type)

78. Installation of infrastructure (above the seabed) will lead to the physical change to the seabed and sediment within the Annex I sandbank habitat, resulting in a reduction in habitat extent and permanent habitat loss.

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[6] *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212); *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212); and *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)

79. As detailed in **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9),** the benthic communities found within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are considered to be sensitive to long-term habitat loss. However, the communities in the Projects site-specific surveys are typical to those found within the SAC, being dominated by the amphipod *Bathyporeia elegans* and the polychaete *Nephtys cirrosa,* in line with the overall community composition noted in the SACO (JNCC, 2022c) for the south-western area of the SAC. As such, any loss in habitat for these communities will be minimal in the context of the remaining habitat still available for these communities.

80. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** 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. As with the benthic communities, any loss in habitat for sandeel will be minimal in the context of the remaining habitat still available (see **Volume 6, Appendix B (application ref: 6.1.2))**.

81. The worst case area of habitat loss within the SAC from the presence of the Projects is estimated to be 1.82km² (see section 6.3.2). This area represents 0.015% of the Dogger Bank SAC's overall extent of 12,331km², and 0.015% of the medium to high potential habitat for sandeel of the SAC. As noted in section 6.3, the Applicants are committed to minimising the use of scour protection and external cable protection measures where possible. As such the final area of permanent habitat loss within the SAC is likely to be lower than that estimated as a worst case in this assessment.

82. In their relevant representation [RR-039] Natural England raised the topic of 'ecological halo effects'. This effect can be defined as the potential change in the characteristic composition of the benthic habitat and/or biological community in the surrounding area of newly introduced infrastructure, creating a so-called 'halo' of changed habitat and ecology. Natural England have suggested that this effect should be included in consideration of the 'Physical change to another habitat type' impact, hence inclusion of this additional text.

83. As noted in paragraph 77, the worst-case area of habitat loss within the SAC from the presence of the Projects is estimated to be 1.82km^2. There is already an assumption of 100% physical change (i.e. permanent habitat loss) within these footprints. If this scour and cable protection is subsequently colonised there is no further loss of habitat – this footprint was already lost. If scour protection or cable protection is not required (either in fewer locations, a lower percentage of cables or less scour protection is required at turbines) then the footprint for physical change will be below the worst case.

84. There is potential for fouling communities to develop on turbine towers, scour protection and cable protection. Organic material will be lost through mortality or effects of currents / storm action meaning that organic matter may be dispersed from the turbine towers, scour protection and cable protection. There may also be inputs from faeces of sessile species such as mussels.

85. In the case of turbine towers, material being shed will act as per sediment particles assessed elsewhere in the assessment (e.g. Impact 2 – Increased Suspended Sediment Concentrations) thus it is expected that the heavier material (e.g. aggregations of mussels) will settle rapidly to the seabed, in close proximity of the turbine tower. At Thanet, heavier material was deposited within 10 – 15m of the foundation (Vattenfall Wind Power Ltd, 2018). It is likely that for the Projects heavier material would therefore be deposited on the scour protection (or within the area assessed for habitat loss if no scour protection is deployed). This is supported by evidence from Block Island Wind Farm (Hutchison *et al*, 2020) where operational monitoring shows greatest benthic changes have occurred on or within the footprints of the foundations (four years post installation). This footprint is already accounted for within the footprint for physical change.

86. Smaller detritus may stay in suspension within the water column for a longer period of time and become advected by tidal currents. Therefore, not all material that is shed from the turbines towers would be deposited in the immediate vicinity. It is likely that there will be some input of organic material from the turbines, cable and scour protection to the sediments surrounding them. This could potentially lead to changes in the ecology of those sediments.

87. The evidence is equivocal at best for whether any significant effect is detectable, and effects seem highly variable and dependent on the type of structure and location, seabed-type and hydrographic conditions. The following cases come from a review of available literature from comparable locations to the Dogger Bank.

88. Lefaible *et al* (2019) report different results between jacket and monopile foundations at operational windfarms in Belgium. The Thornton Bank and Bligh Bank locations are environments that are subject to strong physical disturbance where the seafloor typically consists of well-sorted, medium-coarse and mobile sediments with relatively "poor" communities (Lefaible *et al*, 2019), and so are comparable to the Dogger Bank. In two consecutive years of monitoring (Lefaible *et al*, 2019), higher fine sand fractions were observed <50m around the jacket foundations and organic enrichment was also observed around the jackets in Year 1, but not in Year 2. In contrast, an opposite trend of lower average organic matter content was observed at very close distances around the monopiles. Higher densities and diversity of the benthos in close vicinity of the turbines was reported, which was most pronounced around the jackets, with differences at the monopiles not statistically significant.

89. Evidence from Block Island Wind Farm (HDR, 2020) (which included a comprehensive series of diver, grab and video sampling) generally showed no strong gradients of change in sediment grain size, enrichment, or benthic macrofauna in monitoring conducted 4 years after construction in most study locations. The seabed was described as a coarse sediment environment with medium to very coarse sands dominating, with some fines, so is comparable to the Dogger Bank. Notably, the largest changes in communities beyond the footprint of the turbine were seen in the lowest energy study location, which also showed least post-construction recovery.

90. Moray East has a range of sandy and coarse sediment biotopes (Moray Offshore Wind Farm (East) Limited, 2024). In post construction monitoring at Moray East (undertaken 2 – 3 years post installation) (Moray Offshore Wind Farm (East) Limited, 2024) no gross changes in benthic habitat types were observed between pre- and post-construction occasions. Significant broadscale habitat alteration was not detected, no evidence of seabed organic enrichment was recorded and no accumulation of biomass from fouling communities was observed (Moray Offshore Wind Farm (East) Limited, 2024). It is noted that survey techniques were acoustic or visual and no grab sampling was undertaken.

91. Whilst there is evidence of 'change' in some of the literature, from the comparable situations to Dogger Bank (e.g. Lefaible *et al,* 2019,) the most gross change was from a community typical of well-sorted, medium-coarse and mobile sediment to one with fine to medium sandy sediment.

92. Biotopes are a useful **statistical construct** whereby the similarity between the content of individual small sediment grab samples (approx. 0.1m^2) often collected at relatively wide spacing (up to 10's of kilometres) is calculated in

terms of the number and abundance of infaunal species present and sediment grain size. The degree of similarity between such samples is a judgement and varies with scale. Often samples collected at the same location and time will display significant variation in number and abundance of species. When the distribution and extent of biotopes are mapped, it is necessary to interpolate between individual sample points using additional environmental information such as water depth, broad sediment type and various statistical techniques. When broader scale Annex I habitat types are mapped, such areas can incorporate considerable variation in biological communities present in time and space depending on many factors such as localised variations in sediment type, slope, organic matter content, availability of small scale hard substrates (e.g. pebbles, shells) for attachment and disturbance, larval settlement and recruitment. Such localised variation in small scale community types is characteristic of heterogeneous habitats in naturally disturbed environmental conditions, rather than a physical change to another habitat type at Annex I habitat level. Any change that is potentially occurring as a result of the wind farm therefore needs to be considered in light of the fundamental variability between communities even if assigned to the same biotope.

93. The Dogger Bank is a mosaic of different types of sandbank biotopes, based upon gravel, sand and silt sediments, all which are highly variable (in terms of both species composition and abundances) even within biotopes, and all of which are encompassed by the 'Annex I sandbank' habitat. For example, Dogger Bank Creyke Beck (now Dogger Bank A & B) and Dogger Bank Teesside A & B (now Dogger Bank C and Sofia) surveys found very different communities from the Projects, including brittlestar beds, *Lanice conchilega* aggregations and seapen habitat (Forewind, 2013, 2014), and all of these are considered to be encompassed by the Annex I feature.

94. From a review of the evidence for halo effects it is considered unlikely that these effects would be expressed in dynamic environments such as the Dogger Bank, to such a degree that the change represents a loss of Annex I sandbank given the variability of sandbank biotopes at Dogger Bank. While there may be changes to biotopes as a result of this effect, it would not represent a loss of extent of Annex I sandbank. It is therefore considered that the 'halo effect' (if detectable) would not give rise to habitat loss additional to the loss from the installation of infrastructure.

95. Notwithstanding the above, without prejudice estimates of the potential extent of 'halo effects' within the Dogger Bank SAC are presented in **Appendix E - Ecological Halo Effects Technical Note** [document reference 15.7] and in section 6.4.2.3 and Table 6-7.

96. Although the extent of habitat loss from the installation of infrastructure is minimal, as discussed in section 6.4.1.3, the Dogger Bank SAC has a restore objective in relation to the extent of the sandbank feature in terms of its sedimentary composition and biological assemblages. With regard to the physical structure the restore objectives relates to finer scale topography and sediment composition and distribution. With regard to biological structure the restore objective relates to the key and influential species and characteristic communities present. Given that the restore objectives were in place from the designation of the Dogger Bank SAC (i.e. before any wind farms were present) and that the objectives apply at the fine scale it is clear that *any permanent footprint* would be considered to hinder the restore objectives no matter how small (even in comparison to the historic fishing impacts which affected at least 70% of the site).

97. Therefore, it is considered that physical change to the seabed and sediment would significantly affect:

- The **extent** of the sandbank feature in terms of its sedimentary composition or biological assemblages;
- The **physical structure and function** in terms finer scale topography and sediment composition and distribution;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

98. Therefore, an AEoI of the Dogger Bank SAC in relation to physical change to the seabed and sediment from the Projects alone cannot be ruled out.

99. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 3 Project Level Dogger Bank Compensation Plan (application ref: 6.2.3)**.

6.4.2.7.1 Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)

100. Operation and maintenance activities may lead to the release of synthetic compounds within the SAC, resulting in an adverse effect on the existing communities.

101. Paint flakes from the wind turbines may be shed throughout the life of the Projects as fine particles. The majority of these particles will enter the water column and be distributed by currents across a wide area. Given that these particles will be of low density (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** for discussion of fine particulates) it is unlikely they would fall out of suspension in proximity to the wind turbines and build up over time in the Array Areas. In addition, flakes would not be released as a plume (as per SSC increases from construction or maintenance activities), instead being released episodically over the lifetimes of the Projects.

102. In addition, the Applicants are committed to ensuring any paint utilised for the Projects would be approved for use in the marine environment by the relevant bodies.

103. There is also potential for the release of metals from sacrificial anodes associated with the Projects infrastructure. Ebeling *et al.*, (2023) investigated the potential metal emissions from galvanic anodes in offshore wind farms into the North Sea sediments. Results showed that mass fractions of the legacy pollutants cadmium, lead and zinc were mostly within the known variability of North Sea sediments with no evidence of an accumulation of metals in sediments caused by galvanic anodes used in OWFs.

104. Given the limited and episodic nature of any release of synthetic compounds, mitigation committed to by the Applicants and lack of evidence indicating any potential effects, it is considered that contamination from synthetic compound contaminants would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

105. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to contamination from synthetic compound contaminants from the Projects alone.

6.4.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

106. There is the potential for an AEoI of the Dogger Bank SAC from in-combination effects with other plans and projects. Schemes that could overlap spatially and temporally with the Projects and have an in-combination effect on the SAC are detailed in **Table 6-5**.

Table 6-5 List of Schemes Screened In For In-Combination Assessment for the Dogger Bank SAC

Tier	Plan / Project	Distance to Offshore Development Area Within the Dogger Bank SAC	
		Export Cable Corridor	Array Areas
Offshore Wind Farms			
2	Dogger Bank A	3.9km	6.5km
2	Dogger Bank B	7.55km	17km
2	Dogger Bank C	35km	56km
2	Sofia	35km	40km
6	Dogger Bank D	11km	0km*

**Export cable route adjacent to DBS East*

107. **Table 6-6** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects that have been screened in for the in-combination assessment. Note that in the assessment effects have been grouped where relevant and assessed together to avoid repetition. Any operational and decommissioning impacts, where not explicitly mentioned, are at worst the same as impacts during the construction phase. Therefore where no AEOI is determined for construction impacts, the same is assessed for operation and decommissioning.

Table 6-6 Potential effects identified for Annex I habitats (screened in (✓) and screened out (×) screened in for in combination assessment

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Abrasion/disturbance of the substrate on the surface of the seabed	✓	✓	✓
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	✓	✓	✓
Habitat structure changes – removal of substratum (extraction)	✓	×	×
Changes in suspended solids (water clarity)	✓	✓	✓
Smothering and siltation rate changes (Heavy)	✓	✓	✓
Smothering and siltation rate changes (Light)	✓	✓	✓
Electromagnetic changes	×	✓	×
Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Physical change (to another seabed type)	✓	✓	✓
Physical change (to another sediment type)	✓	✓	✓

6.4.2.1.2 Abrasion / disturbance of the substrate on the surface of the seabed / Penetration and/or disturbance of the substratum below the surface of the seabed / Habitat structure changes – removal of substratum (extraction)

108. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

109. Construction, operation and maintenance and decommissioning activities of schemes within the Dogger Bank SAC will result in abrasion/disturbance of the substrate on the surface of the seabed / penetration and/or disturbance of the substratum below the surface of the seabed. In addition, dredging or sandwave clearance could result in habitat structure changes – removal of substratum (extraction). These effects are considered together as 'abrasion/disturbance of the seabed'.

110. As noted in section 6.4.2.1.1, analysis of the seabed recovery from two met masts that were located in the Dogger Bank SAC between 2013 and 2017 found no significant seabed features resulting from the presence of met masts and showed that trawl marks and localised depressions visible in the pre-installation surveys had infilled over the 10 year period. As such, it is expected that areas of seabed affected abrasion / disturbance of the seabed from the Dogger Bank A, B, C and Sofia construction activities will have recovered or be recovering by the time of construction beginning on the Projects.

111. When construction commences on the Projects, overlap in construction activities would potentially occur only with Dogger Bank D. No estimated temporary disturbance areas are publicly available for Dogger Bank D at the time of writing. However, as with the Projects any abrasion/disturbance of the seabed from these schemes will occupy a minimal area of the seabed in comparison to the overall size of the Dogger Bank SAC, with effects being temporary in nature.

112. **Volume 6, Appendix B (application ref: 6.1.2)** shows that the Offshore Development Area and Dogger Bank D cover 7.7% of the medium to high potential habitat for sandeel of the SAC, although the actual footprints of construction activity within these (and Offshore Export Cables Route etc) would be much less.

113. In addition, by the time of construction, the seabed will have been in recovery for at least four years from the effects of bottom-towed fishing, which as described in section 6.4.1.3, had extensive impacts across the majority of the SAC.

114. Given the low sensitivity of the biotopes within the Dogger Bank SAC (in particular due to their high recoverability); the relatively small footprint; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that abrasion/disturbance of the seabed would not significantly affect:

- The **extent** of the sandbank feature in terms of its sedimentary composition or biological assemblages;
- The **physical structure and function** in terms finer scale topography and sediment composition and distribution;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

115. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to abrasion/disturbance of the seabed in combination with other schemes.

116. As noted previously in section 6.4.2.1.1, whilst the Plan Level HRA (The Crown Estate, 2022) considers 'direct physical damage' as contributing to its conclusion of AEoI for the Projects, the Applicants do not consider that this is evidenced in that assessment. In addition, the Applicants consider that conclusion to be out of step with the Hornsea Project Three decision (BEIS, 2020) which only relates to permanent effects impeding restoration in line with the earlier Round 3 decisions (DECC, 2015).

6.4.2.2.2 Changes in suspended solids (water clarity) / Smothering and siltation rate changes (Heavy and Light)

117. Construction, operation and maintenance and decommissioning activities will lead to the dispersal of sediments within the SAC, leading to changes in suspended solids within the water column and deposition of those sediments potentially leading to smothering.

118. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

119. As detailed in section 6.4.2.2.1 above, suspended sediment concentrations within the Array Areas may reach values of up to 5mg/l within 1km of the point of disturbance, with values returning to background levels within 5-7km of the cable corridor, settling out of the water column within 1.5 hours in the worst case. These areas of elevated sediment concentration may overlap with sediment disturbed during operational activities for Dogger Bank A or B. Given the distances between the Array Areas and Dogger Bank C and Sofia there will not be any overlaps of increases in suspended sediment concentrations from any sediment disturbed during operational activities, although there could be additive effects. There is potential for some overlap of increases in suspended sediment concentrations from construction of the Projects and the installation of the Dogger Bank D export cables and additive effects during construction and operation of the wind farms.

120. For all schemes, the potential for a release of sediment from the seabed will be short term, temporary and localised, with levels falling to within background rapidly within the SAC boundary. Only construction activities for Dogger Bank D may occur simultaneously with those of the Projects, with in-combination effects for the remaining schemes being limited to their operational phases, where changes in suspended solids will be limited to localised maintenance activities.

121. Given low sensitivity of the biotopes within the Dogger Bank SAC (in particular due to their high recoverability; the small area of effect in relation to available sandeel or other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that changes to suspended solids would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

122. Therefore there is no potential for an AEoI of the Dogger Bank SAC in relation to changes to suspended solids in combination with other schemes.

6.4.2.3.2 Electromagnetic changes

123. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

124. The Offshore Export Cable Corridor, Array Cables or Inter-Platform Cables for the Projects will not cross any other offshore cables associated with another plan/project within the Dogger Bank SAC.

125. Given that the effects of EMF have been found to be detectable up to only 5m from any unburied cables (Moray Offshore Renewables Ltd, 2019), there is no potential for overlap of EMF effects to occur between the Projects and other schemes. There would be additive effects but as discussed for the Projects alone (see section 6.4.2.3.2) these would be minimal for each project.

126. Given the lack of sensitivity of the biotopes within the Dogger Bank SAC; low sensitivity of sandeel and other fish species and small footprint of effect; it is considered that electromagnetic changes would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

127. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to electromagnetic changes in-combination with other schemes.

6.4.2.4.2 Introduction or spread of invasive non-indigenous species (INIS)

128. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;

- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

129. The potential risk of the spread of INIS by the other plans and projects identified is similar to that of the Projects given the similarities in development type. The mitigation measures proposed for the Projects are considered to be industry standard, and as such have either been committed to already (in the case of the Dogger Bank A, B, C and Sofia offshore wind farms) or are expected to be included within the Dogger Bank D development application.

130. Given the mitigation measures that will be employed during the Projects and other schemes lifespans, it is considered that introduction or spread of invasive INIS would not significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages;
- The **biological structure and function** in terms of the key and influential species and characteristic communities present; and
- The **function of the feature within the site**.

131. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to the introduction or spread of invasive INIS in combination with other schemes.

6.4.2.5.2 Physical change (to another seabed/sediment type)

132. Installation of infrastructure (above the seabed) will lead to the physical change to the seabed and sediment within the Annex I sandbank habitat, resulting in a reduction in the habitats extent and permanent habitat loss.

133. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

134. Based on the publicly available information for the schemes listed above, an area of approximately 11.71km² may be permanently lost within the Dogger Bank SAC[7], representing 0.16% of the total SAC area. Permanent habitat loss as a result of the Projects would equate to an additional 0.015% of the total SAC area (see section 6.3.2).

135. Although the extent of habitat loss is minimal, as discussed in section 6.4.1.3, the Dogger Bank SAC has a restore objective in relation to the extent of the sandbank feature in terms of its sedimentary composition and biological assemblages. With regard to the physical structure the restore objectives relates to finer scale topography and sediment composition and distribution. With regard to biological structure the restore objective relates to the key and influential species and characteristic communities present. As discussed in section 6.4.2.6.1 *any permanent footprint* would be considered to hinder the restore objectives no matter how small.

136. As such, it is considered that physical change (to another seabed / sediment type) in combination with other schemes would significantly affect:

- The **extent** of the sandbank feature in terms of its biological assemblages; and
- The **physical structure and function** in terms finer scale topography and sediment composition and distribution; and
- The **function of the feature within the site**.

137. Therefore, an AEoI of the Dogger Bank SAC in relation to physical change (to another seabed / sediment type) in combination with other schemes cannot be ruled out.

138. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Project Level Dogger Bank Compensation Plan (application ref: 6.2.3)**.

[7] Based on the consented footprints and not including Dogger Bank D for which figures are not available at the time of writing.

6.4.2.3 Summary

139. In conclusion, the majority of effects resulting from the Projects alone and in combination with other schemes will not result in an AEoI on the designated features of the Dogger Bank SAC. However, given the restore objectives there is potential AEoI for the Projects alone or in combination with other schemes in relation to physical change (to another seabed / sediment type). Therefore, the Annex I sandbank feature of the Dogger SAC may not be maintained as favourable in the long term without the implementation of any additional compensation measures.

140. In addition, there are areas of disagreement between the Applicants and Natural England with regard to whether abrasion / disturbance contributes to AEOI, potential for loss of habitat from 'halo effects' and inclusion of UXO clearance and jack-up operations in permanent habitat loss estimates. Therefore, in line with comments received from Natural England at Deadline 6 and Deadline 9 of the Projects Examination, **Table 6-7** presents ~~four~~ five without prejudice scenarios for the consideration by the Secretary of State for different scenarios that could lead to AEOI:

- Habitat loss from infrastructure alone (the Applicants conclusion);
- Habitat loss from infrastructure, UXO clearance activities and jack-up footprint;
- Habitat loss with an estimated 50m halo effect around turbine / offshore platform foundations and 20m halo effect around cable protection measures;
- Habitat loss and habitat disturbance; and
- ~~Habitat loss with an estimated 50m halo effect plus habitat disturbance.~~ Habitat loss with an estimated 50m halo effect around turbine / offshore platform foundations and 20m halo effect around cable protection measures plus habitat disturbance.

141. It should be noted that these potential effects would overlap (e.g. infrastructure is within the footprint of disturbance, halo effects and area of temporary habitat disturbance would overlap) and would therefore not be additive.

Table 6-7 Scenarios for Consideration Regarding Habitat Loss, Disturbance and Inclusion of Estimated Halo Effects in the Dogger Bank SAC

Parameter	**Scenario 1 – Habitat Loss from Infrastructure Only**	**Scenario 2 - Habitat loss from infrastructure, UXO clearance activities and jack-up footprint**	**Scenario 3 – Halo Effect (Encompassing Scenario 1 - Habitat Loss from Infrastructure Only)**	**Scenario 43 – Habitat Loss + Disturbance (Encompassing Habitat Loss)**	**Scenario 54 – Habitat Loss Including Halo Effect + Disturbance (Encompassing Habitat Loss)**
Foundations (turbines + offshore platforms)	**639,682m²** The constituent parts of this value include: 623,449m² small turbine foundation area 16,233m² offshore platform foundation area.	**1,977,002m²** The constituent parts of this value include: 623,449m² small turbine foundation area 16,233m² offshore platform foundation area 820m² for UXO clearance activities 1,320,000m² jack-up footprint for turbines 16,500m² jack-up footprint for offshore platforms	**4,252,906.73m²** The constituent parts of this value include: 4,173,989.90m² area of turbine / offshore platform foundations and 50m halo 78,916.83m² area of offshore platform foundations and 50m halo Note that all foundations are within the halo effect footprint therefore this is not additional footprint	**2,543,094m914m²** The constituent parts of this value include: 716,966m² seabed preparation area for 200 small turbines 18,668m² seabed preparation area for three offshore platforms 820m² for UXO clearance activities 1,320,000m² jack-up footprint for turbines 16,500m² jack-up footprint for offshore platforms 470,960m² anchoring footprint for turbine and offshore platform installation. Note that all foundations are within the disturbance footprint therefore this is not additional footprint	**4,252,856906.73m²** The constituent parts of this value include: 4,173,989.90m² area of turbine / offshore platform foundations and 50m halo 78,916.83m² area of offshore platform foundations and 50m halo Note that all foundations and disturbance are within the halo effect footprint therefore this is not additional footprint

Parameter	Scenario 1 – Habitat Loss from Infrastructure Only	Scenario 2 - Habitat loss from infrastructure, UXO clearance activities and jack-up footprint	Scenario 3 – Halo Effect (Encompassing Scenario 1 - Habitat Loss from Infrastructure Only)	Scenario ~~4~~3 – ~~Habitat Loss +~~ Disturbance (Encompassing Habitat Loss)	Scenario ~~5~~4 – ~~Habitat Loss Including~~ Halo Effect + Disturbance (Encompassing Habitat Loss)
Cable Protection + Cable Crossings (Array, Inter-Platform and Offshore Export Cables) Note that maximum width of cable protection measures for Array Cables is 6m. Maximum width of cable protection measures for Inter-Platform and Offshore Export Cables is 15.2m.	**~~1,175,670~~966,654m²** The constituent parts of this value include: ~~653,400~~420,000m² array cable protection 247,760m² inter-platform cable protection 87,278m² cable protection 175,040m² array / inter-platform cable crossing material ~~12,192~~36,576m² cable crossing material	**~~1,175,670~~966,654m²** The constituent parts of this value include: ~~653,400~~420,000m² array cable protection 247,760m² inter-platform cable protection 87,278m² cable protection 175,040m² array / inter-platform cable crossing material ~~12,192~~36,576m² cable crossing material	**5,592,334.4m²** Estimated Offshore Export Cable & Inter Platform protection length of 22,042m x 55.2m Cable Protection & Halo Effect Width = 1,216,718.4m² Estimated Array Cable protection length of 70,000m x 46m Cable Protection + Halo Effect Width = 3,220,000m² Estimated Offshore Export Cable Crossing Length of 2,400m x 55.24m Cable Crossing + Halo Effect Width = 132,576m² Estimated Inter-Platform Cable Crossing Length of 5,200m x 55.2m Cable Crossing + Halo Effect Width – 287,040m² Estimated Array Cable Crossing Length of 16,000m x 46m Cable Crossing + Halo Effect Width – 736,000m² Note that all foundations are within the halo effect footprint therefore this is not additional footprint	**22,474,610m²** The constituent parts of this value include: 14,000,000m² array cable trench area 3,220,000m² inter-platform cable trench area 1,148,400m² offshore export cable trench area 2,152,500m² sandwave levelling area for array and inter-platform cables 1,946,205m² sandwave levelling area for offshore export cables 7,505m² anchoring footprint for offshore export cable installation. Note that all cable protection is within the disturbance footprint therefore this is not additional footprint	**25,819,483.4m²** The constituent parts of this value include: 5,592,334.4m² area of cable protection / crossing material and 20m halo 20,227,149m² disturbance area for array, inter-platform and offshore export cable installation works Note that where cable protection is required, and a 20m halo applied, this encompasses the disturbance footprint. Therefore, the residual disturbance footprint relates only to the buried cable extent (i.e. 90% of the total 22,474,600m² disturbance area estimated for array, inter-platform and offshore export cable installation works).~~30,807,334.4m²~~ ~~The constituent parts of this value include:~~ ~~10,580,194.4m² area of cable protection / crossing material and 50m halo~~ ~~20,227,140m² disturbance area for array, inter-platform and offshore export cable installation works.~~ ~~Note that where cable protection is required, and a 50m halo applied, this encompasses the disturbance footprint. Therefore, the residual disturbance footprint relates only to the buried cable extent (i.e. 90% of the total 22,474,600m² disturbance area estimated for array, inter-platform and offshore export cable installation works).~~

Parameter	Scenario 1 – Habitat Loss from Infrastructure Only	Scenario 2 - Habitat loss from infrastructure, UXO clearance activities and jack-up footprint	Scenario 3 – Halo Effect (Encompassing Scenario 1 - Habitat Loss from Infrastructure Only)	Scenario 43 – Habitat Loss + Disturbance (Encompassing Habitat Loss)	Scenario 54 – Habitat Loss Including Halo Effect + Disturbance (Encompassing Habitat Loss)
Total	**1,815,352606,336m²** As stated in **Table 6-3**	**3,152,6722,943,656m²**	**9,845,241.13m²**	**25,017,7048,254m²** As stated in **Table 6-3**	**30,072,390.13m²35,069,191,13m²**

6.5 Flamborough Head SAC

6.5.1 Site Description

142. Flamborough Head SAC is designated for the Annex I habitats *Reefs, Vegetated sea cliffs of the Atlantic and Baltic Coasts* and *Submerged or partially submerged sea caves*. Of the designated habitats for the site, those of interest in relation to potential effects from the Projects activities are the areas of reef within the site. The clarity of the relatively unpolluted sea water and the hard nature of the extensive sublittoral chalk habitat have enabled kelp *Laminaria hyperborea* forests to become established in the shallow sublittoral zone. The reefs to the north of the site support a different range of species from those on the slightly softer and more sheltered south side of the headland. The site supports an unusual range of marine species and includes rich animal communities and some species that are at the southern limit of their North Sea distribution, e.g. the northern alga *Ptilota plumosa* (JNCC, 2022a).

6.5.1.1 Qualifying Features

143. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following relevant Annex I habitats:

- *Reefs; and*
- *Submerged or partially submerged sea caves*

144. As noted in Natural England's Advice on Operations for the Flamborough Head SAC (Natural England, 2025), the evidence base suggests that there is no interaction of concern between the feature '*Vegetated sea cliffs of the Atlantic and Baltic Coasts*' and the potential pressures associated with the activity 'Power cable: laying, burial and protection' (i.e. installation of the Offshore Export Cable Corridor). As such, this feature has not been considered further in this assessment.

