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RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Environmental Statement

Volume 7

Chapter 9 – Benthic and Intertidal Ecology

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Contents

Glossary 7
Acronyms 12
9 Benthic and Intertidal Ecology 16
9.1 Introduction 16
9.2 Consultation 17
9.3 Scope 17
9.3.1 Study Area 17
9.3.2 Realistic Worst Case Scenario 18
9.3.2.1 General Approach 18
9.3.2.2 Development Scenarios 27
9.3.2.3 Operation Scenarios 29
9.3.2.4 Decommissioning Scenarios 29
9.3.3 Embedded Mitigation 30
9.4 Assessment Methodology 35
9.4.1 Policy, Legislation and Guidance 35
9.4.1.1 National Policy Statements 35
9.4.1.2 Other 40
9.4.2 Data and Information Sources 43
9.4.2.1 Site-Specific Surveys 43
9.4.2.2 Other Available Sources 44
9.4.3 Impact Assessment Methodology 45
9.4.3.1 Definitions 46
9.4.3.2 Significance of Effect 50
9.4.4 Cumulative Effects Assessment Methodology 51
9.4.5 Assumptions and Limitations 51
9.5 Existing Environment 52
9.5.1 Offshore 53
9.5.1.1 Sediment Characterisation 53
9.5.1.2 Contaminants 54
9.5.1.3 Habitat and Biotope Classification 55
9.5.1.4 Potential Sensitive Habitats and Species 62
9.5.2 Intertidal Zone 64

9.5.3 Designated Sites 64
9.5.3.1 Dogger Bank SAC....65
9.5.3.2 Holderness Inshore MCZ....65
9.5.3.3 Holderness Offshore MCZ....66
9.5.3.4 Flamborough Head SAC....66
9.5.3.5 Humber Estuary SAC....66
9.5.3.6 Summary of Designated Sites....67
9.5.4 Invasive / Non-Native Species 68
9.5.5 Future Trends....69
9.6 Assessment of Significance 71
9.6.1 Consideration of Potential Impacts on Designated Sites....72
9.6.2 Potential Effects During Construction 73
9.6.2.1 Impact 1 - Temporary Physical Disturbance....73
9.6.2.2 Impact 2 – Increased Suspended Sediment Concentrations (Including Sediment Deposition and Smothering)....82
9.6.2.3 Impact 3 - Remobilisation of Contaminated Sediments 92
9.6.2.4 Impact 4 - Underwater Noise and Vibration....94
9.6.3 Potential Effects During Operation 96
9.6.3.1 Impact 1 - Temporary Physical Disturbance....96
9.6.3.2 Impact 2 – Increased Suspended Sediment Concentrations (Including Sediment Deposition and Smothering)....98
9.6.3.3 Impact 5 - Permanent Habitat Loss 99
9.6.3.4 Impact 6 - Interactions of EMF (Including Potential Cumulative EMF Effects).. 103
9.6.3.5 Impact 7 - Colonisation of Introduced Substrate, Including Invasive / Non-native Species 105
9.6.4 Potential Effects During Decommissioning.... 108
9.7 Potential Monitoring Requirements.... 110
9.8 Cumulative Effects Assessment 110
9.8.1 Screening for Cumulative Effects 110
9.8.2 Potential Cumulative Effects During Construction (and Decommissioning) 117
9.8.2.1 Impact 1 -Temporary physical disturbance.... 117
9.8.2.2 Impact 2 – Increased suspended sediment concentrations (including sediment deposition and smothering) 119

9.8.3 Potential Cumulative Effects During Operation 122
9.8.3.1 Impact 1 -Temporary physical disturbance 122
9.8.3.2 Impact 2 - Increased suspended sediment concentrations (including sediment deposition and smothering) 123
9.8.3.3 Impact 5 – Permanent habitat loss 124
9.8.3.4 Impact 7 - Colonisation of introduced substrate, including non-native species 126
9.9 Transboundary Effects 127
9.10 Interactions 127
9.11 Inter-relationships 131
9.12 Summary 133
References 137