6.5.1.2 Conservation Objectives

145. With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change (Natural England, 2018a);

146. Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats;
- The structure and function (including typical species) of qualifying natural habitats; and

- The supporting processes on which qualifying natural habitats rely.

6.5.1.3 Condition Assessment

147. There is no current publicly available information regarding the current condition of the qualifying features of the Flamborough Head SAC (Natural England, 2024a). However, information on the Unit condition of the Flamborough Head SSSI (which encompasses the same geographical footprint as that of the SAC) indicates the habitat is in good overall condition (Natural England, 2021). Of the locations assessed within the SSSI, 67.3% is noted as being in favourable condition, 3.81% in unfavourable recovering and 28.89% as unfavourable declining.

6.5.2 Assessment

148. **Table 6-7** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022).

Table 6-8 Potential effects identified for the Flamborough Head SAC (screened in (✓) and screened out(×)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Smothering and siltation rate changes (Heavy and Light)	✓	✓	✓

6.5.2.1 Assessment of potential effects of the Projects alone

149. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

6.5.2.1.1 Smothering and siltation rate changes (Heavy and Light)

150. Suspended sediment disturbed by the Projects construction, operation and maintenance and decommissioning activities have the potential to result in an indirect impact on the qualifying features of the Flamborough Head SAC.

151. Project specific physical processes modelling (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** for further details) indicates that sediment disturbed by the construction activities will primarily be deposited within 1km of the source of disturbance. Due to the Flamborough Head SAC being located approximately 3km from the closest point of the Projects Offshore Export Cable Corridor, there is no pathway for effect between heavy smothering and siltation rate changes and the SAC.

152. There does exist the potential for light smothering and siltation rate changes to occur however, with sediment plumes exceeding 0.5mg/l being dispersed up to 28.5km from the point of disturbance in the nearshore. Such plumes would result in an average sediment deposition of 1-5mm within 10km of the disturbance and is less than 0.5mm within 35km. Surface turbidity within the area of the Flamborough Head SAC (represented by suspended particulate matter) is generally low, with average monthly concentrations typically less than 5 mg/l across the whole year (Cefas, 2016), with minimal seasonal variation.

153. The reef habitat found within the Flamborough Head SAC is classified as subtidal chalk reef (JNCC, 2022a). Communities typically associated with this habitat are known to be tolerant of light increases in sediment smothering, owing to mobile nature of characterising species and the existing sediment mobility found within such habitat (De-Bastos and Hill, 2016). Further detail of the underlying biotopes present within the Flamborough Head SAC, and their sensitivity to sediment smothering, is provided in Appendix D – Benthic Ecology Technical Note[8] to this document.

154. Any sediment disturbed by the Projects activities that reaches the Flamborough Head SAC would be expected to settle at a minimal overlaying depth and be dispersed within a matter of days, representing a temporary increase over the natural baseline.

155. In regards to the *Submerged or partially submerged sea caves* within the SAC, given the minimal settling depth and short-term nature of any sediment deposition within the SAC resulting from the Projects activities, it is expected that any sediment that may enter such cave features would be rapidly dispersed, with any effects being a temporary localised effect.

[8] Previously submitted into Examination as **Benthic Ecology Technical Note (Revision 2)** [REP3-024]

156. As such, given the tolerant nature of the receptors within the SAC to light sediment deposition and the localised and temporary nature of any light smothering events, it is concluded that the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEoI to Annex I habitats within the Flamborough Head SAC in relation to smothering and siltation rate changes (Heavy and Light) from the Projects alone and therefore, subject to natural change, the Annex I habitat features will be maintained in the long term as favourable.

6.5.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

6.5.2.1.2 Smothering and siltation rate changes (Heavy and Light)

157. There exists the potential for an AEoI on the Annex I habitat features of the Flamborough Head SAC in-combination with other plans and projects. Plans and projects that could overlap spatially and temporally with the Projects in relation to smothering and siltation rate changes (heavy and light) are listed below:

- Hornsea Project Four Offshore Wind Farm
- Eastern Green Link (EGL) 2, 3 and 4
- Bridlington A Disposal Site (Open)

158. Previous assessment of the Bridlington A disposal site on the Flamborough Head SAC (Cefas, 2009) concluded that there would be no LSE on the Annex I habitat features of the SAC as a result of the disposal of dredged material at Bridlington A.

159. The cumulative effects assessment conducted **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** determined that any increases in SSC in-combination with Hornsea Project Four, EGL2,3 and 4 or the Bridlington A disposal site would not result in any significant impacts due to the likely minimal overlap in disturbed sediment plumes and minimal potential for these events to overlap temporally with each other.

160. Overall, it is concluded that there is no potential for an AEoI to the conservation objectives of the reef and submerged cave features of the Flamborough Coast SAC in relation to increases in suspended sediment from the Projects in-combination with other plans or projects and therefore, subject to natural change, the Annex I habitat features will be maintained as favourable in the long term.

6.5.2.3 Summary

161. In conclusion, due to the tolerant nature of the Annex I habitats within the Flamborough Head SAC to changes in SSC, and the short-term and localised nature of the effect, there is no potential for an AEoI to Annex I habitat features in relation to smothering and siltation rate changes (Heavy and Light) impacts from the Projects both alone and in combination with other plans and projects. Therefore, subject to natural change, the Annex I habitat features of the Flamborough Head SAC will be maintained as favourable in the long term.

6.6 Humber Estuary SAC

6.6.1 Site Description

162. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). The high suspended sediment loads in the estuary feed a dynamic and rapidly changing system of accreting and eroding intertidal and sub-tidal mudflats and sandflats as well as saltmarsh and reedbeds. Other notable habitats include a range of sand dune types in the outer estuary, together with sub-tidal sandbanks and coastal lagoons.

163. A number of developing managed realignment sites on the estuary also contribute to the wide variety of estuarine and wetland habitats. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion. As salinity declines upstream tidal reedbeds and brackish saltmarsh communities fringe the estuary (Natural England, 2024b).

6.6.1.1 Qualifying Features

164. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following Annex I habitats relevant to this assessment:

- Estuaries;
- Coastal lagoons;
- *Salicornia* and other annuals colonising mud and sand Atlantic salt meadows (*Glauco puccinellietalia maritimae*);
- Sandbanks which are slightly covered by seawater all the time; and
- Mudflats and sandflats not covered by seawater at low tide.

6.6.1.2 Conservation Objectives

165. With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change (Natural England, 2018b);

166. Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats;
- The structure and function (including typical species) of qualifying natural habitats; and
- The supporting processes on which qualifying natural habitats rely.

6.6.1.3 Condition Assessment

167. There is no current publicly available information regarding the current condition of Annex I sandbank habitat within the Humber Estuary SAC (Natural England, 2024c), or overlapping Humber Estuary SSSI (Natural England, 2024e).

6.6.2 Assessment

168. **Table 6-8** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022).

169. It should be noted that potential effects of oxides of Nitrogen (NOx) and ammonia (NH_3) above Critical Levels were screened in for assessment after the publication of the final HRA Screening Report, following consultation with Natural England. Such effects are assessed under the introduction of other substances (solid, liquid or gas) standard pressure definition.

Table 6-9 Potential effects identified for the Humber Estuary SAC (screened in (✓) and screened out(×)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Smothering and siltation rate changes (Heavy and Light)	✓	✓	✓
Introduction of other substances (solid, liquid or gas)	✓	×	×

6.6.2.1 Assessment of potential effects of the Projects alone

170. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

6.6.2.1.1 Smothering and Siltation rate changes

171. Suspended sediment disturbed by the Projects construction, operation and maintenance and decommissioning activities or changes to nearshore sediment transport processes from Project infrastructure (including potential cable protection and cofferdams) have the potential to result in an indirect impact on the qualifying features of the Humber Estuary SAC.

172. Sediment transport processes in the region of the Offshore Export Cable Corridor, through longshore drift and residual currents in the nearshore area, drive fine sediment eroded from the Holderness cliffs in a southerly direction (Pye and Blott, 2015), and feed into the sediment process within the Humber Estuary. Should any infrastructure for the Projects in the nearshore (e.g. cable protection measures) disrupt this flow of fine sediment, the sandbank habitat within the Humber Estuary SAC may see a reduction in available sediment.

173. Following submission of the initial revision of this report and further consultation with stakeholders, the Applicants have removed the short trenchless crossing at landfall, avoiding the need for exit pits in the intertidal area (see **Project Change Request 1 - Offshore & Intertidal Works** [AS-141] for further information). As such, there is no longer any pathway for effect for sediment transport resulting from construction works in the intertidal environment.

174. During the operational phases of the Projects, the presence of cable protection measures in the nearshore environment could potentially have an effect on sediment transport in the nearshore and along the coast.

175. As detailed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** and the Assessment of Coastal Processes at the Dogger Bank South Landfall (document ref: REP5-041] that accompany this report, project-specific nearshore modelling has demonstrated that there will be no significant interruption of wave-driven alongshore sediment supply to the Humber Estuary SAC. Potential changes are likely to be of the order of a 1% reduction in sediment transport when compared to baseline conditions (the value of 1% was determined assuming a 25% blockage effect of the water column). Even these values are precautionary as these are based on the LAT water depth and over the operational lifetime of the Projects, water levels will be higher than this most of the time allowing even more sediment to bypass the structures.

176. As detailed in section 6.3, the Applicants have committed to burial across the intertidal zone from Mean High Water Springs (MHWS) to 350m seaward of MLWS.

177. The results of the nearshore wave modelling shown in **Assessment of Coastal Processes at the Dogger Bank South Landfall** (document ref: 15.6) show there are localised changes in significant wave height which occur primarily within 20m of the structures. As waves are the primary driver of sediment transport in the nearshore, the results can be used to infer broader sediment transport pathways. The modelling indicates the structures could lead to reduction in significant wave height by 10% compared to the baseline within 380m of the structures, with an increase in wave height directly above the structure as they create a 'reef' when water levels are at their lowest. A reduction in significant wave height would theoretically reduce the duration when waves are acting on the seabed potentially leading to an increase in deposition with sediment accumulating around the margins of the cable protection.

178. The wave modelling results support the conceptual assessment which predicted that sediment would first accumulate on one side or both sides of the obstacle (on the northern side in the nearshore where net sediment transport is from north to south). With continued build-up, it would then form a 'ramp' over which sediment transport would eventually occur by bedload processes, thereby bypassing the protection. The gross patterns of bedload transport across the export cables would therefore not be affected significantly.

179. As such, given the minimal reduction in sediment transport predicted to occur as a result of nearshore cable protection for the Projects, it is concluded that the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEoI to Annex I habitats within the Humber Estuary SAC in relation to siltation rate changes from the Projects alone and therefore, subject to natural change, the Annex I habitat features will be maintained in the long term as favourable.

6.6.2.2.1 Introduction of other substances (solid, liquid or gas)

180. Air quality assessments in **Technical Note: Comparison of Approaches using the Natural England Guidance NEA001 and JNCC Guidance** (document reference **10.30 Response to Natural England's Relevant Representations (including Appendices A - F, and I, Annex A**)) indicated that an area of mudflat and sandflat habitat not covered by seawater at low tide, a designated feature of the Humber Estuary SAC, could potentially be affected by a Process Contribution (PC) increase over 1% of the upper Critical Level for NH_3 (the lower Critical Level of NH_3 is not relevant for this habitat because no lichens or bryophytes are present). This impact results from road traffic related to the onshore construction of the Projects in-combination with other plans and projects (i.e. DBS project traffic, growth from the base year (2022) to future year (2026) and EIA committed developments), as per the requirement of the assessment methodology. When the results of the in-combination assessment are compared against the impact of the Projects alone, it shows that only a small percentage of the impact experienced at the Humber Estuary SAC is due to the contribution from the Projects. Further to this, the PC from Projects alone does not result in impacts in excess of 1% of the respective Critical Levels for NO_x or NH_3, and the in-combination PC does not result in impacts in excess of 1% of the Critical Level for NOx (see **Technical Note: Comparison of Approaches using the Natural England Guidance NEA001 and JNCC Guidance** (document reference **10.30 Response to Natural England's Relevant Representations (including Appendices A - F, and I, Annex A)**) for further information). The contribution of the Projects is based upon worst case assumptions for vehicle movements.

181. The air quality assessments also calculated the total Predicted Environmental Concentrations (PECs) of NOx and NH_3 experienced at the Humber Estuary SAC (i.e., the impact of Projects alone or in-combination traffic, combined with the background concentration) (see document reference **10.30 Response to Natural England's Relevant Representations (including Appendices A - F, and I, Annex A Technical Note: Comparison of Approaches using the Natural England Guidance NEA001 and JNCC Guidance))**. PECs of NH_3 do not exceed the upper Critical Level of 3 µg m^{-3}. PECs of NOx do not exceed the Critical Level of 30 µg m^{-3} (this Critical Level is the UK national air quality objective derived from the European Directive limit value for the protection of vegetation and ecosystems) at the Humber Estuary SAC.

182. Effects arising from a potential increase in NH_3 at the Humber Estuary SAC would occur only in a localised area of mudflat and sandflat habitat not covered by seawater at low tide along the River Hull, adjacent to the A63 trunk road. The mudflat and sandflat habitat feature covers an extent of 89.97km² within the site (Natural England, 2024d), and the area affected is approximately 0.17km² in the worst-case, representing 0.18% of this habitat within the SAC. Any effects related to PC exceedances of 1% of the Critical Level for NH_3 would only occur during a short period of construction, resulting in a short-term peak in airborne pollutants from construction vehicles. The 1% Critical Level PC threshold would only be marginally exceeded (see document reference **10.30 Response to Natural England's Relevant Representations (including Appendices A - F, and I, Annex A Technical Note: Comparison of Approaches using the Natural England Guidance NEA001 and JNCC Guidance**)) for further information). Furthermore, the NH_3 PEC is not predicted to exceed the Critical Level.

183. It should be noted that with regard to nutrient nitrogen deposition and acid deposition, there is no comparable habitat with an established Critical Load estimate available, and the habitat is not sensitive to acid deposition. Therefore, nutrient nitrogen deposition and acid deposition were not assessed further.

184. Given the small exceedance, limited duration and footprint of effect, there is no potential for an AEoI to the Humber Estuary SAC from the introduction of other substances (solid, liquid or gas) from the Projects alone or in-combination with other plans and projects. Therefore, subject to natural change, the qualifying features of the Humber Estuary SAC will be maintained in the long term.

6.6.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

6.6.2.1.2 Smothering and Siltation rate changes

185. There is potential for an AEoI on the Annex I habitat features of the Humber Estuary SAC in-combination with other plans and projects. Plans and projects that could overlap spatially and temporally with the Projects in relation to smothering and siltation rate changes (heavy and light) are listed below:

- Hornsea Project Four Offshore Wind Farm; and
- EGL2, 3 and 4.

186. The worst-case design scenario for Hornsea Project Four does not account for any infrastructure (e.g. cable protection) to be located in the nearshore environment (Orsted, 2021). In addition, due to Hornsea Project Four and EGL 2 being expected to begin construction prior to the Projects, there will be no overlap in nearshore construction activities. As such, there is no potential for an in-combination effect to occur to nearshore sediment processes in-combination between Hornsea Project Four and the Projects.

187. Due to the early stages of development that the EGL3 and 4 projects are currently in, there is no publicly available information to determine if any nearshore infrastructure will be utilised for these projects. As such, any in-combination effects between EGL3 and 4 and the Projects will need to be considered within the assessments conducted for those projects.

6.6.2.2.2 Introduction of other substances (solid, liquid or gas)

188. The assessment of NOx and NH_3 as part of the assessment in section 6.6.2.2.1 is inherently cumulative, due to the assessment including background traffic growth (from 2022 to 2026, which represents regional growth due to residential and employment developments), and associated cumulative developments (see section 26.6.1.3.1.2 and section 26.6.1.3.2.2 **Volume 7, Chapter 26 Air Quality (application ref: 7.26)** for further information).

189. As such, the previous conclusion reached in section 6.6.2.2.1 remains applicable. There is, therefore, no potential for an AEoI to the Humber Estuary SAC from introduction of other substances (solid, liquid or gas) from the Projects alone or in combination with other schemes and therefore, subject to natural change, the qualifying features of the Humber Estuary SAC will be maintained in the long term.

6.6.2.3 Summary

190. Due to the minimal changes in sediment transport to the Humber Estuary SAC resulting from the presence of the Projects, there is no potential for an AEoI to Annex I habitat features in relation to siltation rate changes from the Projects both alone and in combination with other schemes. Due to the minimal levels of introduction of NOx and NH_3 modelled to occur within the SAC, there is no potential for an AEoI to Annex I habitat features in relation to introduction of other substances (solid, liquid or gas) from the Projects both alone and in-combination with other schemes. Therefore, subject to natural change, the Annex I habitat features of the Humber Estuary SAC will be maintained as favourable in the long term.

7 Sites Designated For Annex II Migratory Fish

7.1 Approach to Assessment

191. This section provides information to allow the determination of the potential for the Projects to have an adverse effect on the integrity of sites designated for Annex II migratory fish species.

192. For each site designated for fish species screened in for further assessment, the following have been provided:

- A summary of the ecology of the fish species considered for assessment for each European site;
- An assessment of potential effects during the construction, operation, maintenance and decommissioning phases of the Projects; and
- An assessment of the potential for in-combination effects alongside other relevant developments and projects.

7.2 Consultation

193. The key elements of consultation to date have included the HRA Screening Report (**Volume 6, Appendix A (application ref: 6.1.1)**) and the ongoing technical consultation via the DBS Seabed Expert Topic Group. The feedback received has been considered in preparing this RIAA. **Table 7-1** provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

Table 7-1 Consultation Responses Relevant to Offshore Annex II Migratory Fish

Comment	Applicants Response
Final HRA Screening Report, MMO (17/07/2023)	
The document correctly identifies that UWN generated by construction activities has the potential to displace fish from supporting habitats or migratory routes by acting as an acoustic barrier. UWN is screened out as a likely significant effect on migratory fish as it is considered that the range of impact for TTS would be 48km from the source, and as the Projects are located more than 100km from the coast, a pathway for potential impacts does not exist. The MMO notes that this statement is supported with a footnote stating; 'there are no numerical criteria available for behavioural effects on fish from underwater noise, therefore TTS range is used as a proxy here for behaviour'. This is not entirely accurate. Whilst the MMO agrees that there is no known numerical threshold for behavioural responses in fish (except for the recommended 135dB for clupeids), it should be understood that TTS and behavioural responses are not the same thing. TTS is a physical effect which causes a temporary reduction in hearing sensitivity caused by exposure to intense sound and is not the same as a behavioural response. This should be corrected in the ES.	The Applicants acknowledge that TTS and behavioural responses are different. As detailed in this comment, TTS ranges were utilised as a proxy in place of an estimated behavioural response range due to the lack of suitable behavioural criteria. In addition, The Applicants note that the referenced 135dB for clupeids is not relevant to the lamprey species present within the sites screened in for further assessment.

7.3 Assessment of Potential Effects

194. The HRA Screening report (**Volume 6, Appendix A (application ref: 6.1.1)**) identified the following potential effect to be taken forward for further assessment in relation to the construction, operation and maintenance and decommissioning phases of the Projects for Annex II migratory fish:

- Underwater noise and vibration impacts to hearing sensitive species due to Unexploded Ordnance (UXO) clearance

7.3.1 Embedded Mitigation

195. **Table 7-2** outlines the embedded and standard mitigation measures incorporated into the design of the Projects relevant to the assessment for Annex II migratory fish species.

Table 7-2 Embedded Mitigation Measures Relevant for Annex II Migratory Fish

Parameter	Mitigation measures embedded into the design of the Project
Underwater Noise	Low-yield methods will be utilised for the detonation of UXO where viable. This will have the effect of mitigating underwater noise impacts on any fish and shellfish species sensitive to noise.

196. Mitigation will be required for any potential UXO clearance but a separate Marine Licence would be submitted following a detailed UXO survey prior to construction, and a detailed assessment based on that latest available information (including potential UXO locations, size, type, and number) has been undertaken.

197. A summary report will be provided following conclusion of any UXO clearance activities to provide detail on the activities and mitigation undertaken.

7.3.2 Worst Case Scenario

198. The final design of the Projects will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects screened into the assessment. These are presented in the ES and **Table 7-3**.

Table 7-3 Worst-Case Scenario for Annex II Migratory Fish Assessment

Impact	Worst Case Scenario	Notes
Construction		
Underwater noise and vibration impacts to hearing sensitive species due to UXO clearance	**UXO** Various possible types and sizes of UXO: Up to 698kg (net explosive quantities NEQ) Final numbers of UXO are unknown at this stage. However, predictive numbers have been produced (Ordtek, 2023) which indicate a potential for 41 total UXO across the offshore development area, of which 25 may be located within the offshore export cable corridor (see section 7.4.2.1.1 below).	Impact ranges for noise associated with UXO clearance are included in the underwater noise modelling report that accompanies this submission (**Volume 7, Appendix 11-3 (application ref: 7.11.11.3**).

7.4 River Derwent SAC

7.4.1 Site Description

199. The Yorkshire Derwent is considered to represent one of the best British examples of the classic river profile. This lowland section, stretching from Ryemouth to the confluence with the Ouse, supports diverse communities of aquatic flora and fauna. Fed from an extensive upland catchment, the lowland course of the Derwent has been considerably diverted and extended as a result of glacial action in the Vale of Pickering. The Derwent is noted for the diversity of its fish communities, which include river lampreys *Lampetra fluviatilis* and sea lampreys *Petromyzon marinus* populations that spawn in the lower reaches (Natural England, 2005).

7.4.1.1 Qualifying Features

200. The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following Annex II fish species:

- Sea lamprey; and
- River lamprey (present as a qualifying feature, but not a primary reason for site selection).

7.4.1.2 Conservation Objectives

201. The conservation objectives of the SAC are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function (including typical species) of qualifying natural habitats;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- The populations of qualifying species; and
- The distribution of qualifying species within the site.

7.4.1.3 Condition Assessment

202. At the time of writing, the latest available information for the River Derwent SAC states that both sea lamprey and river lamprey are in unfavourable recovering condition (Natural England, 2023). The current population of adult returning sea lamprey is estimated to be 1-15 individuals, with the current population of adult returning river lamprey is estimated to be 1,000 individuals (Natural England, 2022).

7.4.2 Assessment

7.4.2.1 Assessment of potential effects of the Projects alone

203. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

7.4.2.1.1 Underwater noise and vibration impacts due to UXO clearance

204. Of all the senses used by fish to obtain information about their surrounding environment, sound is one of the most important due to its three-dimensional nature (Popper *et al.*,, 2019; Popper and Hawkins, 2019). As each species has a unique sensitivity to noise, the potential impact of noise on fish varies. Anthropogenic sounds can be so intense as to result in death or mortal injury, or lower sound levels may result in temporary hearing impairment, physiological changes including stress effects, changes in behaviour or the masking of biologically important sounds (Popper and Hawkins, 2019).

205. Few experiments on the hearing of fishes have been carried out under suitable acoustic conditions, and only a few species have valid data that provide actual thresholds of effect (Popper and Hawkins, 2019). Recent papers on the effects of underwater noise on fish and shellfish species have highlighted the lack of clear evidence to support setting thresholds for impacts on fish and shellfish receptors (Popper *et al.*,, 2014; Hawkins and Popper, 2017). These have highlighted some of the shortcomings of impact assessments, including the use of broad criteria for injury and behavioural effects based on limited studies. The effects of particle motion are not well understood but are considered to be more important for many fish and species, than sound pressure which has been the main consideration in noise impact assessments to date (Popper and Hawkins, 2018).

206. The most recent and relevant guidelines for the purposes of this assessment, are the Acoustical Society of America (ASA) Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al.*,, 2014). These guidelines provide directions and recommendations for setting criteria (including injury and behavioural criteria) for fish. The Popper *et al.*, (2014) guidelines broadly group fish into the following categories based on their anatomy and the available information on hearing of other fish species with comparable anatomies:

- Group 1: Fishes lacking swim bladders that are sensitive only to sound induced particle motion and show sensitivity to a narrow band of frequencies (includes flatfishes and elasmobranchs);
- Group 2: Fishes with a swim bladder where the organ does not appear to play a role in hearing. These fish are sensitive only to particle motion and show sensitivity to a narrow band of frequencies (includes salmonids and some tuna);
- Group 3: Fishes with swim bladders that are close, but not intimately connected to the ear. These fishes are sensitive to both particle motion and sound pressure and show a more extended frequency range than groups 1 and 2, extending to about 500 Hz (includes gadoids and eels); and
- Group 4: Fishes that have special structures mechanically linking the swim bladder to the ear. These fishes are sensitive primarily to sound pressure, although they also detect particle motion. These species have a wider frequency range, extending to several kHz and generally show higher sensitivity to sound pressure than fishes in Groups 1, 2 and 3 (includes clupeids such as herring, sprat and shads).

207. Lamprey species lack specialist hearing structures and are considered to have low noise sensitivity (Popper, 2005), falling under the Group 1 definition as detailed in Popper *et al.*, 2014.

208. It is possible that there will be a requirement for UXO clearance during the construction phase of the Projects. The underwater noise output resulting from a given charge will vary depending on both the charge weight (size of the explosive charge within the UXO) and the clearance method used. Three clearance methods are described in detail within the Underwater Noise Modelling Report produced for the Projects (**Volume 7, Appendix 11-3 (application ref: 7.11.11.3)** and summarised below:

- High-order clearance (detonation of the charge using a donor charge);
- Low-order clearance (slow burning of the charge); and

- Low-yield clearance (e.g. use of the HYDRA UXO clearance system (or similar) to burn and disintegrate the charge).

209. Impact ranges for a number of UXO detonation scenarios in relation to the potential impact on fish species is provided in **Table 7-4.** As UXO clearance is a single noise event, it is assumed that receptors will not engage in fleeing behaviour.

Table 7-4 Summary of the impact ranges for UXO detonation using the unweighted SPLpeak¬ explosion noise criteria from Popper et al., (2014) for species of fish

Popper *et al.*, (2014) Unweighted SPL_{RMS}	**Mortality and potential mortal injury range (m)**	
	234 dB	**229 dB**
Low yield	130	210
Low order (0.25kg)	40	65
25 kg + 0.5kg donor	170	290
55 kg + 0.5kg donor	230	380
120 kg + 0.5kg donor	300	490
240 kg + 0.5kg donor	370	620
525 kg + 0.5kg donor	490	810
698 kg + 0.5kg donor	530	890

210. Specific surveys to identify potential locations of UXO would not be undertaken until the DCO for the Projects is granted. This is to allow more detailed engineering work to be carried out on the cable routes and locations of wind turbines to allow a targeted survey for potential UXO to be undertaken.

211. Ordtek (2023) has produced a report predicting the number of potential UXO that may be found within the Offshore Development Area. This report reviewed data sources including past potential UXO quantities seen on similar projects, site-specific geophysical data and historic use of the Offshore Development Area. It should be noted that real-world number of UXO may differ from these predicted figures. **Table 7-5** below details these predictive UXO numbers across the Offshore Development Area.

Table 7-5 Predicted UXO Numbers Requiring Clearance Within the Offshore Development Area

UXO Type	Nearshore Cable Route (<10m LAT)	Offshore Cable Route (>10m LAT)	DBS East Array Area	DBS West Array Area	Subtotal
German SC-50 Bomb	1	2	0	0	3
British 250lb MC Bomb	1	1	0	0	2
WWI German Mine	0	3	2	2	7
WWI British Mine	0	2	1	1	4
British 500lb MC Bomb	3	3	1	1	8
WWI U-Boat Torpedo (Multiple Variants)	0	1	0	0	1
German SC-250 Bomb	0	1	1	1	3
WWII British Buoyant Mine	0	2	1	1	4
German SC-500 Bomb	0	1	1	1	3
British 1000lb MC Bomb	0	1	1	1	3
WWII U-Boat Torpedo (Multiple Variants)	0	1	0	0	1
British 2000lb MC Bomb	0	0	0	0	0
German LMB Mine	0	1	0	0	1
German TMB Mine	0	0	0	0	0
German SC-1000 Bomb	0	1	0	0	1
German TMC Mine	0	0	0	0	0

UXO Type	Nearshore Cable Route (<10m LAT)	Offshore Cable Route (>10m LAT)	DBS East Array Area	DBS West Array Area	Subtotal
Totals	5	20	8	8	41

212. Both river and sea lamprey are a normally anadromous species (i.e. spawning in freshwater but completing part of its life cycle in the coastal waters) (JNCC, 2023). While no impacts will occur to fish within the River Derwent SAC due to its location inland, due to its connectivity to the Humber Estuary SAC there exists the potential for individuals from the site to be found in coastal waters near the Humber Estuary SAC.

213. The mouth of the Humber Estuary SAC is located approximately 46km from the offshore export cable corridor at its closest point. As the worst case impact range for UXO clearance is estimated to be 890m, UXO clearance activities would not directly impact any individuals within or in the vicinity of the Humber Estuary. However, adult river and sea lamprey could be found within the vicinity of UXO clearance activities in the nearshore offshore export cable corridor. As detailed in **Table 7-5,** it is estimated that up to five UXO found within this area.

214. There is little evidence available to suggest that river and sea lamprey are found in significant numbers within the Offshore Export Cable Corridor. As such, there is a minimal likelihood that any individuals would be found within 890m of a UXO detonation, the largest distance at which potential mortality or mortal injury could occur.

215. The range at which behavioural effects could occur is unknown and no suitable metric exists. However, given lamprey species low sensitivity to underwater noise (Popper *et al.*,, 2014), distance from the SAC and population size, it is considered unlikely that significant numbers of individuals would be disturbed by any detonation activities.

216. To mitigate any potential impacts of UXO detonation, low-order or low-yield UXO detonation methods would be used where possible to further reduce the distance at which any individuals could be impacted by UXO detonation events.

217. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects alone and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

7.4.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

7.4.2.1.2 Underwater noise and vibration impacts due to UXO clearance

218. Plans and projects that could overlap spatially and temporally with the Projects and are likely to require UXO detonation activities are listed below:

- Aminth subsea cable;
- Continental Link;
- Dogger Bank D;
- Eastern Green Link (EGL) 2, EGL3 and EGL4;
- Hornsea Project Four;
- Northern Endurance carbon capture and storage (CCS) project;
- CCS projects within leasing areas CS020, CS025 and CS028; and
- Outer Dowsing offshore wind farm.

219. As detailed in section 7.4.2.1.1, sea and river lamprey are considered to not be sensitive to underwater noise due to their lack of specialist hearing structures.

220. At present, there is no publicly available information regarding the potential number of UXO planned to be cleared by other plans and projects within the vicinity of the Offshore Development Area. However, given the minimal numbers of UXO estimated to require clearance in this area for the Projects, it is likely that the other nearby plans and projects will also require similar levels of clearance. The same mitigation measures as detailed in section 7.4.2.1.1 are industry standard approaches to mitigating for UXO detonation, and would be expected to be required by the other plans and projects. Given the low sensitivity of lamprey, levels of UXO clearance likely required and mitigation employed across projects and lack of evidence of the species presence within the Offshore Development Area, a minimal number of individuals could be impacted by UXO detonation events.

221. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects in combination with other plans and projects and therefore, subject to natural change, the migratory fish features of the River Derwent SAC will be maintained in the long term.

7.4.2.3 Summary

222. Due to the minimal numbers of UXO clearance activities required within the nearshore for the Projects, low sensitivity to underwater noise changes for lamprey species and mitigation measures available, there is no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects both alone or in combination with other plans and projects.

223. Therefore, subject to natural change, the migratory fish features of the River Derwent SAC will be maintained in the long term.

7.5 Humber Estuary SAC / Ramsar

7.5.1 Site Description

224. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). The high suspended sediment loads in the estuary feed a dynamic and rapidly changing system of accreting and eroding intertidal and sub-tidal mudflats and sandflats as well as saltmarsh and reedbeds. Other notable habitats include a range of sand dune types in the outer estuary, together with sub-tidal sandbanks and coastal lagoons.

225. A number of developing managed realignment sites on the estuary also contribute to the wide variety of estuarine and wetland habitats. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion. As salinity declines upstream tidal reedbeds and brackish saltmarsh communities fringe the estuary (Natural England, 2024b). The migratory fish species river lamprey and sea lamprey are known to route through the estuary to breed in the rivers of the Humber catchment.

7.5.1.1 Humber Estuary SAC Qualifying Feature / Ramsar Criteria

226. The site is designated as a SAC under article 4(4) of the Directive (92/43/EEC) as it hosts the following Annex II fish species:

- Sea lamprey; and
- River lamprey.

227. The Humber Estuary is also designated under Criterion 8 of the Ramsar convention due to the Humber Estuary acting as an important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas (JNCC, 2008).

228. As the geographical extent of the Humber Estuary SAC and Ramsar are identical, any conclusions drawn for one site can be transposed to that of the other site.

7.5.1.2 Humber Estuary SAC Conservation Objectives

229. The conservation objectives of the SAC are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function (including typical species) of qualifying natural habitats;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- The populations of qualifying species; and
- The distribution of qualifying species within the site.

7.5.1.3 SAC Condition Assessment

230. There is no current publicly available information regarding the condition of river lamprey or sea lamprey populations within the Humber Estuary SAC (Natural England, 2024c), or overlapping Humber Estuary SSSI (Natural England, 2024e).

7.5.2 Assessment

7.5.2.1 Assessment of potential effects of the Projects alone

231. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

7.5.2.1.1 Underwater noise and vibration impacts due to UXO clearance

232. As detailed in section 7.4.2.1.1, lamprey species lack specialist hearing structures and are considered to have low noise sensitivity (Popper, 2005), being defined as fishes lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to a narrow band of frequencies (includes flatfishes and elasmobranchs) (Popper *et al.*, 2014). The Humber Estuary SAC / Ramsar is located approximately 46km from the offshore export cable corridor at its closest point.

233. Predictive UXO numbers estimated for the Projects indicate up to five UXO may require clearance in the nearshore environment (<10km of Lowest Astronomical Tide), where migratory fish species from the Humber Estuary SAC / Ramsar may be found. There is little available evidence to suggest that river lamprey or sea lamprey are found in significant numbers within the vicinity of the Projects' Offshore Export Cable Corridor. As such, there is a minimal likelihood that any individuals would be found within 890m of a UXO detonation, the largest distance at which potential mortality or mortal injury could occur.

234. The range at which behavioural effects could occur is unknown and no suitable metric exists. However, given lamprey species low sensitivity to underwater noise (Popper *et al.*, 2014) and distance from the SAC / Ramsar, it is considered unlikely that significant numbers of individuals would be disturbed by any detonation activities.

235. To mitigate any potential impacts of UXO detonation, low-order or low-yield UXO detonation methods would be used where possible to further reduce the distance at which any individuals could be impacted by UXO detonation events.

236. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects together and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

7.5.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

7.5.2.1.2 Underwater noise and vibration impacts due to UXO clearance

237. The in-combination assessment for the Humber Estuary SAC / Ramsar is the same as that presented above for the River Derwent SAC (see section 7.4.2.2).

238. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects in combination with other plans and projects and therefore, subject to natural change, the migratory fish features of the Humber Estuary SAC / Ramsar will be maintained in the long term.

7.5.2.3 Summary

239. Due to the minimal numbers of UXO clearance activities required within the nearshore for the Projects, low sensitivity to underwater noise changes for lamprey species and mitigation measures available to reduce the impacts of UXO detonation, there is no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects both alone or in combination with other plans and projects.

240. Therefore, subject to natural change, the migratory fish features of the Humber Estuary SAC / Ramsar will be maintained in the long term.

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Appendix C - Review of evidence on recovery of sandbank habitat following habitat damage

DBS Offshore Wind

RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Review of Evidence on Recovery of Sandbank Habitat Following Habitat Damage (Revision 2) (Clean)

Document Date:	March 2025
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RWE MASDAR

Company:	**RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited**	Asset:	**Development**
Project:	**Dogger Bank South Offshore Wind Farms**	Sub Project/Package	**Consents**
Document Title or Description:	Review of Evidence on Recovery of Sandbank Habitat Following Habitat Damage (Revision 2) (Clean)		
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Rev No.	**Page**	**Section**	**Description**
01	N/A	N/A	Submitted at Pre-Examination Procedural Deadline
02	28-31	Appendix A	Additional information added into Table A-1 on the MarESA sensitivity of habitats and biotopes in response to Natural England's written advice [REP2-065] on benthic and intertidal ecology.
02	32	Figure A1	Updates to Figure A1 were made to indicate a greater quantification of bathymetry depths at the request of the Examining Authority (see BE1.9 in **The Applicants' Responses to EXQ1** [document reference 13.2])

Contents

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Glossary

Term	Definition
Array Area	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.
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.
Environmental Impact Assessment	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).
Environmental Statement	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Habitat Regulations	Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017.
Habitats Regulations Assessment	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.
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.
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.

Term	Definition
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.
Sediment Transport	The movement of a mass of sediment by the forces of currents and waves.
Special Area of Conservation	Strictly protected sites designated pursuant to Article 3 of the Habitats Directive (via the Habitats Regulations) for habitats listed on Annex I and species listed on Annex II of the Directive.
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).
Vessel Monitoring System	Satellite tracking system using a device on a vessel which transmits the location, speed and course of the vessel.

Acronyms

Acronym	Definition
AEOI	Adverse Effect on Integrity
BEIS	Business, Energy and Industrial Strategy
DBS	Dogger Bank South
EUNIS	Europe Nature Information System
HRA	Habitats Regulations Assessments
JNCC	Joint Nature Conservation Committee
MarESA	Marine Evidence-based Sensitivity Assessment
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
UXO	Unexploded Ordnance

1 Introduction

1. Several comments within the Natural England Relevant Representation (RR 039, Appendices C and D) refer to a disagreement over the conclusions within the **RIAA (Report to Inform Appropriate Assessment Habitats Regulations Assessment Part 2 of 4** [APP-046]) on habitat damage (also sometimes referred to as habitat disturbance and covered in the RIAA in section 6.4.2.1.1 (project alone and section 6.4.2.1.2 (in-combination)). The disagreements are around the extent to which recovery occurs, the timescales for this and how this should be interpreted in the assessment (i.e. whether this contributes to the conclusion of Adverse effect on Integrity (AEOI) for the sandbank feature of the Dogger Bank Special Area of Conservation (SAC)). Fundamentally, the Applicants argue in their conclusion for this impact that the sandbank feature of the Dogger Bank SAC is no less recoverable than the sandbank features of other SACs and that Secretary of State conclusions for previous projects are applicable in this case.

2. This note provides further explanation of the Applicants' position on this issue and additional site-specific evidence of habitat recovery from within the Dogger Bank SAC (see **Annex B - Dogger Bank B UXO crater survey results)**.

2 Background and Evidence of Recovery

3. The Dogger Bank is the largest single continuous expanse of shallow sandbank in UK, located in the middle of the North Sea, approximately 150km from the nearest coastline. The bank itself was formed by glacial processes before being submerged following sea level rise and covered with sand. The seabed over the majority of the bank within the SAC is 15-35m below current sea level. Its location in open sea and its shallow depth exposes the bank to substantial wave energy. Wave and tidal action mobilise the sandy sediment layer over the underlying hard structure of the bank itself, demonstrated by the formation of sediment ridges, particularly around the western edges of the bank (Diesing *et al*., 2009). This hydrodynamic environment determines the biological communities that are able to live and thrive within the surface sediments. It also prevents colonisation by vegetation and a range of sessile longer-lived species which require stable sediments to survive (JNCC, 2011).

2.1 The Dogger Bank SAC

4. The Dogger Bank SAC covers 12,331km^2 of the shallower parts of the bank structure it was identified for its biological communities characteristic of shallow sandy sediments on sandbanks. A range of characteristic biological community types has been identified through sampling across the bank (summarised in JNCC, 2011). The communities present do not depend on the underlying structure of the bank, but on the nature of the shallow sediment layer in or on which they live. Principle factors determining community composition include an interrelated combination of sediment grain size, water depth, hydrodynamic regime and organic content – as well as interactions between species such as predation. The majority of living organisms are found either on or near the sediment surface or burrowing within the top 5-30cm. In stable fine-grained muddy sediments found in deeper or very sheltered waters burrows of some species may extend to depths of 1-2m from the surface, but such sediment conditions are not found within the Dogger Bank SAC.

5. Biological communities of sandy sediments across the SAC vary depending primarily on the sediment type and water depth. Sandy sediments vary in character across the bank and support several slightly different biological communities of infauna living within the sediment and epifauna living at the seabed surface. Sand eels *Ammodytidae sp*. occur in large numbers around the Dogger Bank, are characteristic of sandbank habitat and are an important prey resource for fish, seabirds, seals and cetaceans. Occasional, discrete areas of coarser sediments (including pebbles) have been recorded on the bank, colonised by the soft coral *Alcyonium digitatum*, the bryozoan *Alcyonidium diaphanum* and Serpulid worms – all common species characteristic of rock and stable gravels and found throughout UK waters.

6. The JNCC supplementary advice on conservation objectives for Dogger Bank SAC lists four main community types present across the SAC (JNCC, 2022). One of those community types is found in the shallower regions in the south-west of the SAC (and covers the majority of the DBS Array Areas). This sediment community is characterised by the presence of the polychaete *Nephtys cirrosa* and amphipods of the genus *Bathyporeia sp*. This community can be likened to the 'South-West Patch' community previously described prior to 2003 by Wieking and Krönke and is equivalent to the EUNIS biotope MB5233 (previous EUNIS code A5.233, UK biotope code Ss.SSa.IFiSa.NcirBat (*Nephtys cirrosa* and *Bathyporeia spp*. in infralittoral sand)).

7. Such communities typically have low numbers of individuals, low species diversity and biomass and are dominated by small, short-lived rapidly reproducing mobile species that can recolonise areas quickly following disturbance from wave and tidal action. Eggleton *et al.* (2016) found that during all years sampled between 1985 and 2014 there was high temporal similarity in species composition within the 'south-west patch', and numbers of species, individuals and diversity were considerably lower in this area in comparison with communities in slightly deeper water further to the north and east on the Dogger Bank. These impoverished communities are not unique to the Dogger Bank and have been identified within similar dynamic habitats in offshore waters in the North Sea, for example on Leman Bank within the North Norfolk and Saturn Reef SAC (Eggleton *et al*., 2020).

2.2 Biological Community Types within the DBS Offshore Development Area

8. Within the DBS Offshore Development Area (within the Dogger Bank SAC), sediments consist of fine and medium sands with low silt content, with patches of coarser sands and gravels occurring predominantly in slightly deeper waters around the western edge of the DBS West Array Area and the southern edge of the DBS East Array Area (**Figure 9-2 Spatial Variations of Percentage of Sand, Gravel and Fines Across the Array Areas of DBS East and DBS West** [APP-086]).

9. Recent surveys conducted to inform the DBS EIA (**Appendix 9-3 - Benthic Ecology Monitoring Report** [APP-089]) recorded six habitats and associated biotopes from within the DBS Array Areas, Inter-Platform Cable Corridor and the part of the Offshore Export Cable Corridor that is within the Dogger Bank SAC (see **Annex A – Habitat / Biotope Recoverability to Disturbance**). The survey confirmed previous information on biotopes and biological communities characteristic of the southern and western parts of the Dogger Bank.

10. The biological communities of the majority of the 70 samples correspond to those previously identified as the 'south-west patch' community, being dominated by small mobile amphipods and polychaete worms (biotope MB5233 *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand). The coarser sediments in slightly deeper water around the western and southern edges of the Offshore Development Area within the SAC support slightly more diverse infaunal communities characteristic of these conditions (biotopes MC5212 *Abra prismatica, Bathyporeia elegans* and *polychaetes* in Atlantic circalittoral fine sand to the west and MC5214 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment to the west and south. See **Figure A-1** which details the locations and classifications of all sample points recorded in in the Offshore Development Area within the Dogger Bank SAC.

11. One community (biotope MC1251 Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay) found at two locations at the southern edge of the DBS East Array Area, is likely to be present as a result of erosion of sand and exposure of the underlying clay structure of the Dogger Bank.

2.3 Evidence for Recovery of Community Types from Disturbance

12. JNCC Supplementary advice on Conservation Objectives for Dogger Bank (JNCC 2022) states that for sandy mound sandbanks created by glacial processes but covered by sandy surface sediments, large scale topography or the underlying immobile substrates would not be expected to recover should they be physically impacted. The sandbank communities, however, are capable of recovering from impacts but this will be dependent on prevailing environmental conditions, the influence of human activities i.e. the scale of any current impacts, species life history traits, environmental connectivity between populations and habitat suitability. Recovery of biological communities of sandy habitats is only likely to be possible when the small scale topography and original sediment composition are restored (Boyd *et al*., 2005 cited in Mazik *et al*., 2015).

2.3.1 UK Government Studies

13. Baseline survey of cross-sections of sandbank habitat within offshore SACs in the southern North Sea demonstrated that the crests of sandbanks, their flanks and the troughs between the banks supported slightly different benthic communities. In general, the cleaner more mobile sands of the crests of the banks had lower numbers of surface dwelling and infaunal species, biomass, species richness and diversity than the communities of the more stable flanks and troughs (Eggleton *et al*., 2020).

14. Fishing using bottom-contacting gears was prohibited from the whole of the Dogger Bank SAC, in summer 2022. This prohibition was put in place as sediment abrasion from bottom-contacting fishing gears was assessed to be a factor preventing the SAC from achieving its conservation objectives. Cessation of fishing with such gears should allow the sediment communities of the Dogger Bank to recover from such disturbance (JNCC, 2022).

15. The Dogger Bank is located in an exposed area in the middle of the North Sea and subject to high natural disturbance, applying in particular to the shallower areas over the top of the bank which comprise most of the Offshore Development Area within the SAC. The species that comprise the benthic communities in these shallower more hydrodynamic areas will have evolved to withstand frequent natural disturbance events. Opportunistic species dominate the benthic community and larger, sedentary and longer-lived species are less well represented. This is akin to the crest communities described by Eggleton *et al*. (2020).

16. Sampling under Defra's Natural Capital and Ecosystem Assessment programme in 2023 will contribute to monitoring the effects of the 2022 fishing closure at Dogger Bank, but the results are not yet available.

17. Diesing *et al.* (2013) modelled natural disturbance of sediments compared to disturbance from fishing in the North Sea and Channel. Results indicated that fishing disturbance was less than natural disturbance in shallow areas such as the Dogger Bank and North Norfolk sandbanks. A comparative study of benthic samples from fished and non-fished areas within the Dogger Bank SAC prior to the fishing closure could not identify significant differences in sediment communities between fished and non-fished areas (Eggleton *et al.*, 2016). Conclusions from both these studies had to rely on information on fishing location and effort from Vessel Monitoring System data, which limited confidence in their conclusions, especially when considered at a fine scale. This limitation is indicative of the challenges associated with trying to distinguish impacts of sediment disturbance (natural or otherwise) on biological communities, in particular, in very hydrodynamically active areas such as the Dogger Bank where there is high natural disturbance.

2.3.2 Offshore Wind Industry Studies

18. RPS (2019) reviewed monitoring data from numerous offshore wind farms in UK waters on behalf of The Crown Estate (e.g. Barrow, Burbo Bank, Sheringham Shoal and Robin Rigg) and collated information on how the seabed has recovered from various different impacts in various different marine conditions. The report demonstrates that areas with sandy seabed types usually recover rapidly and in full following seabed levelling and trenching. Where evidence of sandwave levelling or cable trenching does remain following cable installation this occurs in areas with higher fine sediment content (muds and silts). RPS (2019) also demonstrates that where recovery has not occurred completely in sandy habitats, these examples were limited to areas with low levels of sediment transport (i.e. less dynamic areas with low seabed mobility).

19. Monitoring undertaken at Race Bank showed that after five months either partial or full recovery had occurred at ten out of 12 monitoring locations comprising 14 out of 19 sandwaves (Orsted, 2018a) which were levelled for the Race Bank Project. Sandwaves were levelled with a swathe width of up to 210m. A further bathymetric monitoring report, including data from 2018 (two years after construction), concluded that the seabed had either completely recovered or was close to recovering to pre-construction levels along most of the nine monitoring locations that were selected (Orsted, 2018b). The seabed in this case was between 4 and 14m below LAT. Orsted (2018a) concluded that the Race Bank data provided evidence of recovery but that in cases where waters were deeper recovery would likely take longer due to the reduced influence of wave effects at the seabed (from months to years). For the Dogger Bank South projects, sandwave levelling is estimated to require a swathe width of between 25 – 70m centered on each cable route in waters up to approximately 35m within the Dogger Bank SAC.

2.3.3 Evidence from the Dogger Bank

20. There is limited direct evidence of recovery from offshore wind activities within the Dogger Bank SAC itself, however where data are available these show rapid recovery of the physical structure of the surface sediments:

- The Applicants commissioned a geophysical survey to look at potential recovery of the seabed following the installation and removal of two met masts (monopiles on 15m diameter suction caissons) which were located in the Dogger Bank Wind Farm zone between 2013 and 2017 in the Dogger Bank B and Dogger Bank C wind farms (see Appendix 8-2 Met Mast Survey Analysis [APP-083]). A comparison of pre-installation and post removal geophysical survey data was undertaken. The analysis showed no significant seabed features resulting from the presence of met masts (which had been in place for four years prior to decommissioning) and showed that trawl marks and localised depressions visible in the pre-installation surveys had infilled over the 10-year period since installation of the met masts in 2013.

- Dogger Bank B undertook monitoring of craters caused by high-order UXO clearance in 2023 (Dogger Bank B, 2023). The UXO clearance campaign was completed in February-March 2023, with a survey of the craters in June 2023 at five of six clearance locations. Survey showed that in all cases the craters had infilled rapidly, in some cases infilling was largely complete, and even where there was the least recovery in (DBB_027) a 0.8m crater infilled to approximately 0.4m depth (see Appendix B - Dogger Bank B UXO crater survey results).

21. Whilst these examples only consider the physical structure of the sandbank, given the absence of physical barriers to communities re-establishing post-construction (other than in locations of above-surface infrastructure), ecological recovery is likely as the Dogger Bank communities typically have low numbers of individuals, low species diversity and are dominated by small, short-lived rapidly reproducing mobile species that can recolonise areas quickly following disturbance.

22. Sensitivity of the habitats and biotopes identified within the DBS Offshore Development Area from the RWE survey in 2023 was assessed using the Marine Evidence-based Sensitivity Assessment (MarESA) approach as part of the Environmental Assessment process (**Chapter 9 Benthic and Intertidal Ecology** [APP-085]). The MarESA approach was developed by the Marine Biological Association with support from the UK conservation agencies including Natural England and JNCC (Tyler-Walters *et al.*, 2023). Academic literature is reviewed to compile evidence on the biology and ecology of species and habitats to systematically assess their likely sensitivity to anthropogenic pressures. Part of that process assesses recoverability (or resilience) of the habitat or species based on life history of species and their ecology.

23. Recoverability of the six biotopes identified from the survey that are within the DBS Offshore Development Area within Dogger Bank SAC is compiled in Annex A of this report and summarised below:

- Shallow sediment biotope types present over the majority of the Offshore Development Area were assessed to have High recoverability, i.e. full recovery within 2 years of disturbance.
- Coarser sediments in deeper waters at the edges of the Dogger Bank in the west of the DBS West Array Area and the south of the DBS East Array Area were assessed as either high (full recovery within 2 years) or medium (full recovery within 2-10 years) depending on the type of abrasion pressure.
- One biotope type consisting of clay with burrows and identified at two locations at the far southern extremity of the DBS East Array Area, is identified as having very low recovery from habitat disturbance and unlikely to recover within 25 years.

24. In summary, survey evidence from the Dogger Bank and interpretation of the recoverability of biotopes using the MarESA approach suggests that the majority of communities within the DBS Offshore Development Area within Dogger Bank SAC would have high recovery rates.

2.4 Recovery of Sandeel Populations

25. Lesser and greater sandeel species (*Ammodytes marinus* and *Hyperoplus lanceolatus*) are widespread in UK waters, particularly the North Sea. Prior to the 2022 closure of the Dogger Bank to bottom contacting fishing gears there was an industrial fishery for these species in UK waters focussed around the western slopes of the Dogger Bank including much of the Offshore Development Area. Sandeel have a close association with the sandy sediments into which they burrow to depths of 20-50 cm. Larvae are planktonic and after settlement adults are largely stationary and show a strong preference for sediments composed of medium and coarse sands and avoid sediments containing more than 4% silt. During the spring and summer, sandeel emerge during the day to feed in schools and at night return to bury in the sand (Wright *et al.*, 2000; Holland *et al.*, 2005).

26. The recruitment and recoverability of sandeel populations is driven by oceanographic factors such as temperature and plankton availability, but also by the availability of suitable clean sands with low silt content. Following any disturbance of sediments due to construction of the windfarm, timescale for recovery will be dependent on availability of suitable sediment (i.e. without raised silt content), the size of the remaining population within the recovery area, rates of recruitment and mortality, and immigration from outside the area of impact. Given ideal conditions, noticeable changes in population size within a depleted area could be apparent after 4-6 years assuming 50 % of the individuals are sexually mature after 2 years and therefore recruitment from the following cohort will recruit after another 2 years (Mazik *et al.*, 2015).

27. **RIAA Appendix B – Sandeel Habitat Potential in the Dogger Bank SAC and Southern North Sea SAC** [APP-050] presents an overview of sandeel habitats across the SAC (based upon modelling of the potential for habitat to be suitable for sandeel) considering impact footprints of the Projects in the context of the SAC and also the wider Southern North Sea. The worst case for activities that may result in abrasion / disturbance of the seabed will be during the construction phase of the Projects. The activities are estimated to impact approximately 31.4km² within DBS East and DBS West Array Areas combined, representing 0.23% of the medium to high potential habitat for sandeel of the SAC.[1]

[1] It should be noted that the Applicants have proposed changes to the Projects' Design Envelope which would reduce the footprint of abrasion / disturbance of the seabed to 28.4km². This change will be detailed in the Project Change Request – Environmental Assessment Update [document reference: TBC]. It is expected that the change request will be submitted in mid-January 2025 following targeted consultation.

3 Determination of Adverse Effect from Previous Projects

28. The Hornsea Project Three offshore export cables crossed the North Norfolk Sandbanks and Saturn Reef SAC. The SAC is designated for Annex I Sandbanks and Annex I Reefs. The area predicted to be impacted was up to approximately 9.3km^2, approximately 0.26% of the SAC.

29. The conservation status of the site was not favourable and the objective for this site was to restore sandbanks to favourable condition by restoring their extent and distribution, structure and function and any supporting processes upon which they rely.

30. Hornsea Project Three argued in their application that temporary impacts from export cable installation within the SAC would not lead to adverse effect on integrity. This point was discussed during the examination of that project, and evidence from the Race Bank project (Orsted, 2018a, 2018b, see section 2.3.2) was presented to demonstrate recovery from, in particular, sandwave levelling. Detailed consideration of this issue contributed to the Secretary of State's decision on AEOI in this case (BEIS, 2020)

31. Natural England agreed with Hornsea Project Three that the Race Bank monitoring provided some confidence that sandwaves would recover, but questioned its applicability and whether the same conclusions apply within the North Norfolk Sandbanks and Saturn Reef SAC (BEIS, 2020). Natural England advised that whilst the extent of the potential impact was unclear, the extent of sandwave levelling was such that it could not be considered de minimis (BEIS, 2020). The Secretary of State concluded that monitoring undertaken by other projects, at other locations does not guarantee that identical results would occur elsewhere for similar activities in similar habitats; no two sites are identical and that any decision made is to be done so on the best available scientific evidence and not absolute certainty and without the use of existing monitoring data informed decisions cannot be made (BEIS, 2020).

32. Ultimately the Secretary of State concluded that:

"The Secretary of State recognises that the site [the North Norfolk Sandbanks and Saturn Reef SAC] has an unfavourable conservation status arising in part from human activities and that the conservation objectives for the site include the need to restore the sandbank feature to favourable condition. The Secretary of State considers that there is sufficient evidence to indicate that sandwaves will start to recover shortly after cable laying has been completed and cable installation will not reduce the conservation status of the sandbanks or delay the achievement of favourable status. Consequently, the Secretary of State is satisfied that the potential for impacts on Annex I sandbank features from cable

installation resulting from the Project alone would not represent an adverse effect upon the conservation objectives of the North Norfolk Sandbanks and Saturn Reef SAC."

33. The Applicants consider this case is highly relevant to the projects and the conclusions of the RIAA (**Report to Inform Appropriate Assessment Habitats Regulations Assessment Part 2 of 4** [APP-046]), given:

- This pertains to the same feature (sandbanks);
- The quantum of impact is similar to the Projects (0.26% of the SAC);
- The feature is considered to be in unfavourable condition with a restore objective; and
- Evidence of recovery from the feature elsewhere was considered in the conclusion.

34. In addition, the Applicants note that similar conclusions were reached for both the Norfolk Boreas and Norfolk Vanguard Projects (BEIS, 2021, 2022) where again, in spite of the unfavourable condition of the sandbank feature of the Haisborough, Hammond and Winterton SAC, the Secretary of State concluded no AEOI on the feature from temporary construction impacts.

35. The Applicants accept that in the three cases cited above, the sandbank feature was considered to be 'an active and highly dynamic environment', however highlight the evidence from sections 2.2 and 2.3 (in particular in situ evidence in section 2.3.3) that recovery is likely to be rapid within the Dogger Bank also.

4 Plan Level HRA and Compensation Plan and Natural England Advice

36. Limited evidence was provided in the Plan Level process for how abrasion / disturbance of the seabed should be considered. The Plan Level RIAA (The Crown Estate, 2022a)[2] states that:

"The Secondary Assessment has calculated the impact from the Round 4 Plan alone to be 32.209km², which equates to 0.261% of this features distribution within this Protected Site. This is due to the footprint of subsea infrastructure required for Preferred Projects 1 and 2. This impact will be a long-term impact (which is currently expected to be up to 60 years) on the feature's extent and distribution (currently in unfavourable condition). Following installation this feature will have limited potential to recover, and the feature is already in unfavourable condition. Such an impact would delay restoration, which would be contrary to the Conservation Objectives of this SAC."