Tables

Table 9-1 Realistic Worst Case Design Parameters 19
Table 9-2 Development Scenarios and Construction Durations 27
Table 9-3 Embedded Mitigation 30
Table 9-4 NPS Assessment Requirements 35
Table 9-5 Site-Specific Data 43
Table 9-6 Other Available Data and Information Sources 44
Table 9-7 Tolerance and Recoverability Scale Definitions 47
Table 9-8 Sensitivity Matrix 48
Table 9-9 Definition of Value for Benthic and Intertidal Ecology Receptors 49
Table 9-10 Definition of Magnitude of Impacts 49
Table 9-11 Definition of Effect Significance 50
Table 9-12 Biotope Classifications 55
Table 9-13 Designated Sites for Benthic Features Within/In the Vicinity of the Offshore Development Area 67
Table 9-14 Impacts scoped in and out of assessment 71
Table 9-15 Sensitivity of Biotopes to Temporary Physical Disturbance 74
Table 9-16 The Sensitivity of Barren Littoral Coarse Sand to Temporary Physical Disturbance 81
Table 9-17 The Sensitivity of Biotopes to Increased Suspended Sediments 83

Table 9-18 The Sensitivity of Barren Littoral Coarse Sand to Increased Suspended Sediments 91

Table 9-19 The Sensitivity of Biotopes to Physical Change to Another Seabed Type 100

Table 9-20 Sensitivity of Biotopes to Introduction or Spread of Invasive Non-Indigenous Species 106

Table 9-21 Potential Cumulative Effects 111

Table 9-22 List of Plans / Projects Screened for Further Assessment in the CEA 114

Table 9-23 Predicted permanent habitat loss for screened in operational schemes within the Dogger Bank (using the Dogger Bank SAC area of 12,331km^2 as a reference) 126

Table 9-24 Interactions Between Impacts – Screening 128

Table 9-25 Interaction Between Impacts – Phase and Lifetime Assessment.... 130

Table 9-26 Benthic and Intertidal Ecology Inter-Relationships 131

Table 9-27 Summary of Potential Likely Significant Effects on Benthic and Intertidal Ecology 135

Volume 7 - Figures

Figure 9-1 Benthic and Intertidal Ecology Study Area

Figure 9-2 Spatial Variations of Percentage of Sand, Gravel and Fines Across the Array Areas of DBS East and DBS West

Figure 9-3 Spatial Variations of Percentage of Sand, Gravel and Fines Across the Offshore Export Cable Corridor for DBS East and DBS West

Figure 9-4 Completed environmental stations and EUNIS (EEA, 2022) habitat classifications within the proposed Array Areas

Figure 9-5 Completed environmental stations and EUNIS (EEA, 2022) habitat classifications along the Offshore Export Cable Corridor

Figure 9-6 The extent of the Projects Offshore Development Area which falls within the Dogger Bank SAC

Volume 7 – Appendices

Appendix 9-1 Consultation Responses

Appendix 9-2 Intertidal Survey Report

Appendix 9-3 Benthic Ecology Monitoring Report

Appendix 9-4 Environmental Features Report

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).
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.
Cumulative Effects	The combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource.
Cumulative Effects Assessment (CEA)	The assessment of the combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource.
Cumulative impact	The combined impact of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource.

Term	Definition
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.
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.
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).
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.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.

Term	Definition
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.
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.
In Isolation scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Inter-Platform Cabling 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.
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.

Term	Definition
National Policy Statement (NPS)	A document setting out national policy against which proposals for NSIPs will be assessed and decided upon.
Offshore Converter Platforms (OCPs)	The OCPs are fixed structures located within the Array Areas that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the Offshore Export Cables to the Project's Onshore Grid Connection Points.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the offshore export cables (and potentially the ESP) between the Offshore Converter Platforms and Transition Joint Bays at the landfall.
Projects Design (or Rochdale) Envelope	A concept that ensures the EIA is based on assessing the realistic worst-case scenario where flexibility or a range of options is sought as part of the consent application.
Scoping opinion	The report adopted by the Planning Inspectorate on behalf of the Secretary of State.
Scoping report	The report that was produced in order to request a Scoping Opinion from the Secretary of State.
Sequential scenario	A potential construction scenario for the Projects where DBS East and DBS West are constructed with a lag between the commencement of construction activities. Either Project could be built first.
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).