37. This is the sole basis upon which The Crown Estate conclude adverse effect on integrity. No evidence is presented for the 'limited potential to recover'. The Applicants note that the Plan Level HRA documentation makes limited mention of supporting functions of the Dogger Bank SAC in terms of provision of prey species (The Crown Estate, 2022b), the assessment therefore is purely in terms of footprint upon the seabed. The Plan Level RIAA (The Crown Estate, 2022a) notes the conclusion from the Hornsea Project Three HRA, but seems to conflate habitat loss and habitat damage within its interpretation of that decision.

38. The Applicants note that the Plan level HRA states the following (The Crown Estate, 2022c):

"The Crown Estate is satisfied that the approach to uncertainties adopted by the RIAA is appropriate, namely that where meaningful assessment cannot be undertaken at plan level (owing to this absence of key information), reliance can be placed on the project-level assessment (specifically at the lower the project-level HRA). This is on the basis that project-level HRA:

- *Will be required as a matter of law at that stage;*
- *Will need to identify and assess the magnitude of all LSEs including those effects identified at plan level which are affected by uncertainty;*
- *Will be able to determine and secure, where necessary, appropriate and feasible mitigation measures;*

[2] Note that all references to footprints in the Plan Level HRA refer to values assumed during that process and subsequently refined during the Project level EIA, although these have change, however they do not change the substance of the arguments.

- *Will be able to more precisely identify the nature timing, duration, scale or location of development, based on further detailed information and data, and therefore will be able to ascertain with more certainty the magnitude of the effects of each project to enable an AEOSI to be avoided."*

39. The Applicants opinion, therefore, is that the conclusions of the Plan Level HRA may be superseded by Project Level assessments where more detailed information is available. The Applicants note that in the case of guillemot at Flamborough and Filey Coast Special Protection Area, for example, the Plan Level HRA concluded no adverse effect (either for the Plan alone or in-combination) but this conclusion is unlikely to be upheld at the project Level given that decisions made by the Secretary of State subsequent to the Plan Level HRA concluded AEOI for that feature. The Applicants consider that it would be unreasonable to only update Plan Level HRA conclusions in a negative way in response to information which '*more precisely identify the nature timing, duration, scale or location of development, based on further detailed information and data, and therefore will be able to ascertain with more certainty the magnitude of the effects of each project'.*

40. The Dogger Bank Strategic Compensation Plan paragraphs 3.1.3 and 3.1.4 (**Round 4 Dogger Bank Strategic Compensation Plan** [APP-060]) states the following (noting that although the following is described as recovery from loss the text appears in relation to habitat damage) (emphasis added):

"The impact of habitat loss was considered in the Report to Inform Appropriate Assessment (RIAA) as effectively a permanent impact since it would persist for the lifetime of the Round 4 projects, specifically Dogger Bank South West and Dogger Bank South East, which is currently expected to be as long as the impact persists, up to 60 years (the duration of the lease). <u>Recovery from habitat damage would be expected (e.g. BEIS, 2019) but the Round 4 Plan Level HRA recognised that sandy mound sandbanks such as Dogger Bank have limited recovery ability compared to more dynamic current tidal sandbanks. For this reason, habitat damage was included as part of the reason behind the conclusion of Adverse Effects of Special Interest (AEOSI) of the sandbank feature of Dogger Bank SAC, alongside habitat loss.</u>

The habitat damage value represents the seabed area expected to be affected by activities such as cable burial (where not followed by rock protection, for which habitat loss is assumed), placement of temporary anchors and jack-up barge legs etc. Habitat recovery from damage would be expected (e.g. BEIS, 2019) <u>but the Round 4 Plan Level HRA recognised that sandy mound sandbanks such as Dogger Bank have limited recovery ability compared to more dynamic current tidal sandbanks. Recovery from habitat loss would not occur until decommissioning has been completed, and, may take 10-25 years (based on Natural England's advice).</u> Such impacts would delay restoration which would be contrary to the conservation objectives of this the Dogger Bank SAC. This *impact can be reduced with mitigation that limits the extent of infrastructure within the SAC, but not to levels at which an AEOSI can be discounted."*

41. Natural England were asked by the Applicants during The Crown Estate Strategic Compensation Steering Group meetings to provide evidence for the above position on duration of recovery (i.e. 10 – 25 years), and no evidence has been provided to date or has been put forward within their Relevant Representation.

42. Within their Relevant Representation Natural England provide the following advice (Annex C1). This is in relation to small-scale habitat loss, not damage, but is the fullest articulation to date by Natural England of how adverse effect on integrity could be concluded.

"Whilst there are no hard and fast rules or thresholds, in order for Natural England to advise that there is no likelihood of an adverse effect the Applicant would need to demonstrate the following:

1) That the loss is not on the priority habitat/feature/ sub feature/ supporting habitat; and/or

2) That the loss is temporarily and reversible (within guidelines above); and/or

3) That the scale of loss is so small as to be de minimus alone and/ or

4) That the scale of loss is inconsequential including other impacts on the site/ feature/ sub feature"

43. It is the Applicants' opinion that the question of recovery is a particularly important issue to consider, given the implications for compensation in the event of a conclusion of AEOI from the Secretary of State and the uncertain position on compensation ratios reached by Dogger Bank Strategic Compensation Plan (Round 4 Dogger Bank Strategic Compensation Plan [App-060]). The plan states that (paragraph 6.2.6):

"In summary, the Steering Group do not agree that a simple value (e.g. 25%) to represent required level of compensation for damage can currently be supported. Whilst some value below 100% is likely to be justified, (Natural England indicated during consultation that the habitat recovery time of Dogger Bank is 10 to 25 years), further study to develop a robust figure will be required. In the absence of this the compensation level for habitat damage should be considered as 1:1 in line with the precautionary principle."

44. The Applicants' view is that there will be no AEOI in relation to habitat disturbance/damage and compensation for this effect is unnecessary. However, if AEOI is determined by the Secretary of State, any compensation requirement must take into account evidence of recovery as stated in the Dogger Bank Strategic Compensation Plan (quoted above). At present, it is the Applicants' understanding that the Defra-led process (to which they are not parties) is considering the scale of compensation required for strategic needs. As stated by Natural England in their Relevant Representation (Appendix D of RR-039):

"Information on the expected impacts of OWF projects on designated habitats has been collected from developers and the DEFRA team will be taking this into account when developing the proposals, alongside advice from SNCBs on ecological viability, ratios and any management measures that may be required. Ultimately it will be for DEFRA to determine the amount of compensation required, irrespective of what the Applicant has detailed in Section 5 Compensation Quantum."

45. The Applicants are concerned that an over-precautionary approach to the quantum of compensation could undermine the justification for any site put forward for designation as strategic compensation measure and delay the implementation of the compensation.

5 Conclusions

46. The Plan level HRA and Natural England advice assert that the communities of the Dogger Bank SAC are unlike those of other sandbanks within SACs and will take a long time to recover from disturbance (10 -25 years). No evidence has been provided for this position.

47. The Applicants' evidence on the recoverability of sediment communities in the Dogger Bank SAC come from several sources:

- The biotopes recorded in the site-specific surveys are all stated to have high (full recovery within two years) or medium (full recovery within 2 – 10 years) recovery rates, using the MarESA sensitivity criteria which are supported by JNCC and Natural England.[3]
- Evidence from site specific survey from offshore wind developments within the SAC demonstrate rapid recovery from construction effects (see **Annex B - Dogger Bank B UXO crater survey results**) and recovery from longer-term operational effects (see **Appendix 8-2 Met Mast Survey Analysis** [APP-083])
- Evidence from industry studies of recovery of habitats (RPS, 2019, Orsted, 2018a, 2018b).
- UK Government studies which describe the sandy habitats characteristic of the Dogger Bank as being typified by fauna that are adapted to high rates of mortality and natural disturbance (Eggleton *et al.*, 2016). This study (which was of the effects of fishing activity on the Dogger Bank), found that faunal communities did not noticeably differ along an abrasion pressure gradient.

48. There is no evidence to indicate that recovery of the sediment communities at Dogger Bank would be any more limited than on sandbanks formed by tidal currents such as those within other SACs in the southern North Sea. Recovery of biological communities would be likely to start to occur within individual damaged areas as soon as the sediment characteristics in that area are restored following construction. The Applicants maintain the position that the Plan Level HRA, did not adequately address recovery, irrespective of whether its conclusions are 'signed off'.

49. All of the above suggest that recovery will take place and that this needs to be considered within any conclusions on AEOI. The Applicants have therefore considered the criteria for small-scale habitat loss provided by Natural England in their Relevant Representation and provided commentary on each point (see **Table 5-1**).

[3] The exception to this is the piddock habitat which was picked up in site specific survey. The Applicants note that the presence of piddock habitat within the Dogger Bank is potentially the result of bottom contacting fisheries removing overlaying sediments and exposing suitable substrates for the piddocks. This habitat is not mentioned in the site selection documentation (JNCC, 2011) or the Supplementary Advice on Conservation Objectives (SACO) for Dogger Bank (JNCC, 2022). This habitat is not a recognised feature of sandbanks. Recovery of the sandbank feature as a result of the cessation of fisheries within the SAC may well lead to the loss of the piddock habitat.

50. In conclusion, the Applicants maintain the position that given the evidence for recovery, the situation for habitat damage in the Dogger Bank SAC is no different from that of Hornsea Project Three and the North Norfolk Sandbanks and Saturn Reef SAC, or Norfolk Boreas and Norfolk Vanguard Projects and the Haisborough, Hammond and Winterton SAC. Habitat damage therefore should not contribute to the conclusion of AEOI for the Dogger Bank SAC sandbank feature.

Table 5-1 The Applicants commentary on Natural England Criteria for consideration of small-scale habitat loss with SACs in relation to AOEI.

Criterion	Response
Whilst there are no hard and fast rules or thresholds, in order for Natural England to advise that there is no likelihood of an adverse effect the Applicants would need to demonstrate the following	n/a
That the loss is not on the priority habitat/feature/ sub feature/ supporting habitat; **and/or**	All seabed within the SAC is considered to be Annex 1 sandbank – whether this criterion is relevant is therefore dependent upon interpretation of the 'and/or' This is the same situation as for North Norfolk Sandbanks and Saturn Reef SAC the entire SAC is designated and viewed as an Annex I sandbank system (BEIS, 2020)
That the loss is temporarily [sic] and reversible (within guidelines above); **and/or**	The Natural England advice states *"for loss to be considered temporary it must be clearly time limited to the point where the impact is predicted to return to the same pre-impact condition and must include a detailed remediation plan using proven techniques as part of the licence."* The Applicants contend that all of the evidence summarised in **paragraph 47** show that recovery will be full, and occur well below the 25 year timescales Natural England has suggested for the Dogger Bank. Remediation is not considered necessary given the dynamic nature of the habitats and evidence of natural recovery.
That the scale of loss is so small as to be de minimis alone **and/ or**	There is no agreement on scale of impact in qualitative terms, the Applicants maintain that the disturbance effect at 0.2% of the area of the SAC (as a worst case) would qualify as de-minimis. Note that Natural England's advice for Hornsea Project Three (see **paragraph 31**) was that the impacts were not de minimis, nevertheless SoS concluded no AEOI. The scale of

Criterion	Response
	impact from the Projects is similar to Hornsea Project Three (0.2% for the Projects compared with 0.26% for Hornsea Project Three).
That the scale of loss is inconsequential including other impacts on the site/ feature/ sub feature	As stated in paragraph 20 of the RIAA **(Report to Inform Appropriate Assessment Habitats Regulations Assessment Part 2 of 4** [APP-046]), fisheries impacts were considered to have affected 8,700km^2 of the SAC seabed (70.5% of the SAC) in 2016 alone. This demonstrates the difference in magnitude of these effects, acknowledging that bottom contacting fisheries are now prohibited within the SAC.As such the Applicants consider the scale of loss to be inconsequential.

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Annex A – Habitat / Biotope Recoverability to Disturbance

51. **Table A-1** details the habitats identified in the ES as observed (June 2023) within the proposed Array Areas, Inter-Platform Cable Corridor and the offshore part of the Offshore Export Cable Corridor (after Tables 9-12 and 9-15 in **Chapter 9 Benthic and Intertidal Ecology** [APP-085]). Habitats are listed in order of most to least commonly identified biotope, described in relation to the Dogger Bank SAC, and recoverability to types of disturbance is listed according to MarESA assessments. **Figure A-1** details the locations and classifications of all sample points recorded in in the Offshore Development Area within the Dogger Bank SAC.

Table A-1 Habitats Identified During Site Specific Surveys Within the Dogger Bank SAC and Potential Recoverability to Disturbance

<table>
<tr><th>EUNIS (EEA, 2022) Habitat Classification
(Equivalent EUNIS 2007 and JNCC 2023 codes)</th><th>Description of distribution of biotope/habitat within the Offshore Development Area (7.9 ES Chapter 9)</th><th>Recoverability from removal of substratum (extraction)</th><th>Recoverability from abrasion/surface disturbance</th><th>Recoverability from subsurface disturbance</th></tr>
<tr><td colspan="5">Habitats/Biotopes Located Identified Within the Dogger Bank SAC</td></tr>
<tr><td rowspan="2">MB5233 Nephtys cirrosa and Bathyporeia spp. in Atlantic infralittoral sand
(A5.233 or SS.SSa.IFiSa.NcirBat)</td><td rowspan="2">Occurred at 70 stations across the entirety of the Inter-Platform Cabling Corridor and the majority of both Array Areas with the exception of the southern half of DBS East and the western reaches of DBS West. This biotope was typical of the shallower parts of the top of the Dogger Bank itself.</td><td>High
(Full recovery within 2 years)</td><td>High
(Full recovery within 2 years)</td><td>High
(Full recovery within 2 years)</td></tr>
<tr><td colspan="3">The following is reproduced from MarESA
https://www.marlin.ac.uk/habitats/detail/154/nephtys_cirrosa_and_bathyporeia_spp_in_infralittoral_sand
Resilience assessment. As a consequence of the dynamic nature of the habitat the faunal component of the biotope is very sparse and low in species richness. Therefore, the community might be considered 'mature' only a few days or weeks after the last storm event, as the mobile species displaced from the biotope and those from adjacent area colonize the substratum via the surf plankton. Even following severe disturbances recovery would be expected to occur within a year; biotope resilience is therefore assessed as 'High' for any level of impact (e.g. where resistance is 'None', 'Low' or 'Medium').
Consideration in the assessment
It is evident from the text reproduced above that recovery will be rapid. Whilst 'resistance' to construction activity is clearly none or low, the ability of mobile fauna to return from surrounding area and their reproductive capacity mean that resilience is high and sensitivity low. MasrESA even state that 'severe' disturbance would be recoverable within a year.
MarESA states that "This assessment may underestimate sensitivity to high-levels of abrasion (repeated events within a short period)." However, for the vast majority of locations across the array there will only be a single disturbance event during construction. In the case of cables for example, once the cable is installed physical recovery will commence. There is no need for repeat disturbance at that location unless remedial work is required, either during construction or for the operational lifetime. Likewise for turbines whilst the initial disturbance footprint is large (if seabed preparation is required) subsequent disturbance is limited to the jack-up footprint. Therefore, there is no need to consider repeated disturbance events</td></tr>
<tr><td rowspan="2">MC5212 Abra prismatica, Bathyporeia elegans and polychaetes in circalittoral fine sand
(A5.252 or SS.SSa.CFiSa.ApriBatPo)</td><td rowspan="2">Occurred at 46 stations primarily in the western extent of the DBS West Array Area and comprised the majority of samples recorded along the Offshore Export Cable Corridor, up to 43km from the landfall. This biotope is typical of the slightly deeper fine sand areas around the edges of the Dogger Bank itself.</td><td>Medium
(Full recovery within 2-10 years)</td><td>High
(Full recovery within 2 years)</td><td>High
(Full recovery within 2 years)</td></tr>
<tr><td colspan="3">The following is reproduced from MarESA
https://www.marlin.ac.uk/habitats/detail/1133/abra_prismatica_bathyporeia_elegans_and_polychaetes_in_circalittoral_fine_sand
Resilience assessment. Where resistance is 'None' or 'Low' and an element of habitat recovery is required, resilience is assessed as 'Medium' (2-10 years), based on evidence from aggregate recovery studies in similar habitats including Boyd et al. (2005). Where resistance of the characterizing species is 'Low' or 'Medium' and the habitat has not been altered, resilience is assessed as 'High' as, due to the number of characterizing species and variability in recruitment patterns, it is likely that the biotope would be considered representative and hence recovered after two years although some parameters such as species richness, abundance and biotopes may be altered. Recovery of the seabed from severe physical disturbances that alter sediment character may also take up to 10 years or longer (Le Bot et al., 2010), although extraction of gravel may result in more permanent changes and this will delay recovery.
Consideration in the assessment
Other than where the substratum is removed (which is really intended to represent aggregate extraction and is not a realistic impact for the Projects) recovery will be rapid. It is not considered that the construction activities would 'alter the sediment character' given that most disturbance would be of the</td></tr>
</table>

EUNIS (EEA, 2022) Habitat Classification (Equivalent EUNIS 2007 and JNCC 2023 codes)	Description of distribution of biotope/habitat within the Offshore Development Area (7.9 ES Chapter 9)	Recoverability from removal of substratum (extraction)	Recoverability from abrasion/surface disturbance	Recoverability from subsurface disturbance
		surface and near-surface sediments. Other than where there is placement of surface infrastructure there is no barrier to fauna from surrounding areas moving to recovering areas. MarESA states *Abrasion is likely to damage epifauna and flora and may damage a proportion of the characterizing species, biotope resistance is therefore assessed as 'Medium'. Resilience is assessed as 'High' as opportunistic species are likely to recruit rapidly and some damaged characterizing species may recover or recolonize. Biotope sensitivity is assessed as 'Low'.* *Penetration or disturbance of the substratum subsurface - The trawling studies and the comparative study by Capasso et al. (2010) suggest that the biological assemblage present in this biotope is characterized by species that are relatively tolerant of penetration and disturbance of the sediments. Either species are robust or buried within sediments or are adapted to habitats with frequent disturbance (natural or anthropogenic) and recover quickly. The results suggest that a reduction in physical disturbance may lead to the development of a community with larger, more fragile species including large bivalves. Biotope resistance is assessed as 'Medium' as some species will be displaced and may be predated or injured and killed. Biotope resilience is assessed as 'High' as most species will recover rapidly and the biotope is likely to still be classified as the same type following disturbance. Biotope sensitivity is therefore assessed as 'Low'.* Whilst it is accepted that there are some longer lived species (i.e. bivalve) that make take longer to recover, it is noted that '*the biotope is likely to still be classified as the same type following disturbance'.* In addition, Tyler-Walters *et al* (2023) state *Full recovery is defined as the return to the state of the habitat that existed prior to impact. This does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognisable as the initial habitat of interest. It should be noted that the recovery rates are only indicative of the recovery potential.* As per the assessment for MB5233 *Nephtys cirrosa* and *Bathyporeia spp.* in Atlantic infralittoral sand, it is not considered that repeated disturbance is relevant and therefore does not affect recovery.		
MC5214 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (A5.261 or SS.SSa.CMuSa.AalbNuc)	Occurred at 31 stations primarily in the southern extent of the DBS East Array Area, in isolated locations within the DBS West Array Area, the DBS East branch of the Offshore Export Cable Corridor. This biotope is typical of the slightly deeper fine, slightly muddy sand areas around the edges of the Dogger Bank itself.	Medium (Full recovery within 2-10 years)	High (Full recovery within 2 years)	High (Full recovery within 2 years)
		As per MC5212 *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand https://www.marlin.ac.uk/habitats/detail/62/abra_alba_and_nucula_nitidosa_in_circalittoral_muddy_sand_or_slightly_mixed_sediment **Consideration in the assessment** The evidence provided by MarESA is the similar to that presented for MC5212, which is to be expected given the similarities between them, our rationale for consideration within the assessment is therefore the same		
MC3215 *Branchiostoma lanceolatum* in Atlantic	Occurred at 11 stations primarily towards the	Medium (Full recovery within 2-10 years)	High (Full recovery within 2 years)	Medium (Full recovery within 2-10 years)

<table>
<tr><th>EUNIS (EEA, 2022) Habitat Classification

(Equivalent EUNIS 2007 and JNCC 2023 codes)</th><th>Description of distribution of biotope/habitat within the Offshore Development Area (7.9 ES Chapter 9)</th><th>Recoverability from removal of substratum (extraction)</th><th>Recoverability from abrasion/surface disturbance</th><th>Recoverability from subsurface disturbance</th></tr>
<tr><td>circalittoral coarse sand with shell gravel

(A5.145 or SS.SCS.CCS.Blan)</td><td>western edge of the DBS West Array Area and isolated locations within DBS East. This biotope is typical of the slightly deeper, more tide-swept coarse sand areas around the edges of the Dogger Bank itself.</td><td colspan="3">The following is reproduced from MarESA

https://www.marlin.ac.uk/habitats/detail/244/branchiostoma_lanceolatum_in_circalittoral_coarse_sand_with_shell_gravel

Resilience assessment. Branchiostoma is likely to recruit as adults from surrounding habitats due to its mobility, where the impact footprint is small (resistance is assessed as 'Medium'), recovery in this instance will be assessed as 'High'. Where resistance is 'None' or 'Low' recovery may depend on reproduction and migration and resilience is assessed as 'Medium'.

Consideration in the assessment

Other than where the substratum is removed (which is really intended to represent aggregate extraction and is not a realistic impact for the Projects) recovery will be rapid. It is not considered that the construction activities would 'alter the sediment character' given that most disturbance would be of the surface and near-surface sediments. Other than where there is placement of surface infrastructure there is no barrier to fauna from surrounding areas moving to recovering areas.

This biotope is characterized by the presence of the Cephalochordate Branchiostoma lanceolatum. As members of this ecological group are generally buried within the sediment this will provide some protection. MarESA highlights that this species can regenerate portions, particularly parts of the tail and recover from injuries and recovery of impacted populations may occur through recovery of damaged individuals, migration of adults or by colonization by planktonic larva and that evidence suggests that recolonization of disturbed habitats by B. lanceolatum can be rapid.

As per the assessment for MB5233 Nephtys cirrosa and Bathyporeia spp. in Atlantic infralittoral sand, it is not considered that repeated disturbance is relevant and therefore does not affect recovery.</td></tr>
<tr><td rowspan="2">MC3 Circalittoral coarse sediment

A5.15 or CCS

(MC3211 Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles used as proxy for recoverability assessment)</td><td rowspan="2">Found in eight isolated samples in the DBS West Array Area, two locations at the southern extent of the DBS East Array Area and in one location in the Offshore Export Cable Corridor. All locations occur in slightly deeper, more tide-swept areas around the south western edges of the Dogger Bank itself.</td><td>High

(Full recovery within 2 years)</td><td>High

(Full recovery within 2 years)</td><td>High

(Full recovery within 2 years)</td></tr>
<tr><td colspan="3">The following is reproduced from MarESA

https://www.marlin.ac.uk/habitats/detail/177/spirobranchus_triqueter_with_barnacles_and_bryozoan_crusts_on_unstable_circalittoral_cobbles_and_pebbles

Resilience assessment. This biotope is considered to have a high recovery potential. Sebens (1985, 1986) noted that calcareous tube worms, encrusting bryozoans and erect hydroids and bryozoans covered scraped areas within four months in spring, summer and autumn. Most of the epifauna is probably subject to severe physical disturbance and scour during winter storms and probably develops annually, through recolonization from any surviving individuals and from adjacent habitats. Therefore, recovery is likely to be very high; the biotope develops within less than a year and probably no more than six months in spring and summer. Where resistance is 'High', resilience is assessed as 'High' by default. Bryozoans, Balanus crenatus and Spirobranchus triqueter are rapid colonizers and are likely to recover quickly, probably within months. Therefore, the resilience, of these species, is assessed as 'High' for any level of perturbation (resistance).

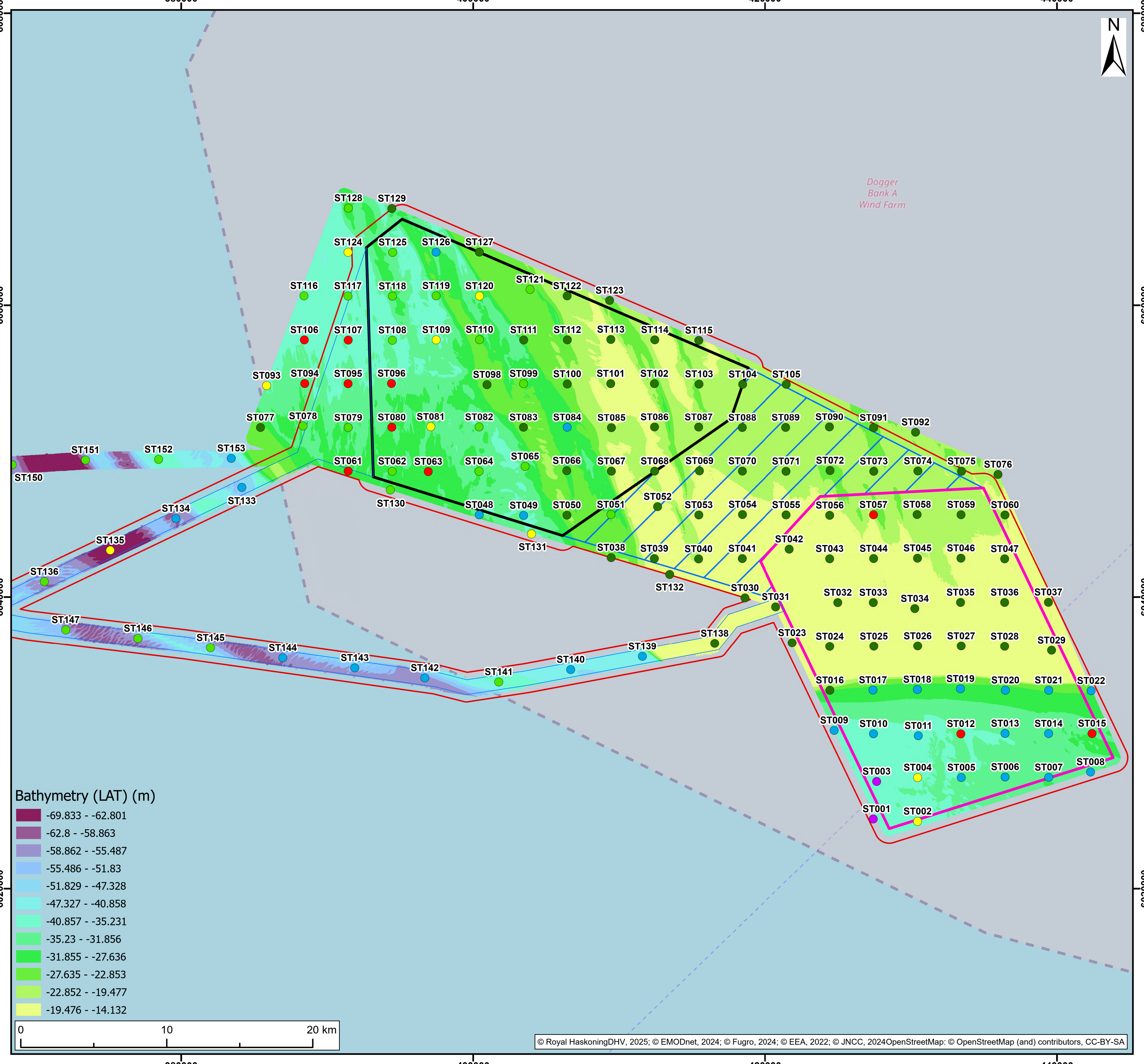
Consideration in the assessment

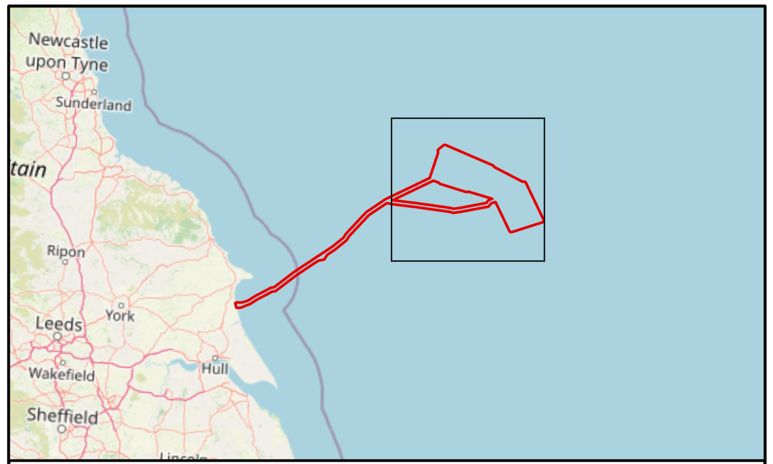
It is evident from the text reproduced above that recovery will be rapid given that 'the resilience, of these species, is assessed as 'High' for any level of perturbation'

As per the assessment for MB5233 Nephtys cirrosa and Bathyporeia spp. in Atlantic infralittoral sand, it is not considered that repeated disturbance is relevant and therefore does not affect recovery.</td></tr>
<tr><td></td><td></td><td>Very low</td><td>Very low</td><td>Very low</td></tr>
</table>

EUNIS (EEA, 2022) Habitat Classification (Equivalent EUNIS 2007 and JNCC 2023 codes)	Description of distribution of biotope/habitat within the Offshore Development Area (7.9 ES Chapter 9)	Recoverability from removal of substratum (extraction)	Recoverability from abrasion/surface disturbance	Recoverability from subsurface disturbance
MC1251 Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (A4.231 or CR.MCR.SfR.Pid)	Found at two locations at the southernmost corner of the DBS East Array Area. This was in association with the biotope *Abra alba* and *Nucula nitidosa* (MC5214) in circalittoral muddy sand or slightly mixed sediment.	(Negligible or prolonged recovery possible; at least 25 years to recover structure and function)	(Negligible or prolonged recovery possible; at least 25 years to recover structure and function)	(Negligible or prolonged recovery possible; at least 25 years to recover structure and function)
		With regard to piddocks, note that the **Draft DCO (Revision 5)** [REP1-004] includes a provision to micro-site and avoid impacts upon this feature.		
Habitats/Biotopes Located Identified Outside of the Dogger Bank SAC				
MC3212 *Mediomastus fragilis, Lumbrineris spp.* and venerid bivalves in Atlantic circalittoral coarse sand or gravel (A5.142 or SS.SCS.CCS.MedLumVen)	Found at five locations in inshore waters in a stretch of the Offshore Export Cable Corridor. Not found within the DB SAC.	High (Full recovery within 2 years)	High (Full recovery within 2 years)	High (Full recovery within 2 years)
		As per MC5212 *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand https://www.marlin.ac.uk/habitats/detail/382/mediomastus_fragilis_lumbrineris_spp_and_venerid_bivalves_in_circalittoral_coarse_sand_or_gravel **Consideration in the assessment** The evidence provided by MarESA is the similar to that presented for MC5212, which is to be expected given the similarities between them, our rationale for consideration within the assessment is therefore the same		

Note: 'Full recovery' is envisaged as a return to the state of the habitat that existed prior to impact. However, this does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognizable as the initial habitat of interest. The assessments are based on key structural or functional or important characteristic species for each biotope (Tyler-Walters *et al* 2023).





Legend

- Offshore Development Area
- Offshore Export Cable Corridor
- DBS East Array Area
- DBS West Array Area
- Inter-Platform Cable Corridor
- Dogger Bank Special Area of Conservation (SAC)

EUNIS Classification

- MB5233: *Nephtys cirrosa and Bothyporeia* spp. in Atlantic infralittoral sand
- MC3212: *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel
- MC3215: *Branchiostoma lanceolatum*in Atlantic circalittoral coarse sand with shell gravel
- MC3: *Circalittoral coarse sediment*
- MC5212: *Abra prismatica, Bathyporeia elegand* and polychaetes in circalittoral fine sand
- MC5214: *Abra alba and Nucula nitikdosa* in ciracllitoral muddy sand or slightly mixed sediment
- MC5214 & MC1251: *Abra alba and Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment and Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay

SUI	REV	DATE	DESCRIPTION	DRW	CHK	APR
S2	P02	13/03/2025	Suitable for Information	SM	CC	RF
S2	P01	06/11/2024	Suitable for Information	SM	CC	RF

Title:

Completed environmental stations and EUNIS (EEA, 2022) habitat classifications within the Offshore Development Area within the Dogger Bank SAC

Figure: A-1 | Drawing No: PC2340-RHD-OF-ZZ-DR-Z-0910

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

Project: Dogger Bank South Offshore Wind Farms

Report: Sandbank Habitat Recovery Technical Note

Royal HaskoningDHV
Enhancing Society Together

DBS Offshore Wind

Appendix B - Dogger Bank B UXO Crater Survey Results

Dogger Bank B UXO crater survey results, June 2023

Prepared by		Checked by		Approved by		Project Review by		Date of Issue
Richard West / Aidan Flint	26/07/23	Dave Scott	28/07/23	Dave Scott	31/07/23			31/07/23

1 Introduction

The Dogger Bank B (DBB) UXO clearance campaign was completed by Boskalis in February-March 2023 under marine licence L-2023-000181. Six confirmed UXO (cUXO) were neutralised using high order clearance methodology due to the degraded nature of the cUXO mine casings. Condition 5.2.21 of the marine licence requires the Project to monitor any craters caused by high order cUXO clearances as follows:

> *Long term monitoring of any craters caused by high order detonation(s) within the Dogger Bank Special Area of Conservation must be undertaken and the results submitted to the MMO for approval within eight weeks of every survey being undertaken.*
>
> *Monitoring is to be undertaken during the post lay survey, which is expected to take place 12 to 18 months after UXO clearance operations.*
>
> *If craters have not recovered at this stage further monitoring and/or remedial action to support recovery of the benthic community must be implemented as approved by MMO in consultation with Natural England and the Joint Nature Conservation Committee.*

Due to survey requirements for Dogger Bank C, there was an opportunity for the Project to carry out a survey of the cUXO clearance craters in June 2023 at five of the six cUXO clearance locations. This Technical Note presents the results of the first post-clearance campaign survey of those five craters.

2 Crater Survey Results

All six cUXO cleared in the 2023 campaign were located within the DBB array area (Figure 1). Post-clearance surveys of the resultant craters were carried out by Boskalis, the UXO clearance contractor, using an ROV mounted Multi-Beam Echo Sounder (MBES) deployed from the vessel *Kamara*. This provided detailed surveys of each 'as left' crater from a position in the water column just above the resultant clearance craters.

The survey on 5 June 2023 was undertaken using the vessel *Mimer* using a hull-mounted MBES to re-survey the UXO crater locations. Unfortunately it was not possible to re-survey DBB_035 at that time, however the Project presents below the results of the five post-clearance surveys achieved in June 2023 in line with marine licence condition 5.2.21.

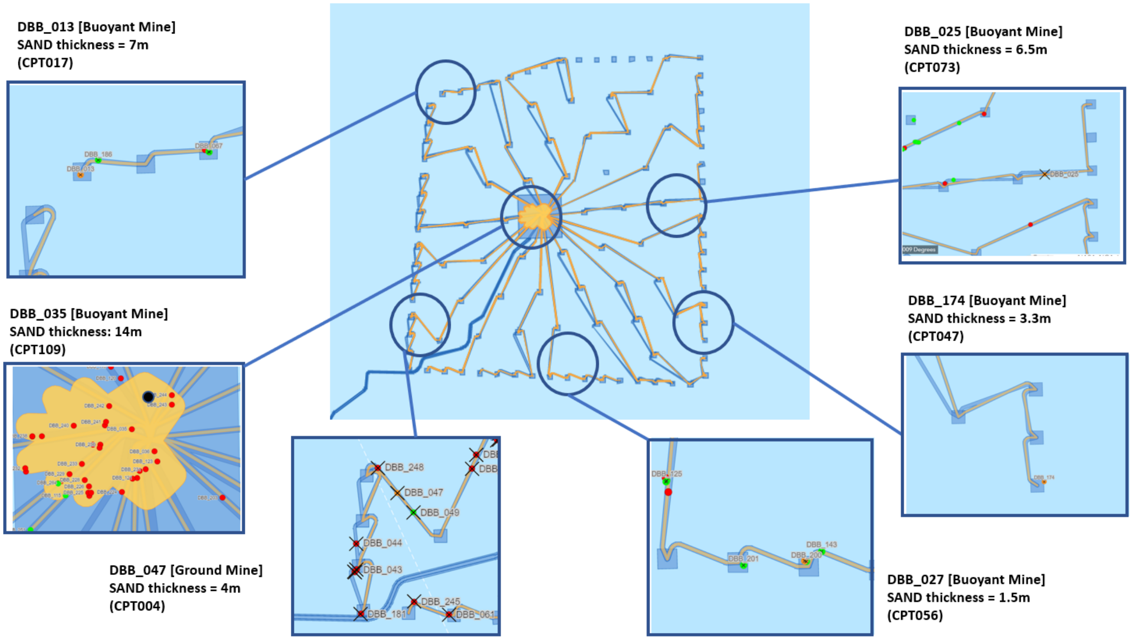
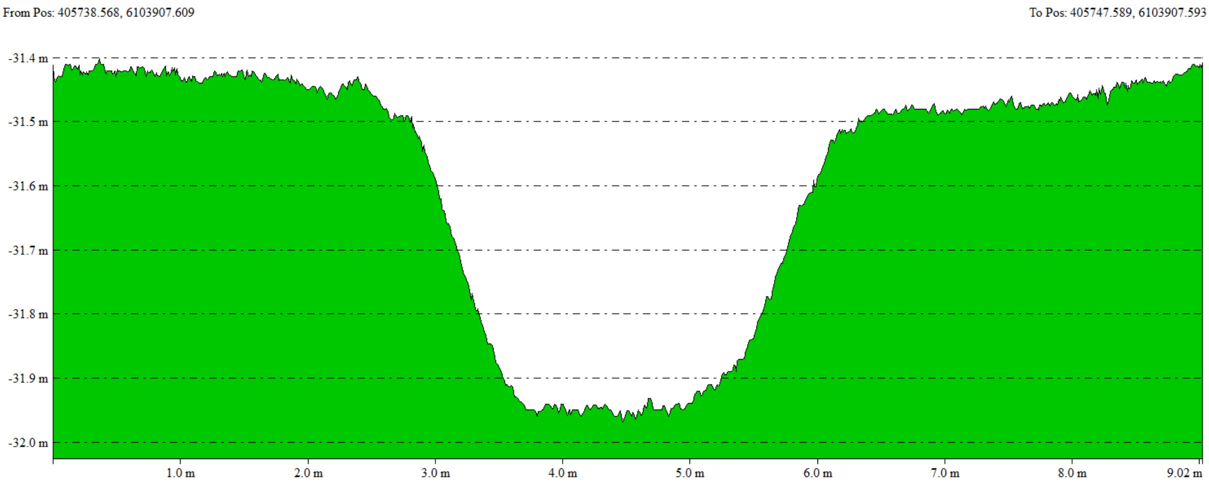


Figure 1. Location of cUXO in Dogger Bank B array area cleared in February and March 2023.

Figure 2 below shows the post-clearance survey results from the *Kamara* for target DBB_013. The site was located over an approximately 7m deep sand layer. The post-clearance 'as left' survey on 20 February 2023 following clearance of the buoyant mine demonstrated that a crater of approximately 0.5m remained after the high order target clearance. The *Mimer* survey on 5 June 2023 showed that the crater had largely infilled within the intervening time period, with a small depression of >0.1m remaining at this location.

DBB_013 - Kamara (as left 22-02-23)



Mimer (monitoring 05-06-23)

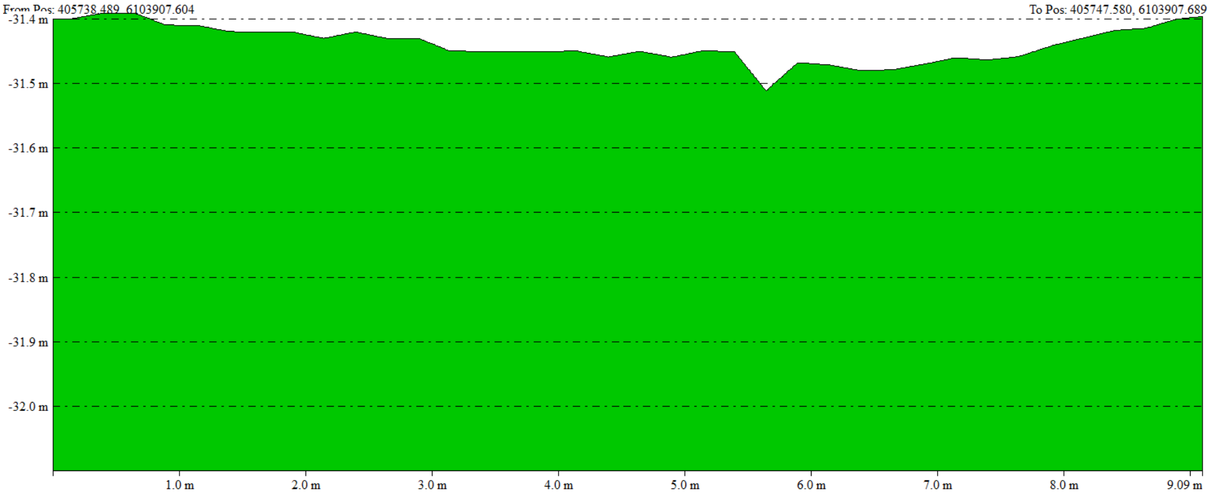
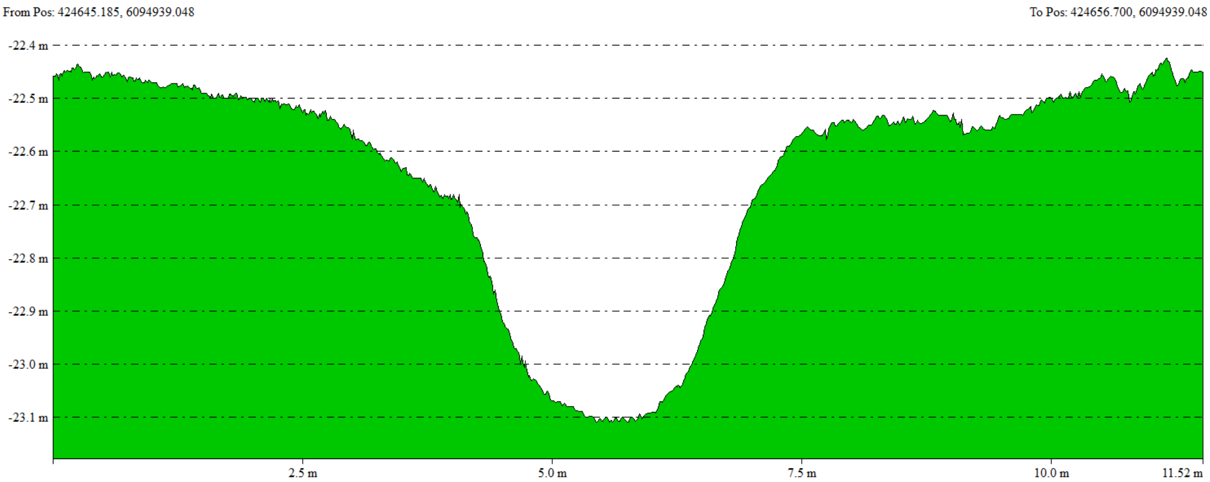


Figure 2. Target DBB_013 MBES surveys 'As left' on 22 February 2023 and Mimer 5 June 2023.

Figure 3 below shows the post-clearance crater survey results from buoyant mine target DBB_025, located in approximately 6.5m depth of sand layer. The 'as-left' survey results collected immediately after the high-order target clearance on 3 March 2023 showed a crater of approximately 0.6m depth. The *Mimer* survey on 5 June 2023 showed that the crater had largely infilled within the intervening time period.

DBB_025 - Kamara (as left 03-03-23)



Mimer (monitoring 05-06-23)

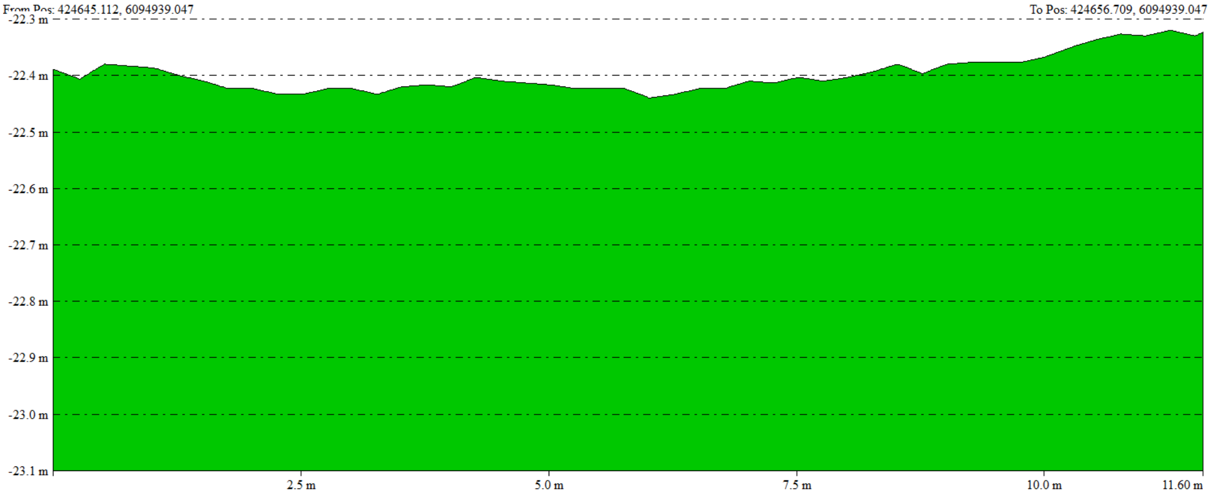
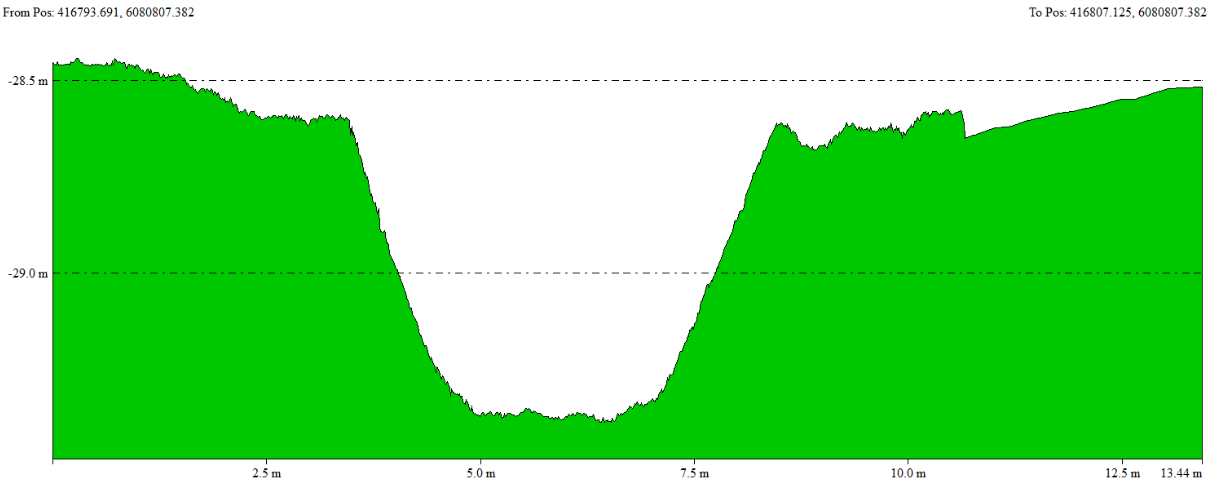


Figure 3. Target DBB_025 MBES surveys 'As left' on 3 March 2023 and Mimer 5 June 2023.

Figure 4 below shows the MBES survey results for UXO buoyant mine clearance target DBB_027, which was cleared using high order methodology on 16 February 2023 in an area of around 1.5m sand depth. The 'as left' survey demonstrated that a crater of approximately 0.8m remained following the UXO clearance. The *Mimer* MBES survey on 5 June 2023 showed that the crater had infilled to half the original depth to approximately 0.4m deep.

DBB_027- Kamara (as left 16-02-23)



Mimer (monitoring 05-06-23)

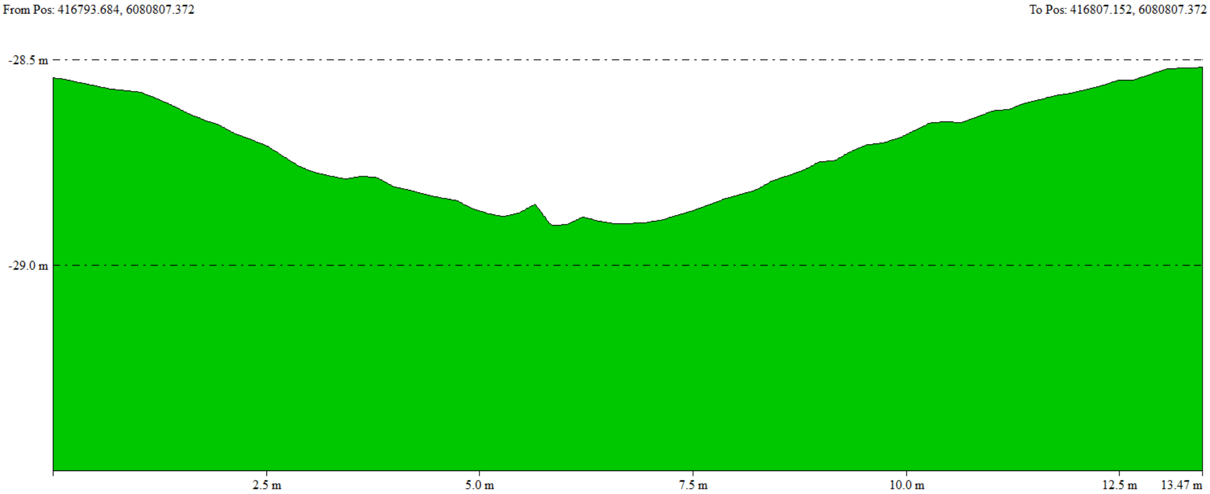
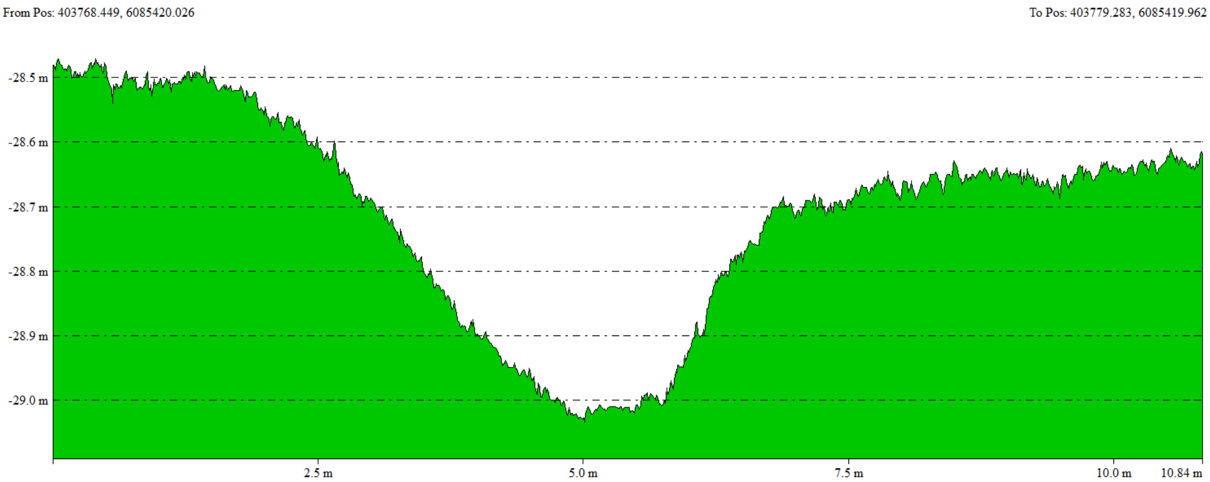


Figure 4. Target DBB_027 MBES surveys 'As left' on 16 February 2023 and Mimer 5 June 2023.

Figure 5 below shows the results of the MBES surveys at target DBB_047, a high order clearance of a ground mine located in a sand depth layer of around 4m on 19 February 2023. The initial 'as left' survey crater was approximately 0.6m deep. The *Mimer* survey on 5 June 2023 showed that the crater had infilled to about half the original depth at around 0.3m at that point in time.

DBB_047 - Kamara (as left 19-02-23)



Mimer (monitoring 05-06-23)

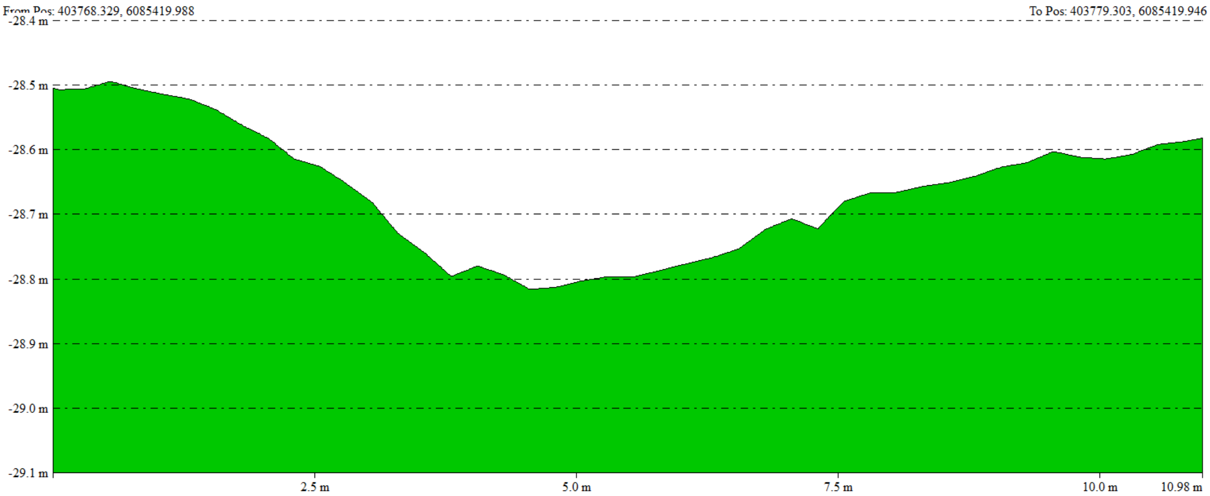
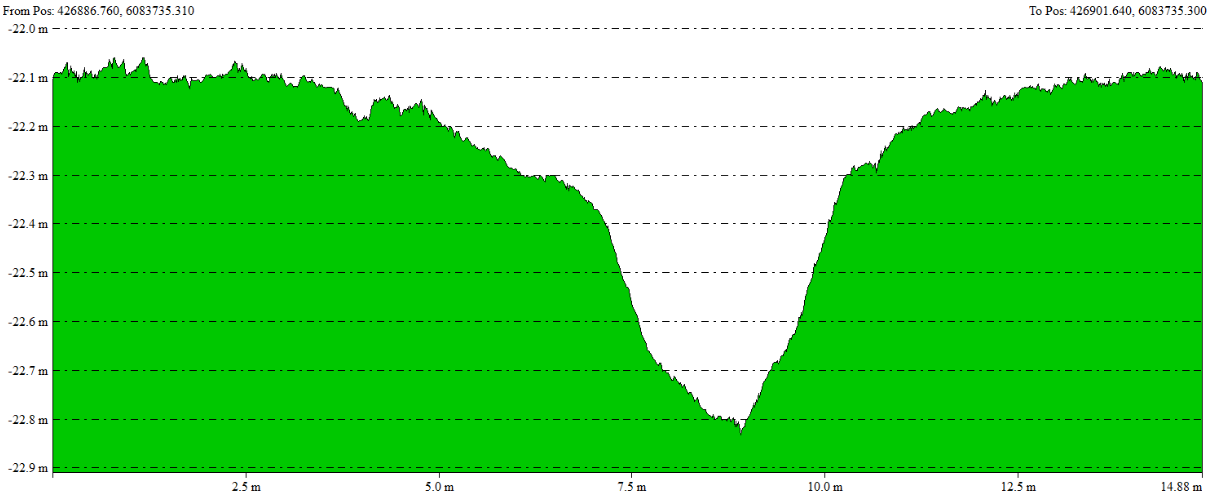


Figure 5. Target DBB_047 MBES surveys 'As left' on 19 February 2023 and Mimer 5 June 2023.

Figure 6 below shows the MBES survey results for UXO target DBB_174, a buoyant mine cleared using high order methodology from a location with 3.3m sand depth. The initial 'as left' survey revealed a crater of approximately 0.7m on 2 March 2023. The subsequent *Mimer* survey on 5 June 2023 indicated that the crater had largely infilled, with a seabed depression of approximately 0.2m remaining at this location.

DBB_174 - Kamara (as left 02-03-23)



Mimer (monitoring 05-06-23)

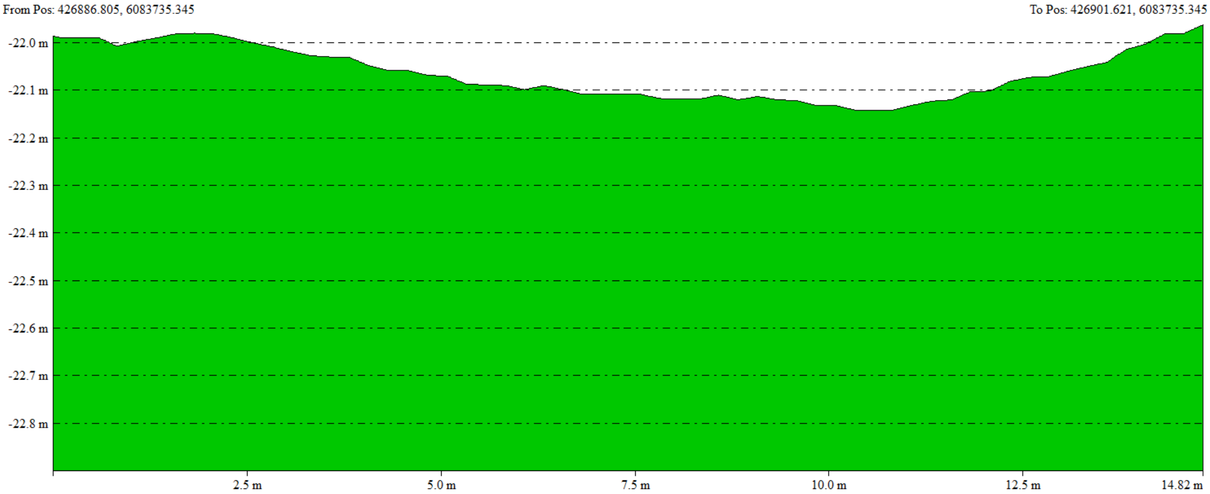


Figure 6. Target DBB_174 MBES surveys 'As left' on 2 March 2023 and Mimer 5 June 2023.

The Project is planning to return to the DBB UXO clearance locations to carry out further UXO clearance crater surveys, which have been tentatively arranged for March 2024. Target DBB_035, which was not surveyed by the *Mimer* in June 2023, will be surveyed at that time.

On the basis of the results presented here at target locations DBB_013, DBB_025 and DBB_174 where 'as left' UXO clearance craters surveyed in June 2023 appear to have already infilled, no further surveys are proposed. The Project asks the MMO to confirm agreement with this strategy. Further surveys are planned for targets DBB_027 and DBB_047 where high order clearance craters had not fully infilled at the time of the *Mimer* survey in June 2023, together with the missing post-clearance survey at DBB_035.

Appendix D – Benthic Ecology Technical Note

DBS Offshore Wind

RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Benthic Ecology Technical Note (Revision 2) (Clean)

Document Date:	March 2025
Document Reference:	10.38
Revision Number:	02
Classification:	Unrestricted

RWE MASDAR

Company:	**RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited**	Asset:	**Development**
Project:	**Dogger Bank South Offshore Wind Farms**	Sub Project/Package	**Consents**
Document Title or Description:	Benthic Ecology Technical Note (Revision 2) (Clean)		
Document Number:	005405059-02	Contractor Reference Number:	PC2340-RHD-OF-ZZ-RP-Z-0182

Rev No.	Date	Status/Reason for Issue	Author	Checked by	Approved by
01	November 2024	Submission in response to relevant representations.	RHDHV	RWE	RWE
02	March 2025	Submission at Deadline 3	RHDHV	RWE	RWE

Revision Change Log

Rev No.	Page	Section	Description
01	N/A	N/A	Submission in response to relevant representations.
02	11	Glossary	Added in term for the Project Change Request 1.
02	15	1	Paragraph added to introduce the accepted Project change request.
02	15-16	1.1	Insert of section to clarify the Marine Physical Environment zone of influence to address response REP2-065:5.2 in **The Applicants' Responses to Deadline 2 Document** [document reference 13.3].
02	17	2.1.1	Clarification on the changes to the zone of influence which do not affect the assessment.
02	20	3.1.1	Clarification on the changes to the zone of influence which do not affect the assessment.
02	21	4.1.1	Clarification on the changes to the zone of influence which do not affect the assessment.
02	22	4.1.2	Correction of typographical error.
02	24	5.1.1.1.1	Addition of distance of the Offshore Export Cable Corridor from the Holderness Offshore MCZ, and text added to explain where the feature sensitivity to pressure range in Table 5-1 has been derived from.
02	26	5.1.1.1.2	Amendment of disposal sites and volumes to be disposed in line with the updated **Disposal Site Characterisation Report (Revision 2)** [REP2-035]
02	28	5.1.2.1.1	Text added to explain where the feature sensitivity to pressure range in Table 5-2 has been derived from.
02	31	5.1.3.1.1	Text added to explain where the feature sensitivity to pressure range in Table 5-3 has been derived from.
02	32	5.1.3.1.2	Addition of distance from the SAC added.
02	39	6	Minor text amendments.
02	40-41	References	Addition of two references.
02	43-86	Appendices	Appendix A to C added.

Contents

Tables

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.
Bathymetry	Topography of the seabed.
Beach	A deposit of non-cohesive sediment (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively 'worked' by present-day hydrodynamic processes (i.e. waves, tides and currents) and sometimes by winds.
Closure depth	The depth that represents the 'seaward limit of significant depth change' but is not an absolute boundary across which there is no cross-shore sediment transport.
Coarse sediment	Sediment of grain diameter greater than 2mm.
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.
Current	Flow of water generated by a variety of forcing mechanisms (e.g. waves, tides, wind).
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
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

Term	Definition
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).
EIA Directive	The EU directive on the assessment of the effects of certain public and private projects on the environment (2011/92/EU as amended by 2014/52/EU)"
EIA Regulations	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations
Erosion	Wearing away of the land or seabed by natural forces (e.g. wind, waves, currents, chemical weathering).
Gravel	Loose, rounded fragments of rock larger than sand but smaller than Cobbles. Sediment larger than 2mm (as classified by the Wentworth scale used in sedimentology).
Habitats Regulations	Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments /increased noise.
Inter-Platform Cable Corridor	The area where Inter-Platform Cables would route between platforms within the DBS East and DBS West Array Areas, should both Projects be constructed.
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.
Nearshore	The zone which extends from the swash zone to the position marking the start of the offshore zone (~20m).

Term	Definition
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
Offshore Export Cables	The cables which would bring electricity from the offshore platforms to the Transition Joint Bays (TJBs).
Project Change Request 1	The changes to the DCO application for the Projects set out in **Project Change Request 1 - Offshore & Intertidal Works** [AS-141] which was accepted into Examination on 21st January 2025.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of Receptors include species (or groups) of animals, plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
Sand	Sediment particles, mainly of quartz with a diameter of between 0.063mm and 2mm. Sand is generally classified as fine, medium or coarse
Sand wave	Bedforms with wavelengths of 10 to 100m, with amplitudes of 1 to 10m.
Scour protection	Protective materials to avoid sediment erosion from the base of the wind turbine foundations and offshore substation platform foundations due to water flow.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter.
Sediment transport	The movement of a mass of sediment by the forces of currents and waves.
Sedimentation (Siltation)	The process by which sediment is mechanically deposited from suspension within a fluid, generally water, or ice, thereby accumulating as layers of sediment that are segregated owing to differences in size, shape, and composition of the sediment particles.
Short-term	Refers to a time period of months to years.
Significant wave height	The average height of the highest of one third of the waves in a given sea state.

Term	Definition
Special Area of Conservation (SAC)	Strictly protected sites designated pursuant to Article 3 of the Habitats Directive (via the Habitats Regulations) for habitats listed on Annex I and species listed on Annex II of the Directive
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension.
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and (Abu Dhabi Future Energy Company) - Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Tidal current	The alternating horizontal movement of water associated with the rise and fall of the tide.
Trenching	Open cut method for cable or duct installation.
Tunnel valley	Generally U-shaped valley(s) of glacial origin eroded out of sediment through subglacial process including meltwater drainage
Wave height	The vertical distance between the crest and the trough.
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
DBS	Dogger Bank South
EIA	Environmental Impact Assessment
ES	Environmental Statement
HRA	Habitat Regulations Appraisal
JNCC	Joint Nature Conservation Committee
MarESA	Marine Evidence based Sensitivity Assessment
MCZ	Marine Conservation Zone
O&M	Operation and Maintenance
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SSC	Suspended Sediment Concentration
ZoI	Zone of Influence

1 Introduction

1. This Benthic Ecology Technical Note has been prepared to address comments within the Applicants' **Responses to Natural England's Relevant Representation** [AS-048] (see RR-039: C15 and RR-039: C38) in relation to the request to provide further characterisation and assessment from an Environmental Impact Assessment (EIA) perspective of biotopes of the Flamborough Head Special Area of Conservation (SAC). Natural England's recommendations are listed below:

- RR-039: C15: *Natural England advises that all benthic receptors within the Zone of Influence (ZoI), particularly those within designated sites, need to be sufficiently characterised to enable a robust, evidenced assessment to be undertaken and presented in light of EIA and Habitat Regulations Appraisal (HRA) requirements. In the absence of characterisation of benthic receptors at a suitable resolution, the worst-case scenario needs to be presented (e.g. most sensitive biotope within the broadscale habitat used as a basis for assessments).*
- RR-039: C38: *Natural England advises that all benthic receptors within Flamborough Head SAC which are within the Zone of Influence, need to be sufficiently characterised to enable a robust, evidenced assessment to be undertaken and presented in light of HRA requirements. In the absence of characterisation of benthic receptors at a suitable resolution, the worst case scenario needs to be presented (e.g. most sensitivity biotope within the broadscale habitat used as a basis for assessments).*

2. For completeness to cover off all designated sites, an assessment of potential impacts of Dogger Bank South (DBS) East and DBS West ('the Projects') on the designated features of the Holderness Inshore Marine Conservation Zone (MCZ) and Holderness Offshore MCZ is also provided.

3. The assessment is informed by the assessments provided in the **Stage 1 MCZ Assessment (MCZA)** [APP-240] and the **Report to Inform Appropriate Assessment (RIAA) Part 2** [APP-046] and has been undertaken based on the description of the Projects provided within **Chapter 5 Project Description** [APP-071] of the Environmental Statement (ES). The assessment methodology and embedded mitigation measures relevant to this assessment are as described in **Chapter 9 Benthic and Intertidal Ecology** [APP-085] of the ES and are not repeated here.

4. The worst case scenario is summarised in Table 9-1, **Chapter 9 Benthic and Intertidal Ecology** [APP-085] and shows the worst case design parameters for likely significant effects based on design parameters in **Chapter 5 Project Description** [APP-071] of the ES.

5. The Applicants' submitted a change request to the Examining Authority, which was accepted into examination on the 21st January 2025. Table4-3 of **Project Change Request 1 – Offshore and Intertidal Works** [AS-141] details the changes to the benthic and intertidal ecology worst case scenario and effect significance. Both this document and the ES (**Chapter 9 Benthic and Intertidal Ecology** [APP-085]) should be read together. However, as a result of the change request, the significance of effect for all impacts was unchanged from what was presented in the ES.

1.1 Zone of Influence

6. This section has been included to add context regarding updates to the Zone of Influence (ZoI) in response to Natural England's comments [REP2-065] on **Chapter 8 Marine Physical Environment** [APP-080] and the response provided in **The Applicants' Responses to Deadline 2 Document** [document reference 13.3] (REP2-065:5.2).

7. The Zone of Influence (ZoI) used to inform this assessment was defined in **Chapter 8 Marine Physical Environment** [APP-080] using the outputs of the numerical modelling (see **Appendix 8-3 Marine Physical Processes Modelling Technical Report** [APP-084]). The ZoI was defined as 8km based on the maximum extent of the plume created during export cable installation in the surface layer. However, the maximum length of a tidal ellipse was 14km (off the coast of Flamborough Head). Therefore, the more conservative value of 14km was used to determine the search distance from the entire Development Consent Order boundary to screen receptors, noting the length of the tidal ellipse in the Array Areas was much lower at 2km.

8. **Appendix 8-3 Marine Physical Processes Modelling Technical Report** [APP-084] was updated at Deadline 2 as **Appendix 8-3 Marine Physical Processes Modelling Technical Report (Revision 3)** [REP2-017] and further detail was included in this version to show the extent of the plume at different levels in the water column (surface, middle and bottom layer) for three localities (Nearshore, Half way between shore and Offshore) (see Table 8-3-17 of **Appendix 8-3 Marine Physical Processes Modelling Technical Report (Revision 3)** [REP2-017]). These results show that the maximum extent of the plume occurs in the bottom layer close to the coast, where it can extend up to 28km. Using these updated values, 28km would be the maximum ZoI for changes in suspended sediment concentrations and seabed level due to cable installation in the nearshore. However, applying a 28km ZoI to the entire Offshore Development Area would not be appropriate as offshore the maximum plume size in the Array Areas is only 2km in the bottom layer. This 2km plume would be applicable to the Array Areas and 28km would be more applicable in the nearshore. The results of the plume dispersion modelling indicate therefore the application of a 14km ZoI offshore, based on the tidal ellipse, was a very conservative approach.

9. In the nearshore, if the ZoI was increased to 28km to represent the maximum plume extent in the bottom layer, this would not change the assessment as all the receptors included are located within 14km of the Offshore Development Area boundary in the nearshore (e.g. Flamborough Head, Holderness Inshore MCZ and Holderness Offshore MCZ) and all biotopes within these receptors are included in the assessment. No further receptors are brought into the assessment due to this change. Therefore, the outcome of this assessment would be the same for a 14km and 28km ZoI.

2 Holderness Offshore MCZ

2.1 Site Description

10. The Holderness Offshore MCZ is located approximately 11km offshore from the Holderness coast (Joint Nature Conservation Committee (JNCC), 2021). The seabed is dominated by subtidal coarse sediment and hosts subtidal sand, subtidal mixed sediments and part of a glacial tunnel valley. The diverse seabed allows for a wide variety of species which live both in and on the sediment such as, crustaceans (crabs and shrimp), starfish and sponges. This site is also a spawning and nursing ground for a range of fish species, including lemon sole *Microstomus kitt*, plaice *Pleuronectes platessa* and European sprat *Sprattus sprattus*. Therefore, the species living both in and on the sediment may benefit from the protection afforded to the habitat features within this site.

11. The slow growing (but widely occurring) bivalve, ocean quahog *Arctica islandica* has been found in the site. Ocean quahog is a threatened / declining species of bivalve mollusc that can take up to six years to reach maturity and can live for over 500 years.

2.1.1 Qualifying Features

12. Designation of this site as a MCZ protects the following features:

- Subtidal coarse sediment;
- Subtidal sand;
- Subtidal mixed sediments;
- Ocean quahog; and
- North Sea glacial tunnel valleys.

13. The Holderness Offshore MCZ lies outside of the Projects' Offshore Development Area, with the closest point where cable burial may take place being located 1.2km outside of the MCZ. Therefore, direct effects on its features will be avoided.

14. However, suspended Sediment Concentrations (SSCs) could increase in the vicinity of the Offshore Export Cable Corridor during cable installation (including seabed preparation), and operation and maintenance (O&M) activities. The maximum tidal excursion ellipse of 14km was used to define ZoI within **Chapter 8 Marine Physical Environment** [APP-080] and was used for the assessment on the Holderness Offshore MCZ features. The changes to the ZoI (see section 1.1) do not affect the assessment given the proximity of the MCZ to the Offshore Export Cable Corridor and the fact that all features of the MCZ were considered irrespective of their mapped location within the site.

15. Increased SSCs could result in potential indirect effects on the MCZ from increases in sediment deposition or deterioration in water quality. It is important to note that the bathymetry data and site surveys recorded no sandbanks or sand waves within the proximity of the MCZ, and therefore impacts are only assessed in relation to export cable trenching (i.e. sand wave levelling is not relevant at this location).

16. The impact of increased SSCs on the features of the Holderness Offshore MCZ is assessed in section 5.1.1 for construction and section 5.2.1 for operation.

2.1.2 Conservation Objectives

17. The conservation objectives for the Holderness Offshore MCZ are that the protected features:

- So far as already in favourable condition, remain in such condition; and
- So far as not already in favourable condition, be brought into such condition, and remain in such condition.

18. With respect to subtidal coarse sediment, subtidal sand and subtidal mixed sediments within the MCZ, this means that:

- Its extent is stable or increasing; and
- Its structures and functions, its quality, and the composition of its characteristic biological communities (which includes a reference to the diversity and abundance of species forming part of or inhabiting that habitat) are such as to ensure that it remains in a condition which is healthy and not deteriorating.

19. With respect to ocean quahog within the MCZ, this means that the quality and quantity of its habitat and the composition of its population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive. Any temporary reduction of numbers is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.

20. With respect to the North Sea glacial tunnel valleys within the MCZ, this means that:

- Its extent, component elements and integrity are maintained.
- Its structure and functioning are unimpaired.
- Its surface remains sufficiently unobscured for the purposes of determining whether the conditions detailed in the above bullets are satisfied.

21. Any obscurement or alteration of that feature brought about entirely by natural processes is to be disregarded (JNCC, 2021).

3 Holderness Inshore MCZ

3.1 Site Description

22. The Holderness Inshore MCZ is located north of the Humber estuary mouth (Defra, 2016). The seabed in this site is comprised of rock, sand, mud and sediment. The mosaic of habitats within the site supports a diverse range of organisms including red algae, sponges and other encrusting fauna. The site also supports fish species such as European eel *Anguilla anguilla*, dab *Limanda limanda* and wrasse *Labridae*, as well as commercially significant crustaceans such as edible crab *Cancer pagurus* and velvet swimming crabs *Necora puber* and lobster *Nephropidae*.

23. Partly above the water, the sandy beaches of intertidal sand and muddy sand are uncovered at low tide. These beaches are home to many species, buried in the damp sand.

24. The Projects' Offshore Export Cable Corridor is located 0.1km from the Holderness Inshore MCZ although the Construction Buffer Zone overlaps the MCZ by approximately 400m. Construction vessels may occupy this area, but no construction would occur within this area. The Applicants' committed pre-application to not using jack-up vessels within the MCZ (see **Draft DCO** [APP-027] and Table 9-3 Embedded Mitigation of **Chapter 9 Benthic and Intertidal Ecology** [APP-085]). In response to the Marine Management Organisation's Relevant Representation (RR-030: 4.15.1) (**The Applicants' Response to Relevant Representations** [PDA-013]), the Applicants have amended this commitment to also include anchoring.

3.1.1 Qualifying Features

25. Designation of this site as a MCZ protects the following features:

- Intertidal sand and muddy sand;
- Moderate energy circalittoral rock;
- High energy circalittoral rock;
- Subtidal coarse sediment;
- Subtidal mixed sediments;
- Subtidal sand;
- Subtidal mud; and
- Spurn Head (subtidal).

26. There is no overlap with the Holderness Inshore MCZ and the Projects' landfall and permanent burial corridor within the Offshore Export Cable Corridor, with the closest point where cable burial may take place being located 0.1km outside of the MCZ. In addition, as the Applicants have committed to no jack-up or anchoring activities taking place within the boundary of the Holderness Inshore MCZ, there is no longer a pathway for direct effects.

27. As noted above for the Holderness Offshore MCZ (section 2.1.1), SSCs could increase in the vicinity of the Offshore Export Cable Corridor during cable installation (including seabed preparation), and O&M activities. In addition, there is the potential during O&M for changes to bedload sediment transport to occur due to the placement of Offshore Export Cable protection within the Offshore Export Cable Corridor.

28. A ZoI of 14km, based on the maximum tidal ellipse (**Chapter 8 Marine Physical Environment** [APP-080]), was used for the assessment on the Holderness Inshore MCZ features. The changes to the ZoI (see section 1.1) do not affect the assessment given the proximity of the MCZ to the Offshore Export Cable Corridor and the fact that all features of the MCZ were considered irrespective of their mapped location within the site.

29. The impact of increased SSCs and changes in bedload sediment transport on the features of the Holderness Inshore MCZ is assessed in section 5.1.2 for construction and section 5.2.2 for operation.

3.1.2 Conservation Objectives

30. The overarching conservation objective for the site is for its designated features to be maintained in 'favourable condition'. For each broadscale marine habitat, favourable condition means that, within an MCZ:

- Its extent is stable or increasing; and
- Its structure and functions, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate.

31. Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery.

32. Any alteration to a feature brought about entirely by natural processes is to be disregarded when determining whether a protected feature is in favourable condition (Natural England, 2024).

4 Flamborough Head SAC

4.1 Site Description

33. The Flamborough Head SAC is designated for the Annex I habitats 'Reefs', 'Vegetated sea cliffs of the Atlantic and Baltic Coasts' and 'Submerged or partially submerged sea caves'. Of the designated habitats for the SAC, those of interest in relation to potential indirect effects from the Projects' activities are the areas of reef.

34. The clarity of the relatively unpolluted sea water and the hard nature of the extensive sublittoral chalk habitat have enabled kelp *Laminaria hyperborea* forests to become established in the shallow sublittoral zone. The reefs to the north of the site support a different range of species from those on the slightly softer and more sheltered south side of the headland. The site supports an unusual range of marine species and includes rich animal communities and some species that are at the southern limit of their North Sea distribution, e.g. the northern alga *Ptilota plumosa* (JNCC, 2018).

4.1.1 Qualifying Features

35. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following relevant Annex I habitats:

- Reefs;
- Submerged or partially submerged sea caves; and
- Vegetated sea cliffs of the Atlantic and Baltic Coasts.

36. There is no overlap with the Flamborough Head SAC and the Projects' Offshore Development Area, with the closest point where cable burial may take place being located 3.5km outside of the SAC. Therefore, direct effects on its features will be avoided.

37. As noted above for the Holderness MCZs (section 2.1.1 and section 3.1.1), SSCs could increase in the vicinity of the Offshore Export Cable Corridor during cable installation activities (including seabed preparation). A ZoI of 14km, based on the maximum tidal ellipse (**Chapter 8 Marine Physical Environment** [APP-080]), was used for the assessment on the Flamborough Head SAC features. The changes to the ZoI (see section 1.1) do not affect the assessment given the proximity of the SAC to the Offshore Export Cable Corridor and the fact that all subtidal features of the SAC were considered irrespective of their mapped location within the site. Given that any increased SSCs and subsequent deposition would manifest in the subtidal area only, there is no potential for impact on the 'Vegetated sea cliffs of the Atlantic and Baltic Coasts' feature of the SAC and it is therefore not considered further.

38. The impact of increased SSCs on the features of the Flamborough Head SAC is assessed in section 5.1.3 for construction and section 5.2.3 for operation.

4.1.2 Conservation Objectives

39. With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed above), and subject to natural change the conservation objectives as described in Natural England (2018) are to:

- Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:
  - The extent and distribution of qualifying natural habitats;
  - The structure and function (including typical species) of qualifying natural habitats; and
  - The supporting processes on which qualifying natural habitats rely.

5 Assessment of Significance

5.1 Potential Effects during Construction

5.1.1 Holderness Offshore MCZ

5.1.1.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during Export Cable Installation

40. Temporary increases in SSCs within the water column, and subsequent deposition onto the seabed, may occur as a result of cable installation activities, including seabed preparation. Activities such as seabed disturbances from jack-up vessels and placement of cable protection are not expected to increase SSCs to an extent that would result in a measurable effect on the MCZs' features. Section 8.7.3.3 of **Chapter 8 Marine Physical Environment** [APP-080] provides details of changes to SSCs and subsequent sediment disposition.

41. It is important to note that the Projects' Offshore Development Area does not overlap with the Holderness Offshore MCZ, with the nearest point where cable burial could take place being along the Offshore Export Cable Corridor, located 1.2km north-west of the site. However, due to the potential distance of sediment being transported in the water column, the following broadscale marine habitat features could be affected by increased SSCs and subsequent deposition during construction:

- Subtidal coarse sediment (A5.1);
- Subtidal sand (A5.2);
- Subtidal mixed sediments (A5.4); and
- Ocean Quahog.

42. There is currently no advice available regarding the sensitivity of North Sea glacial tunnel valleys to the pressures of offshore wind and power cable development. The North Sea glacial tunnel valleys are geological features characterised as curved sub-linear seabed depressions generally considered to have been formed by subglacial erosion and sediment backfill beneath the outer margins of a receding ice sheet (Pearce *et al*., 2012). Due to their status as a geological rather than ecological feature, it is considered that the tunnel valleys would not be sensitive to the effects of increased SSCs. As such, based on professional judgement this feature has been screened out of the assessment.

5.1.1.1.1 Sensitivity of Receptor

43. The sensitivities of the habitats discussed above have been assessed in relation to Marine Evidence based Sensitivity Assessment (MarESA) pressures relevant to construction phase increased SSC and deposition. The relevant pressures are:

- Changes in suspended solids (water clarity); and
- Smothering and siltation rate changes (light).

44. As noted in the MarESA pressures and benchmarks on smothering and siltation rate changes, light siltation rate changes are defined as up to 5cm of fine material added to the habitat in a single, discrete event (MarLIN, 2024). Due to the distance of the Holderness Offshore MCZ from the point of sediment disturbance during Offshore Export Cable Corridor installation (1.2km), any sediment deposition within the site resulting from the Projects would be below 5cm in depth. Therefore, no heavy smothering and siltation rate changes would occur as a result of the Projects' Offshore Export Cable Corridor installation activities.

45. Annex A (**Table A-1** to **Table A-6**) details each of the biotopes and species that comprise the qualifying features detailed in paragraph 37. The MarESA sensitivity (Tyler-Walters *et al.* 2023), based on resistance and resilience, to the impact pressure pathway is also shown. This has been used to inform the pressure range presented in **Table 5-1.** The receptors shown in **Table 5-1** range from 'Not Sensitive' to 'Low' sensitivity (Last *et al.*, 2020), with the highest sensitivity being used to inform the assessment below. Therefore, these biotopes and species will not be affected by, or will recover rapidly from, increased SSCs and subsequent deposition.

Table 5-1 Sensitivity of Biotopes and Species in the Holderness Offshore MCZ to Increased Suspended Sediments (Last *et al.*, 2020)

Receptor	Feature Sensitivity to pressure range
Impact pressure pathway: Changes in suspended solids (water clarity)	
Subtidal coarse sediment (A5.1)	Not sensitive – Low
Subtidal sand (A5.2)	Not sensitive – Low
Subtidal mixed sediments (A5.4)	Not sensitive – Low
Ocean Quahog	Not sensitive
Impact pressure pathway: Smothering and siltation rate changes (light)	
Subtidal coarse sediment (A5.1)	Not sensitive – Low
Subtidal sand (A5.2)	Not sensitive – Low
Subtidal mixed sediments (A5.4)	Not sensitive – Low
Ocean Quahog	Not sensitive

46. Regarding the ocean quahog feature, MarESA describes its sensitivity to the physical pressure of 'changes in suspended solids (water clarity)' and 'smothering and siltation rate changes (light)' as 'Not Sensitive', and therefore any impact on ocean quahog would not be significant and is not considered further.

5.1.1.1.2 Magnitude of Impact

47. As detailed in **Chapter 8 Marine Physical Environment** [APP-080], regional mapping of seabed sediments along the Offshore Export Cable Corridor transition from coarser mixed sediments (sandy gravel and gravelly sand) in the nearshore area, to sand-dominated sediments approaching the Array Areas.

48. It is expected that the coarser sediment found along the Offshore Export Cable Corridor will settle rapidly to the seabed following disturbance, and close to the point of disturbance. The finer sand that comprises the majority of the Array Areas, Inter-Platform Cabling Corridor, and easterly extremes of the Offshore Export Cable Corridor, may stay in suspension within the water column for a longer period of time. Any released fine material will form a plume which would become advected by tidal currents. It is expected that the maximum predicted deposition resulting from a sediment plume will be an average of 1-5mm within 10km of the disturbance. This conceptual evidence-based assessment is supported by the findings of a review of the evidence base into the physical impacts of marine aggregate dredging on sediment plumes and seabed deposits (Whiteside *et al*. 1995; John *et al*. 2000; Hiscock and Bell, 2004; Newell *et al*. 2004; Tillin *et al*. 2011).

49. Based on the modelling undertaken for **Chapter 8 Marine Physical Environment** [APP-080], maximum SSCs due to seabed levelling are predicted to reach up to 5mg/l within 1km of the Offshore Export Cable Corridor with values returning to background levels within 5-7km from the area of disturbance. The plume is expected to persist for a period of two to four hours. The maximum predicted deposition resulting from seabed levelling will be <3cm spatially restricted to within the Offshore Export Cable Corridor.

50. During trenching of the Offshore Export Cable Corridor, SSCs are predicted to reach up to 1,000 – 1,500mg/l, in localised hot spots within the Offshore Export Cable Corridor. However, the extent of the sediment plume differs due to greater variability in tidal currents along the entire length of the Offshore Export Cable Corridor. Closer inshore, and nearer to the MCZ, the extent of the plume may reach 18km due to stronger tidal currents. In the very nearshore part of the Offshore Export Cable Corridor, the plume is much more limited in extent and restricted to within 2km of the point of disturbance. This is likely due to the sheltering effect of Flamborough Head with tidal currents being much lower in the nearshore. While the predicted plume can extend kilometres from the point of disturbance, the changes in SSCs over these distances are small, typically below 1mg/l, persisting for a period of hours. The maximum predicted deposition resulting from trenching will be up to 5cm within and immediately adjacent to the area of trenching, with a maximum change of up to 0.25m occurring in localised hotspots.

51. The maximum predicted deposition resulting from trenching along the Offshore Export Cable Corridor will be up to 5cm within and immediately adjacent to the area of trenching, with a maximum change of up to 0.25m occurring in localised hotspots. Table 8-1 of **Chapter 8 Marine Physical Environment** [APP-080] summarises the worst case volume of sediment displaced.

52. Dredged material from sand wave levelling during the construction process will be disposed at a site or sites agreed during Examination. However, three disposal sites have been proposed within the **Disposal Site Characterisation Report (Revision 2)** [REP2-035] which are defined as the boundaries of each Array Area and the Offshore Export Cable Corridor. The volumes for disposal within the Offshore Export Cable Corridor will be equivalent to a worst case of 33,720,724m³ for DBS East in isolation and 29,901,823m³ for DBS West in isolation or 63,734,551m³ for the Projects together (see **Disposal Site Characterisation Report** [APP-242]). Such redeposition of dredged material will occur over the course of the entire offshore construction period (5 years). In addition, disposal will occur over a large area, for example Dogger Bank C and Sofia were granted a disposal licence across the entirety of their respective Array Areas. As such, it can be expected that redeposition of dredged material for the Projects will disperse over a large area and, thus, will settle at a minimal depth over the existing seabed.

53. Overall, increases in SSCs are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments. However, this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. Also, once installation is complete, tidal currents are likely to rapidly disperse the suspended sediment (i.e. over a period of a few hours) in the absence of any further sediment input.

54. In summary, the maximum predicted deposition resulting from trenching will be within and immediately adjacent to the area of trenching, outside of the MCZ. Deposition within the MCZ is likely to be restricted to fine sediments only with deposition of up to 5mm. Increases in SSCs are expected to be composed of fine sediments. Deposition will be localised and short-term and will be widely and rapidly dispersed. Deposition will be within the range of natural variability within the region. Based on the above, the magnitude of impact is considered to be negligible.

5.1.1.1.3 Significance of Effect

55. Due to the negligible magnitude of impact and 'Not sensitive' to 'Low' sensitivity of biotopes for increased SCCs, the effect is considered to be of **negligible** significance, which is not significant in EIA terms.

56. No additional mitigation is proposed due to the negligible adverse significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high and low confidence in assessments for the described biotopes.

5.1.2 Holderness Inshore MCZ

5.1.2.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during Export Cable Installation

57. Increased SSCs effects on the Holderness Inshore MCZ are similar to those discussed in section 5.1.1.1 for the Holderness Offshore MCZ.

58. As mentioned in section 3.1.1, there is no overlap with the Projects' Offshore Export Cable Corridor. However, due to the potential distance of sediment being transported in the water column, the qualifying features of the site could be affected by temporary increases in SSCs and subsequent deposition during construction. Tidal currents close to the Holderness coast and in the Holderness Inshore MCZ run approximately parallel to the coast in a north-south direction. Closer inshore, near the MCZ, the extent of any plumes could reach 18km due to stronger tidal currents. The maximum predicted deposition resulting from trenching will be up to 5cm within and immediately adjacent to the area of trenching, with a maximum change of up to 0.25m occurring in localised hotspots.

59. There is currently no advice available regarding the sensitivity of Spurn Head (subtidal) to the pressures of offshore wind and power cable development. Due to its status as a geological rather than ecological feature, it is considered that the Spurn Head would not be sensitive to the effects of increased SSCs. As such, based on professional judgement this feature has been screened out of the assessment.

5.1.2.1.1 Sensitivity of Receptor

60. The sensitivities of the habitats protected within the MCZ have been assessed in relation to MarESA pressures relevant to construction phase increased SSC and deposition. The relevant pressures are:

- Changes in suspended solids (water clarity); and
- Smothering and siltation rate changes (light).

61. As noted in section 5.1.1.1.1, heavy smothering and siltation rate changes will not occur within the Holderness Inshore MCZ as a result of the Projects' installation construction activities.

62. Annex A (Table B-1 to Table B-14) details each of the biotopes and species that comprise the qualifying features detailed in section 3.1.1. The MarESA sensitivity (Tyler-Walters *et al.* 2023), based on resistance and resilience, to the impact pressure pathway is also shown. This has been used to inform the pressure range presented in **Table 5-2**. The Natural England 'Designated Sites View – Advice on Operations' (Natural England, 2024a) has been used to identify the pressures associated with 'Power cable: laying burial and protection'. This activity was selected as installation of export cables is the relevant construction activity for the Holderness Inshore MCZ.

63. The majority of receptors shown in **Table 5-2** are considered to range from 'Not Sensitive' to 'Low' sensitivity, with the highest sensitivity being used to inform the assessment below. Therefore these habitats and biotopes will not be affected by, or will recover rapidly from an increase in SSCs and subsequent deposition.

64. The exception is Subtidal mixed sediments (A5.4) which have a Medium sensitivity to light smothering and siltation rate changes. For the Holderness Inshore MCZ, this general habitat classification encompasses two biotopes (Natural England, 2024):

- *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (A5.445); and
- *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment.

65. The *F. foliacea* and *H. falcata* biotope is Not Sensitive to light smothering and siltation rates and is not considered further, whereas the *O. fragilis* and *O. nigra* has a Medium sensitivity. Excessive sedimentation may block brittlestar feeding apparatus (tube feet and arm spines) reducing feeding (De-Bastos & Hill, 2016).

Table 5-2 Sensitivity of Habitats and Biotopes in the Holderness Inshore MCZ to Increased Suspended Sediments (Natural England, 2024)

Receptor	Feature Sensitivity to pressure range
Impact pressure pathway: Changes in suspended solids (water clarity)	
Moderate energy circalittoral rock	Not sensitive - Low

Receptor	Feature Sensitivity to pressure range
High energy circalittoral rock	Not sensitive
Intertidal sand and muddy sand (A2.2)	Not sensitive - Low
Subtidal coarse sediment (A5.1)	Not sensitive - Low
Subtidal mixed sediments (A5.4)	Not sensitive
Subtidal sand (A5.2)	Not sensitive - Low
Subtidal mud (A5.3)	Not sensitive - Low
Impact pressure pathway: Smothering and siltation rate changes (light)	
Moderate energy circalittoral rock	Not sensitive - Low
High energy circalittoral rock	Not sensitive - Low
Intertidal sand and muddy sand (A2.2)	Not sensitive - Low
Subtidal coarse sediment (A5.1)	Not sensitive - Low
Subtidal mixed sediments (A5.4)	Not sensitive - Medium
Subtidal sand (A5.2)	Not sensitive - Low
Subtidal mud (A5.3)	Not sensitive - Low

5.1.2.1.2 Magnitude of Impact

66. As described in section 5.1.1.1.2, overall increases in SSCs are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments. However, this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. Also, once export cable installation is complete, tidal currents are likely to rapidly disperse the suspended sediment (i.e. over a period of a few hours) in the absence of any further sediment input.

67. In summary, the maximum predicted deposition resulting from trenching will be within and immediately adjacent to the area of trenching, outside of the MCZ. Deposition within the MCZ is likely to be restricted to fine sediments only with deposition of up to 5mm. Increases in SSCs are expected to be composed of fine sediments and localised and short-term and widely and rapidly dispersed and within the range of natural variability within the region. Based on the above, the magnitude of impact is considered to be negligible.

5.1.2.1.3 *Significance of Effect*

68. Due to the negligible magnitude of impact and 'Not sensitive' to 'Low' sensitivity of the majority of biotopes and habitats within the Holderness Inshore MCZ to increased SCCs, the effect is considered to be of **negligible** significance.

69. However, the brittlestar biotope encompassed within Subtidal mixed sediments (A5.4) has a Medium sensitivity. As described in section 5.1.2.1.2 above, in areas of high water flow, fine sediments are likely to be rapidly dispersed which would mitigate the magnitude of this pressure by reducing the time exposed. Therefore with a negligible magnitude of impact and a Medium sensitivity, the significance of effect is considered to be of **minor adverse** (at worst), which is not significant in EIA terms. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described biotopes and habitats.

5.1.3 Flamborough Head SAC

5.1.3.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during Export Cable Installation

70. As described in sections 5.1.1 and 5.1.2, temporary increases in SSCs within the water column, and subsequent deposition onto the seabed, may occur as a result of cable installation activities (including seabed preparation).

71. The Projects' Offshore Development Area does not overlap with the Flamborough Head SAC, with the closest point where cable burial may take place being located 3.5km outside of the SAC. Therefore, there is no pathway for direct impacts to occur. However, due to the potential distance of sediment being transported in the water column, the qualifying features listed in section 4.1.1 could be affected by temporary increases in SSCs and subsequent deposition during construction.

5.1.3.1.1 *Sensitivity of Receptor*

72. The sensitivity of the habitats protected within the site have been assessed in relation to MarESA pressures relevant to construction phase increased SSCs and deposition. The relevant pressures are:

- Changes in suspended solids (water clarity); and
- Smothering and siltation rate changes (light).

73. As noted in section 5.1.1.1.1, heavy smothering and siltation rate changes will not occur within the Flamborough Head SAC as a result of the Projects' installation construction activities.

74. Annex A (**Table C-1** to **Table C-6**) details each of the biotopes and species that comprise the qualifying features detailed in section 4.1.1. The MarESA sensitivity (Tyler-Walters *et al.* 2023), based on resistance and resilience, to the impact pressure pathway is also shown. This has been used to inform the pressure range presented in **Table 5-3**. The Natural England 'Designated Sites View – Advice on Operations' (Natural England, 2024a) has been used to identify the pressures associated with 'Power cable: laying burial and protection'. This activity was selected as installation of export cables is the relevant construction activity for the Holderness Inshore MCZ.

75. The receptors shown in **Table 5-3** are considered to range from 'Not Sensitive' to 'Medium' sensitivity with the highest sensitivity being used to inform the assessment below. 'Submerged or partially submerged sea caves' are considered to range from Not sensitive to Low sensitivity, therefore this habitat will not be affected by, or will recover rapidly from an increase in SSCs and subsequent deposition.

76. However, the Annex 1 Reefs of intertidal rock and infralittoral rock have a Medium sensitivity to changes in suspended solids, and intertidal rock and circalittoral rock have Medium sensitivity to light smothering and siltation rate changes. The reef habitat found within the Flamborough Head SAC has been selected as a qualifying feature due to the presence of species associated with the chalk and for the site's location at the southern limit of distribution of several northern species. Communities typically associated with this habitat are known to be tolerant of increased SSCs as the combination of strong tides, wave action and chalk make the shallow waters around the base of the cliffs especially turbid (Howson *et al*., 2002)

Table 5-3 Sensitivity of Annex 1 Habitats in the Flamborough Head SAC to Increased Suspended Sediments (Natural England, 2024)

Receptor	Feature Sensitivity to pressure range
Impact pressure pathway: Changes in suspended solids (water clarity)	
Reefs - Intertidal Rock	Not sensitive - Medium
Reefs - Infralittoral Rock	Not sensitive - Medium
Reefs - Circalittoral Rock	Not sensitive - Low
Submerged or partially submerged sea caves	Not sensitive - Low
Impact pressure pathway: Smothering and siltation rate changes (light)	
Reefs - Intertidal Rock	Not sensitive - Medium
Reefs - Infralittoral Rock	Not sensitive - Low

Receptor	Feature Sensitivity to pressure range
Reefs - Circalittoral Rock	Not sensitive - Medium
Submerged or partially submerged sea caves	Not sensitive - Low

5.1.3.1.2 Magnitude of Impact

77. As described in section 5.1.1.1.2, the overall increases in SSCs are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments. However, this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. Also, once export cable installation is completed, tidal currents are likely to rapidly disperse the suspended sediment (i.e. over a period of a few hours) in the absence of any further sediment input.

78. In summary, the maximum predicted deposition resulting from trenching will be within and immediately adjacent to the area of trenching, i.e. 3.5km from the SAC. Deposition within the SAC is likely to be restricted to fine sediments only with deposition of up to 5mm. Increases in SSCs are expected to be composed of fine sediments and localised and short-term and widely and rapidly dispersed and within the range of natural variability within the region. Based on the above, the magnitude of impact is considered to be negligible.

5.1.3.1.3 Significance of Effect

79. Based on a sensitivity of 'Not sensitive' to 'Low' and a magnitude of impact of negligible, the overall significance of increased SSCs on 'Submerged or partially submerged sea caves' feature is **negligible**.

80. However, the 'Reef' (i.e. intertidal rock, infralittoral rock and circalittoral rock) features of the Flamborough Head SAC have a higher sensitivity to increased SSCs of Medium. As described in section 5.1.3.1.2 above, in areas of high water flow, fine sediments are likely to be rapidly dispersed which would mitigate the magnitude of this pressure by reducing the time exposed. Therefore, with a negligible magnitude of impact and a Medium sensitivity, the significance of effect is considered to be of **minor adverse** significance (at worst) which is not significant in EIA terms.

81. No additional mitigation is proposed due to the minor adverse significance of effect. The confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described habitats.

5.2 Potential Effects during Operation

5.2.1 Holderness Offshore MCZ

5.2.1.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during Export Cable Maintenance

82. As with the impact of increased SSCs during construction (section5.1.1.1), impacts may occur as a result of O&M activities that require the use of jack-up vessels, as well as cable repair, replacement and reburial activities. These activities are not expected to increase SSC to the extent which there could potentially be a significant effect on benthic ecology receptors. The volume of sediment disturbed would be extremely small in comparison to construction. Table 9-1 of **Chapter 9 Benthic and Intertidal Ecology** [APP-085] summarises the worst case volume of sediment displaced.

5.2.1.1.1 Sensitivity of Receptor

83. Features within the Holderness Offshore MCZ as described in **Table 5-1**, are considered to range from 'Not sensitive' to 'Low' sensitivity. Therefore, these biotopes will not be affected by or will recover rapidly from increased SSCs and subsequent deposition.

5.2.1.1.2 Magnitude of Impact

84. As described for the construction phase in section 5.1.1.1.2, the magnitude of impact during construction would be negligible. Any impact during operation would likely be less than that during construction and a magnitude of impact of negligible is therefore assigned for operation.

5.2.1.1.3 Significance of Effect

85. Based on a sensitivity of 'Not sensitive' to 'Low' and a magnitude of impact of negligible, the overall significance of increased SSCs during operation in the Holderness Offshore MCZ is **negligible**, which is not significant in EIA terms.

86. No additional mitigation is proposed due to the negligible adverse significance of effect. The confidence in this assessment is high (as per MarESA) for the described biotopes.

5.2.2 Holderness Inshore MCZ

5.2.2.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during offshore export cable maintenance

87. As with the impact of increased SSCs during construction (section 5.1.2.1), impacts may occur as a result of O&M activities that require the use of jack-up vessels, as well as cable repair, replacement and reburial activities. These activities are not expected to increase SSC to the extent where there could potentially be a significant effect to benthic ecology receptors. The volume of sediment disturbed would be extremely small in comparison to that disturbed during construction. Table 9-1 of **Chapter 9 Benthic and Intertidal Ecology** [APP-085] summarises the worst case volume of sediment displaced.

5.2.2.1.1 Sensitivity of Receptor

88. The majority of features within the Holderness Inshore MCZ as described in **Table 5-2** are considered to range from 'Not sensitive' to 'Low' sensitivity. Therefore, these biotopes and habitats will not be affected by, or will recover rapidly from increased SSCs and subsequent deposition. The exception is Subtidal mixed sediments (A5.4) which have a Medium sensitivity to light smothering and siltation rate changes.

5.2.2.1.2 Magnitude of Impact

89. As described for the construction phase in section 5.1.2.1.2, the magnitude of impact for construction would be negligible. Any impact during operation would likely be less than that during construction and a magnitude of impact of negligible is therefore assigned for operation.

5.2.2.1.3 Significance of Effect

90. Due to the negligible magnitude and 'Not sensitive' to 'Low' sensitivity of the majority of biotopes and habitats within the Holderness Inshore MCZ to increased SCCs, the effect is considered to be of **negligible** significance, which is not significant in EIA terms.

91. However, subtidal mixed sediments (A5.4) has a Medium sensitivity, this combined with a negligible magnitude of impact results in a minor adverse significance, which is not significant in EIA terms.

92. No additional mitigation is proposed due to the negligible adverse significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described biotopes and habitats.

5.2.3 Flamborough Head SAC

5.2.3.1 Increased Suspended Sediment Concentrations (including Sediment Deposition and Smothering) during Export Cable Maintenance

93. As with the impact of increased SSCs during construction (section 5.1.3.1), impacts may occur as a result of O&M activities that require the use of jack-up vessels, as well as cable repair, replacement and reburial activities. These activities are not expected to increase SSC to the extent which there could potentially be a significant effect to benthic ecology receptors. The volume of sediment disturbed would be extremely small in comparison Table 9-1 of **Chapter 9 Benthic and Intertidal Ecology** [APP-085] summarises the worst case volume of sediment displaced.

5.2.3.1.1 Sensitivity of Receptor

94. The sensitivity of receptors within the Flamborough Head SAC is described in **Table 5-3**. 'Submerged or partially submerged sea caves' are considered to be 'Not sensitive' to 'Low' sensitivity, and therefore will not be affected by, or will recover rapidly from increased SSCs and subsequent deposition.

95. However, the Annex 1 Reefs of intertidal rock and infralittoral rock have a Medium sensitivity to changes in suspended solids, and intertidal rock and circalittoral rock have Medium sensitivity to light smothering and siltation rate changes.

5.2.3.1.2 Magnitude of Impact

96. As described for the construction phase in section 5.1.3.1.2, the magnitude of impact for construction would be negligible. Any impact during operation would likely be less than that during construction and a magnitude of impact of negligible is therefore assigned for operation.

5.2.3.1.3 Significance of Effect

97. Due to the negligible magnitude and 'Not sensitive' to 'Low' sensitivity of 'Submerged or partially submerged sea caves' feature to increased SSCs, the effect is considered to be of **negligible** significance.

98. However, the 'Reef' (i.e. intertidal rock, infralittoral rock and circalittoral rock) features of the Flamborough Head SAC have a higher sensitivity to increased SSCs of Medium. As described in section 5.1.3.1.2 above, in areas of high water flow, fine sediments are likely to be rapidly dispersed which would mitigate the magnitude of this pressure by reducing the time exposed. Therefore, with a negligible magnitude of impact and a Medium sensitivity, the significance of effect is considered to be of **minor adverse** significance (at worst) which is not significant in EIA terms.

99. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described habitats.

5.3 Potential Effects during Decommissioning

100. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with best industry practice. The offshore decommissioning programme would be submitted prior to the construction of offshore works (see requirement 7 of the **Draft DCO** [APP-027]), with the methodology and programme finalised nearer to the end of the lifetime of the proposed Projects to ensure it is in line with the most recent guidance, policy and legislation.

101. The scope of the decommissioning works would most likely involve removal of the accessible installed components. This is outlined in **Chapter 5 Project Description** [APP-071] and the detail would be agreed with the relevant authorities at the time of decommissioning. Offshore, this is likely to include removal of all of the wind turbine components and part of the foundations (those above seabed level), removal of some or all of the array and export cables. Scour and cable protection would likely be left in situ unless removal is deemed to be of a greater benefit to the environment at the time of decommissioning.

102. During the decommissioning phase, there is potential for wind turbine foundation and cable removal activities to cause effects that would be comparable to those identified for the construction phase and the operational phase, specifically:

- Temporary increase of SSCs (including sediment deposition and smothering);
- Remobilisation of contaminated sediments; and
- Underwater noise and vibration.

103. The significance of decommissioning effects will be comparable to or less than the construction phase. Accordingly, given that effects were assessed to be of no greater than minor adverse significance for the identified benthic ecology receptors during the construction phase, it is anticipated that the same would be true for the decommissioning phase.

5.4 Cumulative Effects

Cumulative effects can be defined as incremental effects on that same receptor from other proposed and reasonably foreseeable schemes and developments in combination with the Projects. This includes all schemes that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects. **Chapter 9 Benthic and Intertidal Ecology** [APP-085], section 9.8.1 discusses the methodology for screening cumulative effects. The relevant potential cumulative effects are described in **Table 5-4**.

Table 5-4 Potential Cumulative Effects

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Construction (and decommissioning)			
Increased SSCs (including sediment deposition and smothering)	Yes	High	Increased SSCs from projects with overlapping ZoIs could result in a cumulative effect on benthic receptors.
Operation & Maintenance			
Increased SSCs (including sediment deposition and smothering)	Yes	High	Increased SSCs from projects with overlapping ZoIs could result in a cumulative effect on benthic receptors.
Changes to Bedload Sediment Transport	Yes	High	Changes in Bedload Sediment Transport from projects with overlapping ZoIs could result in a cumulative effect on benthic receptors.

5.4.1 Potential Cumulative Effects during Construction

5.4.1.1 Increased suspended sediment concentrations (including sediment deposition and smothering)

104. There is the potential for cumulative increased SSCs and associated deposition as a result of construction activities associated with the Projects and other schemes. This could interact with the features of the Holderness Offshore MCZ, Holderness Inshore MCZ and Flamborough Head SAC.

105. **Chapter 9 Benthic and Intertidal Ecology** [APP-085] section 9.8.2.2 provides a detailed assessment of the potential cumulative impact of increased SSCs. Construction of the Projects could result in a cumulative effect on SSCs due to overlapping ZoIs with Hornsea Project Four, Dogger Bank D and Eastern Green Link 2 (if construction with those schemes occurs at the same time). Where sediment plumes interact, there is likely to be a corresponding increase in SSCs at that location over and above what would be expected should the developments be undertaken in isolation.

106. The cumulative impacts of increased SSCs (and deposition), in keeping with the Projects' assessment are expected to be of local spatial extent, temporary duration, intermittent and reversible. Fine suspended sediment may be transported a further distance than coarse sediments, however this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. The magnitude of impacts is therefore considered to be low.

107. Based on a maximum medium sensitivity of the assessed biotopes (as per those described in section 5.1) and maximum low magnitude of impact, cumulatively increased SSCs and subsequent deposition during construction would have a **minor adverse** (at worst) effect on the features of the Holderness Offshore MCZ, Holderness Inshore MCZ and Flamborough Head SAC, which is not significant in EIA terms.

5.4.2 Potential Cumulative Effects during Operation

5.4.2.1 Increased suspended sediment concentrations (including sediment deposition and smothering)

108. **Chapter 9 Benthic and Intertidal Ecology** [APP-085], section 9.8.3.2 provides details on the potential cumulative effects of increased SSCs.

109. Overall, it is unlikely that maintenance activities would overlap spatially and temporally. However, the impacts associated with maintenance would be temporary and localised, therefore potential for any cumulative impacts is expected to be minimal.

110. As with the cumulative impact of increased SSCs during construction (section 5.4.1.1), impacts are expected to be highly localised, temporary and intermittent. Fine suspended sediment may be transported a further distance than coarse sediments, however this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. The magnitude of impacts is therefore considered to be low.

111. Based on a maximum medium sensitivity of the assessed biotopes (as per those described in section 5.2), and maximum low magnitude of impact, increased SSCs and subsequent deposition during operations would have a **minor adverse** effect (at worst) on the features of the Holderness Offshore MCZ, Holderness Inshore MCZ and Flamborough Head SAC, which is not significant in EIA terms.

6 Summary

112. This Benthic Ecology Technical Note has addressed comments within the Applicants' **Responses to Natural England's Relevant Representations** [AS-048], in relation to the requirement to provide further characterisation and assessment from an EIA perspective of the habitats of the Flamborough Head SAC. It has also investigated the potential impacts on the designated features of the Holderness Inshore MCZ and Holderness Offshore MCZ.

113. The assessment has established that there will be some negligible to minor adverse residual effects during the construction, operation and decommissioning phases of the Projects. Effects are generally localised in nature, being restricted to the project boundaries and immediate surrounding area.

114. Cumulative effects were also considered, and an assessment was carried out examining the potential for interaction of impacts as a result of the combined activities of the Projects and other schemes in the study area. The cumulative assessment established that there will be some minor adverse (at worst) residual effects during the construction and operation of DBS East and DBS West with other schemes in the area.

115. The potential effects (including cumulatively) of the Projects on intertidal and subtidal benthic ecology receptors are therefore not significant in terms of the EIA Regulations.

116. In addition, the updated assessment findings presented in this report do not alter the conclusions reached in the **Stage 1 MCZA** [APP-240] or the **RIAA Part 2 2 of 4 – Annex I Offshore Habitats and Annex II Migratory Fish** [APP-045].

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Annex A: Biotopes / species of the Holderness Offshore MCZ

Table A-1 - Biotopes / species comprising Subtidal Coarse Sediment in the Holderness Offshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.134	*Hesionura elongata and Microphthalmus similis* with other interstitial polychaetes in infralittoral mobile coarse sand	Not Sensitive	High	High
A5.135	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Not Sensitive	High	High
A5.137	*Dense Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand	Not Sensitive	High	High
A5.131	Sparse fauna on highly mobile sublittoral shingle (cobbles and pebbles)	Not Sensitive	High	High
A5.133	*Moerella* spp. with venerid bivalves in infralittoral gravelly sand	Low	Medium	High
A5.136	*Cumaceans and Chaetozone setosa* in infralittoral gravelly sand	Low	Medium	High
A5.143	*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	Not sensitive	High	High

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.141	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive	High	High
A5.142	*Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	Low	Medium	High
A5.145	*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel	Not sensitive	High	High
A5.146	Scallops on shell gravel and sand with some sand scour	Unknown	Unknown	Unknown
A5.152	*Hesionura elongata* and *Protodorvillea kefersteini* in offshore coarse sand	No evidence	No evidence	Not relevant
A5.151	*Glycera lapidum, Thyasira* spp. and *Amythasides macroglossus* in offshore gravelly sand	Not sensitive	High	High

Table A-2 Biotopes / species comprising subtidal mixed sediments in the Holderness Offshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.441	*Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment	Not sensitive	High	High
A5.444	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	Not sensitive	High	High

EUNIS Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.445	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Not sensitive	High	High
A5.443	*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	Not sensitive	High	High
A5.451	Polychaete-rich deep *Venus* community in offshore mixed sediments	Low	Medium	High

Table A-3 Biotopes / species comprising subtidal sand in the Holderness Offshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.231	Infralittoral mobile clean sand with sparse fauna	Low	Medium	High
A5.233	*Nephtys cirrosa* and Bathyporeia spp. in infralittoral sand	Low	Medium	High
A5.232	*Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles	Not sensitive	High	High
A5.234	Semi-permanent tube-building amphipods and polychaetes in sublittoral sand	Low	Low	High
A5.242	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low	Medium	High

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.241	*Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand	Not sensitive	High	High
A5.243	*Arenicola marina* in infralittoral fine sand or muddy sand	Not sensitive	High	High
A5.244	*Spisula subtruncata* and *Nephtys hombergii* in shallow muddy sand	Low	Medium	High
A5.251	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Low	Medium	High
A5.252	*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Low	Medium	High
A5.261	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low	Medium	High
A5.262	*Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand	Not sensitive	High	High
A5.271	Maldanid polychaetes and *Eudorellopsis* deformis in deep circalittoral sand or muddy sand	Not sensitive	High	High
A5.272	*Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Not sensitive	High	High

Table A-4 Biotopes / species comprising subtidal coarse sediment in the Holderness Offshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.134	*Hesionura elongata* and *Microphthalmus similis* with other interstitial polychaetes in infralittoral mobile coarse sand	Low	Medium	High
A5.135	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Low	Medium	High
A5.137	Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand	Not sensitive	High	High
A5.131	Sparse fauna on highly mobile sublittoral shingle (cobbles and pebbles)	Not sensitive	High	High
A5.133	*Moerella* spp. with venerid bivalves in infralittoral gravelly sand	Low	Medium	High
A5.136	*Cumaceans* and *Chaetozone setosa* in infralittoral gravelly sand	No evidence	No evidence	Not relevant
A5.143	*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	No evidence	No evidence	Not relevant
A5.141	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive	High	High
A5.142	*Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	Low	Medium	High

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.145	*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel	Low	Low	High
A5.146	Scallops on shell gravel and sand with some sand scour	Unknown	Unknown	Unknown
A5.152	*Hesionura elongata* and *Protodorvillea kefersteini* in offshore coarse sand	No evidence	No evidence	Not relevant
A5.151	*Glycera lapidum, Thyasira* spp. and *Amythasides macroglossus* in offshore gravelly sand	Low	Medium	High

Table A-5 Biotopes / species comprising subtidal mixed sediments in the Holderness Offshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.441	*Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment	Medium	Medium	Medium
A5.444	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	Not sensitive	High	High
A5.445	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Medium	Low	Medium
A5.443	*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	Not sensitive	High	High
A5.451	Polychaete-rich deep Venus community in offshore mixed sediments	Low	Medium	High

Table A-6 Biotopes / species comprising subtidal sand in the Holderness Offshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Last *et al*, 2020; www.marlin.ac.uk)

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.231	Infralittoral mobile clean sand with sparse fauna	Not sensitive	High	High
A5.233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Not sensitive	High	High
A5.232	*Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles	Not sensitive	High	High
A5.234	Semi-permanent tube-building amphipods and polychaetes in sublittoral sand	Low	Medium	High
A5.242	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low	Medium	High
A5.241	*Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand	Not sensitive	High	High
A5.243	*Arenicola marina* in infralittoral fine sand or muddy sand	Not sensitive	High	High
A5.244	*Spisula subtruncata* and *Nephtys hombergii* in shallow muddy sand	Low	Medium	High
A5.251	*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Low	Medium	High
A5.252	*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Low	Medium	High

EUNIS Code	EUNIS Name	Sensitivity	Resistance	Resilience
A5.261	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low	Medium	High
A5.262	*Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand	Low	Medium	High
A5.271	*Maldanid polychaetes* and *Eudorellopsis deformis* in deep circalittoral sand or muddy sand	Not sensitive	High	High
A5.272	*Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	High

Annex B: Biotopes / species of the Holderness Inshore MCZ

Table B-1 Biotopes / species comprising intertidal sand and muddy sand in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A2.222	Oligochaetes in littoral mobile sand	Low	Medium	High
A2.2221	Oligochaetes in full salinity littoral mobile sand	Low	Medium	High
A2.223	Amphipods and *Scolelepis* spp. in littoral medium-fine sand	Low	Low	High
A2.2231	*Scolelepis* spp. in littoral mobile sand	Low	Medium	High
A2.2232	*Eurydice pulchra* in littoral mobile sand	Low	Low	High
A2.2233	Pontocrates arenarius in littoral mobile sand	Low	Low	High
A2.231	Polychaetes in littoral fine sand	Low	Medium	High
A2.2312	Polychaetes and Angulus tenuis in littoral fine sand	Low	Low	High
A2.2313	*Nephtys cirrosa*-dominated littoral fine sand	Low	Medium	High
A2.242	*Cerastoderma edule* and polychaetes in littoral muddy sand	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A2.243	*Hediste diversicolor*, *Macoma balthica* and *Eteone longa* in littoral muddy sand	Low	Medium	High
A2.244	*Bathyporeia pilosa* and *Corophium arenarium* in littoral muddy sand	Low	Low	High
A2.211	Talitrids on the upper shore and strandline	Low	Low	High
A2.22	Barren or amphipod-dominated mobile sand shores	Not sensitive	High	High
A2.221	Barren littoral coarse sand	Not sensitive	High	High

Table B-2 Biotopes / species comprising subtidal coarse sediment in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.136	Cumaceans and *Chaetozone setosa* in infralittoral gravelly sand	Low	Medium	High
A5.137	Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand	Not sensitive	High	High
A5.141	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.143	*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	Not sensitive	High	High
A5.134	*Hesionura elongata* and *Microphthalmus similis* with other interstitial polychaetes in infralittoral mobile coarse sand	Not sensitive	High	High
A5.135	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Not sensitive	High	High

Table B-3 Biotopes / species comprising subtidal mixed sediments in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.444	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	Not sensitive	High	High
A5.445	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Not sensitive	High	High

Table B-4 Biotopes / species comprising subtidal mud in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.321	*Polydora ciliata* and *Corophium volutator* in variable salinity infralittoral firm mud or clay	Low	Low	High
A5.325	*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment	Low	Medium	High
A5.334	*Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in infralittoral sandy mud	Low	Low	High
A5.336	*Capitella capitata* in enriched sublittoral muddy sediments	Low	Medium	High
A5.331	*Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud	Not sensitive	High	High
A5.322	*Aphelochaeta marioni* and *Tubificoides* spp. in variable salinity infralittoral mud	Not sensitive	High	High

Table B-5 Biotopes / species comprising subtidal sand in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.222	*Nephtys cirrosa* and *Macoma balthica* in variable salinity infralittoral mobile sand	Low	Medium	High
A5.223	*Neomysis integer* and *Gammarus* spp. in fluctuating low salinity infralittoral mobile sand	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.231	Infralittoral mobile clean sand with sparse fauna	Low	Medium	High
A5.233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Low	Medium	High
A5.242	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low	Medium	High
A5.22	Sublittoral sand in variable salinity (estuaries)	Low	Medium	High
A5.261	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low	Medium	High
A5.221	Infralittoral mobile sand in variable salinity (estuaries)	Not sensitive	High	High
A5.243	*Arenicola marina* in infralittoral fine sand or muddy sand	Not sensitive	High	High

Table B-6 Biotopes / species comprising high energy circalittoral rock in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.134	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.1341	*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.1343	*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata	Not sensitive	High	High
A4.137	*Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Not sensitive	High	High
A4.138	*Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High

Table B-7 Biotopes / species comprising moderate energy circalittoral rock in the Holderness Inshore MCZ and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.232	*Polydora* sp. tubes on moderately exposed sublittoral soft rock	Low	Low	High
A4.233	*Hiatella*-bored vertical sublittoral limestone rock	Low	Medium	High
A4.241	*Mytilus edulis* beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Not sensitive	High	High
A4.214	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.2141	*Flustra foliacea* on slightly scoured silty circalittoral rock	Not sensitive	High	High
A4.22	*Sabellaria* reefs on circalittoral rock	Not sensitive	High	High
A4.221	*Sabellaria spinulosa* encrusted circalittoral rock	Not sensitive	High	High
A4.2211	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Not sensitive	High	High
A4.231	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Not sensitive	High	High

Table B-8 Biotopes / species comprising intertidal sand and muddy sand in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A2.242	*Cerastoderma edule* and polychaetes in littoral muddy sand	Low	Medium	High
A2.243	*Hediste diversicolor, Macoma balthica* and *Eteone longa* in littoral muddy sand	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A2.244	*Bathyporeia pilosa* and *Corophium arenarium* in littoral muddy sand	Low	Medium	High
A2.211	Talitrids on the upper shore and strandline	Not sensitive	High	High
A2.22	Barren or amphipod-dominated mobile sand shores	Not sensitive	High	High
A2.221	Barren littoral coarse sand	Not sensitive	High	High
A2.222	Oligochaetes in littoral mobile sand	Not sensitive	High	High
A2.2221	Oligochaetes in full salinity littoral mobile sand	Not sensitive	High	High
A2.223	Amphipods and *Scolelepis* spp. in littoral medium-fine sand	Not sensitive	High	High
A2.2231	*Scolelepis* spp. in littoral mobile sand	Not sensitive	High	High
A2.2232	*Eurydice pulchra* in littoral mobile sand	Not sensitive	High	High
A2.2233	*Pontocrates arenarius* in littoral mobile sand	Not sensitive	High	High
A2.231	Polychaetes in littoral fine sand	Not sensitive	High	High
A2.2312	Polychaetes and *Angulus tenuis* in littoral fine sand	Not sensitive	High	High
A2.2313	*Nephtys cirrosa*-dominated littoral fine sand	Not sensitive	High	High

Table B-9 Biotopes / species comprising subtidal coarse sediments in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.134	*Hesionura elongata* and *Microphthalmus similis* with other interstitial polychaetes in infralittoral mobile coarse sand	Low	Medium	High
A5.135	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Low	Medium	High
A5.136	Cumaceans and *Chaetozone setosa* in infralittoral gravelly sand	No evidence	No evidence	No evidence
A5.143	*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	No evidence	No evidence	No evidence
A5.137	Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand	Not sensitive	High	High
A5.141	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive	High	High

Table B-10 Biotopes / species comprising subtidal mixed sediments in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.445	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Medium	Low	Medium
A5.444	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	Not sensitive	High	High

Table B-11 Biotopes / species comprising subtidal mud in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.321	*Polydora ciliata* and *Corophium volutator* in variable salinity infralittoral firm mud or clay	Low	Low	High
A5.325	*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment	Low	Low	High
A5.336	*Capitella capitata* in enriched sublittoral muddy sediments	Low	Low	High
A5.331	*Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud	Not sensitive	High	High
A5.334	*Melinna palmata* with *Magelona* spp. and Thyasira spp. in infralittoral sandy mud	Not sensitive	High	High
A5.322	*Aphelochaeta marioni* and *Tubificoides* spp. in variable salinity infralittoral mud	Not sensitive	High	High

Table B-12 Biotopes / species comprising subtidal sand in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A5.242	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low	Medium	High
A5.261	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low	Medium	High
A5.243	*Arenicola marina* in infralittoral fine sand or muddy sand	Not sensitive	High	High
A5.22	Sublittoral sand in variable salinity (estuaries)	Not sensitive	High	High
A5.221	Infralittoral mobile sand in variable salinity (estuaries)	Not sensitive	High	High
A5.222	*Nephtys cirrosa* and *Macoma balthica* in variable salinity infralittoral mobile sand	Not sensitive	High	High
A5.223	*Neomysis integer* and *Gammarus* spp. in fluctuating low salinity infralittoral mobile sand	Not sensitive	High	High
A5.231	Infralittoral mobile clean sand with sparse fauna	Not sensitive	High	High
A5.233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Not sensitive	High	High

Table B-13 Biotopes / species comprising high energy circalittoral rock in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.134	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock	Low	Medium	High
A4.1341	*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock	Low	Medium	High
A4.1343	*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata	Low	Medium	High
A4.137	*Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Low	Medium	High
A4.138	*Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High

Table B-14 Biotopes / species comprising moderate energy circalittoral rock in the Holderness Inshore MCZ and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024a; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.231	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Medium	Medium	Medium

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.233	*Hiatella*-bored vertical sublittoral limestone rock	Medium	Low	Medium
A4.241	*Mytilus edulis* beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock	Medium	Medium	Medium
A4.2141	*Flustra foliacea* on slightly scoured silty circalittoral rock	Low	Medium	High
A4.22	*Sabellaria* reefs on circalittoral rock	Not sensitive	High	High
A4.221	*Sabellaria spinulosa* encrusted circalittoral rock	Not sensitive	High	High
A4.2211	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Not sensitive	High	High
A4.232	*Polydora* sp. tubes on moderately exposed sublittoral soft rock	Not sensitive	High	High
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Not sensitive	High	High
A4.214	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High

Annex C: Biotopes / species of the Flamborough Head SAC

Table C-1 Biotopes / species comprising intertidal rock in the Flamborough Head SAC and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.21	Barnacles and fucoids on moderately exposed shores	Medium	Medium	Medium
A1.212	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock	Medium	Medium	Medium
A1.213	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock	Medium	Medium	Medium
A1.313	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock	Medium	Medium	Medium
A1.3131	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock	Medium	Medium	Medium
A1.3132	*Fucus vesiculosus* on mid eulittoral mixed substrata	Medium	Medium	Medium
A1.322	*Fucus spiralis* on sheltered variable salinity upper eulittoral rock	Medium	Medium	Medium
A1.323	*Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata	Medium	Medium	Medium
A1.412	Fucoids and kelp in deep eulittoral rockpools	Medium	Low	Medium
A1.413	Seaweeds in sediment-floored eulittoral rockpools	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.446	Sponges and shade-tolerant red seaweeds on overhanging lower eulittoral bedrock and in cave entrances	Low	Medium	High
A1.4461	Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves	Low	Medium	High
A1.447	Sponges, bryozoans and ascidians on deeply overhanging lower shore bedrock or caves	Low	Medium	High
A1.448	Faunal crusts on wave-surged littoral cave walls	Low	Medium	High
A1.315	*Fucus serratus* on sheltered lower eulittoral rock	Low	Medium	High
A1.3151	*Fucus serratus* on full salinity sheltered lower eulittoral rock	Low	Medium	High
A1.3152	*Fucus serratus* on full salinity lower eulittoral mixed substrata	Low	Medium	High
A1.222	*Mytilus edulis, Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock	Low	Low	High
A1.214	*Fucus serratus* on moderately exposed lower eulittoral rock	Low	Medium	High
A1.2141	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock	Low	Medium	High
A1.2142	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	Low	Low	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.113	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock	Low	Medium	High
A1.1131	*Semibalanus balanoides, Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock	Low	Medium	High
A1.1132	*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	Low	Medium	High
A1.1133	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	Low	Medium	High
A1.122	*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock	Not sensitive	High	High
A1.1221	*Corallina officinalis* and *Mastocarpus stellatus* on exposed to moderately exposed lower eulittoral rock	Not sensitive	High	High
A1.1222	*Corallina officinalis, Himanthalia elongata* and *Patella ulyssiponensis* on very exposed lower eulittoral rock	Not sensitive	High	High
A1.123	*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock	Not sensitive	High	High
A1.125	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock	Not sensitive	High	High
A1.126	*Osmundea pinnatifida* on moderately exposed mid eulittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.215	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock	Not sensitive	High	High
A1.221	*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock	Not sensitive	High	High
A1.311	*Pelvetia canaliculata* on sheltered littoral fringe rock	Not sensitive	High	High
A1.312	*Fucus spiralis* on sheltered upper eulittoral rock	Not sensitive	High	High
A1.3121	*Fucus spiralis* on full salinity sheltered upper eulittoral rock	Not sensitive	High	High
A1.3122	*Fucus spiralis* on full salinity upper eulittoral mixed substrata	Not sensitive	High	High
A1.314	*Ascophyllum nodosum* on very sheltered mid eulittoral rock	Not sensitive	High	High
A1.3141	*Ascophyllum nodosum* on full salinity mid eulittoral rock	Not sensitive	High	High
A1.3142	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata	Not sensitive	High	High
A1.321	*Pelvetia canaliculata* on sheltered variable salinity littoral fringe rock	Not sensitive	High	High
A1.324	*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock	Not sensitive	High	High
A1.326	*Fucus serratus* and large *Mytilus edulis* on variable salinity lower eulittoral rock	Not sensitive	High	High
A1.327	*Fucus ceranoides* on reduced salinity eulittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.411	Coralline crust-dominated shallow eulittoral rockpools	Not sensitive	High	High
A1.4111	Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools	Not sensitive	High	High
A1.449	Sparse fauna (barnacles and spirorbids) on sand/pebble-scoured rock in littoral caves	Not sensitive	High	High
A1.44A	Barren and/or boulder-scoured littoral cave walls and floors	Not sensitive	High	High
A1.451	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock	Not sensitive	High	High
A1.452	*Porphyra purpurea* or *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	Not sensitive	High	High
A1.421	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools	Not sensitive	High	High
A1.111	*Mytilus edulis* and barnacles on very exposed eulittoral rock	Not sensitive	High	High
A1.441	*Chrysophyceae* and *Haptophyceae* on vertical upper littoral fringe soft rock	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
A1.442	Green algal films on upper and mid-shore cave walls and ceilings	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
A1.443	*Audouinella purpurea* and *Pilinia maritima* crusts on upper and mid-shore cave walls and ceilings	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.444	*Audouinella purpurea* and *Cladophora rupestris* on upper to mid-shore cave walls	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
A1.445	*Verrucaria mucosa* and/or *Hildenbrandia rubra* on upper to mid shore cave walls	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)

Table C-2 Biotopes / species comprising infralittoral rock in the Flamborough Head SAC and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.115	*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock	Medium	None	Medium
A3.1151	*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock	Medium	None	Medium
A3.116	Foliose red seaweeds on exposed lower infralittoral rock	Medium	Low	Medium
A3.1161	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock	Medium	Low	Medium
A3.123	*Laminaria saccharina, Chorda filum* and dense red seaweeds on shallow unstable infralittoral boulders and cobbles	Medium	None	Medium

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.212	*Laminaria hyperborea* on tide-swept, infralittoral rock	Medium	Low	Medium
A3.2121	*Laminaria hyperborea* forest, foliose red seaweeds and a diverse fauna on tide-swept upper infralittoral rock	Medium	Low	Medium
A3.213	*Laminaria hyperborea* on tide-swept infralittoral mixed substrata	Medium	None	Medium
A3.2131	*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata	Medium	Low	Medium
A3.2132	*Laminaria hyperborea* park and foliose red seaweeds on tide-swept lower infralittoral mixed substrata	Medium	None	Medium
A3.214	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock	Medium	Low	Medium
A3.2141	*Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock	Medium	Low	Medium
A3.2142	*Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock	Medium	Low	Medium
A3.2143	Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock	Medium	None	Medium
A3.2144	Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock	Medium	None	Medium

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.2145	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock	Medium	Low	Medium
A3.216	*Laminaria hyperborea* on moderately exposed vertical rock	Medium	Low	Medium
A3.222	Mixed kelp with foliose red seaweeds, sponges and ascidians on sheltered tide-swept infralittoral rock	Medium	Low	Medium
A3.223	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	Medium	Low	Medium
A3.312	Mixed *Laminaria hyperborea* and *Laminaria saccharina* on sheltered infralittoral rock	Medium	Low	Medium
A3.3121	Mixed *Laminaria hyperborea* and *Laminaria saccharina* forest on sheltered upper infralittoral rock	Medium	Low	Medium
A3.313	*Laminaria saccharina* on very sheltered infralittoral rock	Low	Low	High
A3.3131	*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock	Low	Low	High
A3.3133	*Laminaria saccharina* park on very sheltered lower infralittoral rock	Low	Low	High
A3.713	Crustose sponges and colonial ascidians with *Dendrodoa grossularia* or barnacles on wave-surged infralittoral rock	Low	Medium	High
A3.714	*Dendrodoa grossularia* and *Clathrina coriacea* on wave-surged vertical infralittoral rock	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.715	Crustose sponges on extremely wave-surged infralittoral cave or gully walls	Low	Medium	High
A3.111	*Alaria esculenta* on exposed sublittoral fringe bedrock	Low	Medium	High
A3.1112	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock	Low	Medium	High
A3.124	Dense *Desmarestia* spp. with filamentous red seaweeds on exposed infralittoral cobbles, pebbles and bedrock	Low	Low	High
A3.125	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	Low	Low	High
A3.211	*Laminaria digitata* on moderately exposed sublittoral fringe rock	Low	Medium	High
A3.2111	*Laminaria digitata* on moderately exposed sublittoral fringe bedrock	Low	Medium	High
A3.2112	*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders	Low	Low	High
A3.121	*Saccorhiza polyschides* and other opportunistic kelps on disturbed upper infralittoral rock	Low	Low	High
A3.215	Dense foliose red seaweeds on silty moderately exposed infralittoral rock	Not sensitive	High	High
A3.716	Coralline crusts in surge gullies and scoured infralittoral rock	Not sensitive	High	High
A3.7162	Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies	Not sensitive	High	High

Table C-3 Biotopes / species comprising circalittoral rock in the Flamborough Head SAC and MarESA sensitivity classification to changes in suspended solids (water clarity) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.232	*Polydora* sp. tubes on moderately exposed sublittoral soft rock	Low	Low	High
A4.233	*Hiatella*-bored vertical sublittoral limestone rock	Low	Medium	High
A4.241	*Mytilus edulis* beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.71	Communities of circalittoral caves and overhangs	Not sensitive	High	High
A4.134	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.1341	*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.1343	*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata	Not sensitive	High	High
A4.137	*Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.138	*Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Not sensitive	High	High
A4.214	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.2141	Flustra foliacea on slightly scoured silty circalittoral rock	Not sensitive	High	High
A4.2142	*Alcyonium digitatum*, *Pomatoceros triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock	Not sensitive	High	High
A4.2143	*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.2145	Faunal and algal crusts with *Pomatoceros triqueter* and sparse *Alcyonium digitatum* on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.215	*Alcyonium digitatum* and faunal crust communities on vertical circalittoral bedrock	Not sensitive	High	High
A4.22	*Sabellaria* reefs on circalittoral rock	Not sensitive	High	High
A4.221	*Sabellaria spinulosa* encrusted circalittoral rock	Not sensitive	High	High
A4.2211	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.231	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Not sensitive	High	High

Table C-4 Biotopes / species comprising intertidal rock in the Flamborough Head SAC and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.113	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock	Medium	Low	Medium
A1.1131	*Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock	Medium	Low	Medium
A1.1132	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	Medium	Low	Medium
A1.1133	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	Medium	Low	Medium
A1.21	Barnacles and fucoids on moderately exposed shores	Medium	Medium	Medium
A1.213	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock	Medium	Medium	Medium
A1.313	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock	Medium	Medium	Medium

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.3131	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock	Medium	Medium	Medium
A1.3132	*Fucus vesiculosus* on mid eulittoral mixed substrata	Medium	Medium	Medium
A1.314	*Ascophyllum nodosum* on very sheltered mid eulittoral rock	Medium	Medium	Medium
A1.3141	*Ascophyllum nodosum* on full salinity mid eulittoral rock	Medium	Medium	Medium
A1.3142	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata	Medium	Medium	Medium
A1.321	*Pelvetia canaliculata* on sheltered variable salinity littoral fringe rock	Medium	Medium	Medium
A1.322	*Fucus spiralis* on sheltered variable salinity upper eulittoral rock	Medium	Medium	Medium
A1.323	*Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata	Medium	Medium	Medium
A1.324	*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock	Medium	Medium	Medium
A1.326	*Fucus serratus* and large *Mytilus edulis* on variable salinity lower eulittoral rock	Medium	Medium	Medium
A1.327	*Fucus ceranoides* on reduced salinity eulittoral rock	Medium	Medium	Medium
A1.411	Coralline crust-dominated shallow eulittoral rockpools	Medium	Low	Medium
A1.4111	Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools	Medium	Low	Medium

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.412	Fucoids and kelp in deep eulittoral rockpools	Medium	Medium	Medium
A1.221	*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock	Medium	Medium	Medium
A1.222	*Mytilus edulis*, *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock	Medium	Medium	Medium
A1.311	*Pelvetia canaliculata* on sheltered littoral fringe rock	Medium	Medium	Medium
A1.312	*Fucus spiralis* on sheltered upper eulittoral rock	Low	Medium	High
A1.3121	*Fucus spiralis* on full salinity sheltered upper eulittoral rock	Low	Medium	High
A1.3122	*Fucus spiralis* on full salinity upper eulittoral mixed substrata	Low	Medium	High
A1.446	Sponges and shade-tolerant red seaweeds on overhanging lower eulittoral bedrock and in cave entrances	Low	Medium	High
A1.4461	Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves	Low	Medium	High
A1.447	Sponges, bryozoans and ascidians on deeply overhanging lower shore bedrock or caves	Low	Medium	High
A1.448	Faunal crusts on wave-surged littoral cave walls	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.443	*Audouinella purpurea* and *Pilinia maritima* crusts on upper and mid-shore cave walls and ceilings	Low	Medium	High
A1.444	*Audouinella purpurea* and *Cladophora rupestris* on upper to mid-shore cave walls	Low	Medium	High
A1.451	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock	Low	Low	High
A1.452	*Porphyra purpurea* or *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	Low	Low	High
A1.111	*Mytilus edulis* and barnacles on very exposed eulittoral rock	Low	Medium	High
A1.413	Seaweeds in sediment-floored eulittoral rockpools	Low	Medium	High
A1.421	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools	Low	Low	High
A1.315	*Fucus serratus* on sheltered lower eulittoral rock	Low	Medium	High
A1.3151	*Fucus serratus* on full salinity sheltered lower eulittoral rock	Low	Medium	High
A1.3152	*Fucus serratus* on full salinity lower eulittoral mixed substrata	Low	Medium	High
A1.214	*Fucus serratus* on moderately exposed lower eulittoral rock	Low	Medium	High
A1.2141	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.2142	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	Low	Medium	High
A1.212	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock	Low	Medium	High
A1.125	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock	Low	Medium	High
A1.126	*Osmundea pinnatifida* on moderately exposed mid eulittoral rock	Low	Medium	High
A1.215	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock	Not sensitive	High	High
A1.122	*Corallina* officinalis on exposed to moderately exposed lower eulittoral rock	Not sensitive	High	High
A1.1221	*Corallina officinalis* and *Mastocarpus stellatus* on exposed to moderately exposed lower eulittoral rock	Not sensitive	High	High
A1.1222	*Corallina officinalis*, *Himanthalia elongata* and *Patella ulyssiponensis* on very exposed lower eulittoral rock	Not sensitive	High	High
A1.123	*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock	Not sensitive	High	High
A1.445	*Verrucaria mucosa* and/or *Hildenbrandia rubra* on upper to mid shore cave walls	Not sensitive	High	High
A1.449	Sparse fauna (barnacles and spirorbids) on sand/pebble-scoured rock in littoral caves	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A1.44A	Barren and/or boulder-scoured littoral cave walls and floors	Not sensitive	High	High
A1.441	*Chrysophyceae* and *Haptophyceae* on vertical upper littoral fringe soft rock	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
A1.442	Green algal films on upper and mid-shore cave walls and ceilings	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)

Table C-5 Biotopes / species comprising infralittoral rock in the Flamborough Head SAC and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.2112	*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders	Low	Medium	High
A3.222	Mixed kelp with foliose red seaweeds, sponges and ascidians on sheltered tide-swept infralittoral rock	Low	Medium	High
A3.223	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	Low	Medium	High
A3.312	Mixed *Laminaria hyperborea* and *Laminaria saccharina* on sheltered infralittoral rock	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.3121	Mixed *Laminaria hyperborea* and *Laminaria saccharina* forest on sheltered upper infralittoral rock	Low	Medium	High
A3.713	Crustose sponges and colonial ascidians with *Dendrodoa grossularia* or barnacles on wave-surged infralittoral rock	Low	Medium	High
A3.714	*Dendrodoa grossularia* and *Clathrina coriacea* on wave-surged vertical infralittoral rock	Low	Medium	High
A3.715	Crustose sponges on extremely wave-surged infralittoral cave or gully walls	Low	Medium	High
A3.716	Coralline crusts in surge gullies and scoured infralittoral rock	Not sensitive	High	High
A3.7162	Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies	Not sensitive	High	High
A3.313	*Laminaria saccharina* on very sheltered infralittoral rock	Not sensitive	High	High
A3.3131	*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock	Not sensitive	High	High
A3.3133	*Laminaria saccharina* park on very sheltered lower infralittoral rock	Not sensitive	High	High
A3.212	*Laminaria hyperborea* on tide-swept, infralittoral rock	Not sensitive	High	High
A3.2121	*Laminaria hyperborea* forest, foliose red seaweeds and a diverse fauna on tide-swept upper infralittoral rock	Not sensitive	High	High
A3.213	*Laminaria hyperborea* on tide-swept infralittoral mixed substrata	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.2131	*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata	Not sensitive	High	High
A3.2132	*Laminaria hyperborea* park and foliose red seaweeds on tide-swept lower infralittoral mixed substrata	Not sensitive	High	High
A3.214	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock	Not sensitive	High	High
A3.2141	*Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock	Not sensitive	High	High
A3.2142	*Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock	Not sensitive	High	High
A3.2143	Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock	Not sensitive	High	High
A3.2144	Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock	Not sensitive	High	High
A3.2145	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock	Not sensitive	High	High
A3.215	Dense foliose red seaweeds on silty moderately exposed infralittoral rock	Not sensitive	High	High
A3.216	*Laminaria hyperborea* on moderately exposed vertical rock	Not sensitive	High	High
A3.111	*Alaria esculenta* on exposed sublittoral fringe bedrock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.1112	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock	Not sensitive	High	High
A3.115	*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock	Not sensitive	High	High
A3.1151	*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock	Not sensitive	High	High
A3.116	Foliose red seaweeds on exposed lower infralittoral rock	Not sensitive	High	High
A3.1161	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock	Not sensitive	High	High
A3.121	*Saccorhiza polyschides* and other opportunistic kelps on disturbed upper infralittoral rock	Not sensitive	High	High
A3.123	*Laminaria saccharina, Chorda filum* and dense red seaweeds on shallow unstable infralittoral boulders and cobbles	Not sensitive	High	High
A3.124	Dense D*esmarestia* spp. with filamentous red seaweeds on exposed infralittoral cobbles, pebbles and bedrock	Not sensitive	High	High
A3.125	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	Not sensitive	High	High
A3.211	*Laminaria digitata* on moderately exposed sublittoral fringe rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A3.2111	*Laminaria digitata* on moderately exposed sublittoral fringe bedrock	Not sensitive	High	High

Table C-6 Biotopes / species comprising circalittoral rock in the Flamborough Head SAC and MarESA sensitivity classification to smothering and siltation rate changes (Light) (taken from Natural England, 2024b; www.marlin.ac.uk)

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.231	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Medium	Medium	Medium
A4.233	*Hiatella*-bored vertical sublittoral limestone rock	Medium	Low	Medium
A4.241	*Mytilus edulis* beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock	Medium	Medium	Medium
A4.134	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock	Low	Medium	High
A4.1341	*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock	Low	Medium	High
A4.1343	*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata	Low	Medium	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.137	*Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Low	Medium	High
A4.2141	*Flustra foliacea* on slightly scoured silty circalittoral rock	Low	Medium	High
A4.2142	*Alcyonium digitatum, Pomatoceros triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock	Not sensitive	High	High
A4.2143	*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.2145	Faunal and algal crusts with *Pomatoceros triqueter* and sparse *Alcyonium digitatum* on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.215	*Alcyonium digitatum* and faunal crust communities on vertical circalittoral bedrock	Not sensitive	High	High
A4.22	*Sabellaria* reefs on circalittoral rock	Not sensitive	High	High
A4.221	*Sabellaria* spinulosa encrusted circalittoral rock	Not sensitive	High	High
A4.2211	*Sabellaria* spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock	Not sensitive	High	High
A4.138	*Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Not sensitive	High	High

EUNIS 2007 Code	EUNIS 2007 Name	Sensitivity	Resistance	Resilience
A4.214	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	Not sensitive	High	High
A4.71	Communities of circalittoral caves and overhangs	Not sensitive	High	High
A4.232	*Polydora* sp. tubes on moderately exposed sublittoral soft rock	Not sensitive	High	High

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