Term	Definition
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
AL1	Action Level 1
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BSL	Below Sea Level
BTO	British Trust for Ornithology
BWMC	International Convention for the Control and Management of Ships' Ballast Water and Sediments
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute of Ecology and Environmental Management
CPA	Coast Protection Act 1949
DBS	Dogger Bank South
DBT	Dibutyltin
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EPP	Evidence Plan Process
ERM	Effects Range Median
ES	Environmental Statement
ESP	Electrical Switching Platform

Term	Definition
ETG	Expert Topic Group
EUNIS	European Nature Information System
FEPA	Food and Environmental Protection Act 1985
FERA	Food and Environment Research Agency
FOCI	Features of Conservation Interest
GBS	Gravity Based Structures
GDS	Government Digital Service
HDD	Horizontal Directional Drill
HRA	Habitats Regulations Assessment
HVDC	High Voltage Direct Current
Ifremer	Institut Français de Recherche pour l'Exploitation de la Mer
INNS	Invasive Non-Native Species
IPMP	In-Principal Monitoring Plan
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	The Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MPA	Marine Protected Area

Term	Definition
MPCP	Marine Pollution Contingency Plan
MPS	Marine Policy Statement
NERC	Natural Environment and Rural Communities
NOAA	National Oceanic and Atmospheric Administration
NPL	National Physical Laboratory
NPS	National Policy Statement
O&M	Operation and Maintenance
OCP	Offshore Convertor Platform
PAH	Poly-Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PEIR	Preliminary Environmental Information Report
PEL	Probable Effects Level
PEMP	Project Environmental Management Plan
PLGR	Pre-Lay Grapnel Run
PSD	Particle Size Distribution
SAC	Special Area of Conservation
SMRU	Sea Mammal Research Unit
SQG	Sediment Quality Guidelines
SSC	Suspended Sediment Concentration
ST	Station
SST	Sea Surface Temperature

Term	Definition
TBT	Tributyltin
TEL	Threshold Effects Level
THC	Total Hydrocarbon Content
UXO	Unexploded Ordnance
ZOI	Zone of Influence

9 Benthic and Intertidal Ecology

9.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the likely significant effects of the Projects on benthic and intertidal ecology. The chapter provides an overview of the existing environment for the proposed Offshore Development Area, followed by an assessment of likely significant effects for the construction, operation and maintenance (O&M), and decommissioning of the Projects.

2. This chapter should be read in conjunction with the following linked chapters in **Volume 7**:

- Chapter 8 Marine Physical Environment **(application ref: 7.8);**
- Chapter 10 Fish and Shellfish Ecology **(application ref: 7.10).**

3. Additional information to support the benthic and intertidal ecology assessment is included in **Volume 7**:

- Appendix 9-1 Benthic and Intertidal Ecology Consultation Responses **(application ref: 7.9.9.1);**
- Appendix 9-2 Intertidal Survey Report **(application ref: 7.9.9.2);**
- Appendix 9-3 Benthic Ecology Monitoring Report **(application ref: 7.9.9.3);**
- Appendix 9-4 Environmental Features Report **(application ref: 7.9.9.4).**

4. Note that effects on the Dogger Bank Special Area of Conservation (SAC) are considered in **Volume 6, Report to Inform Appropriate Assessment (RIAA**) **(application ref: 6.1)** with effects on Marine Conservation Zones (MCZ) considered in **Volume 8, Stage 1 Marine Conservation Zone (MCZ) assessment (application ref: 8.17)**.

9.2 Consultation

5. Consultation with regard to benthic and intertidal ecology has been undertaken in line with the general process described in **Volume 7, Chapter 7 Consultation (application ref: 7.7)** and **Volume 5, Consultation Report (application ref: 5.1)**. The key elements to date include Environmental Impact Assessment (EIA) scoping, formal consultation on the Preliminary Environmental Information Report (PEIR) under section 42 of the Planning Act 2008, and the ongoing EPP via the benthic and intertidal ecology Expert Topic Group (ETG).

6. The feedback received throughout this process has been considered in preparing the ES. This chapter has been updated following consultation in order to produce the final assessment submitted within the Development Consent Order (DCO) application. **Volume 7, Appendix 9-1 (application ref: 7.9.9.1)** provides a summary of the consultation responses received to date of relevance to this topic, and details how the comments have been addressed within this chapter.

9.3 Scope

9.3.1 Study Area

7. The benthic and intertidal ecology study area (see **Volume 7, Figure 9-1 (application ref: 7.9.1)**) has been defined on the basis of the potential zone of influence (ZOI) of the Projects. Construction, O&M, and decommissioning activities for the Projects will result in the disturbance of sediment. The suspension and subsequent redeposition of this sediment has the potential to impact benthic receptors that are distant from the source of the disturbance, and it is therefore the effect with the largest (worst case) ZOI.

8. Based on evidence from the hydrodynamic, wave and plume dispersion modelling undertaken for the Projects (see **Volume 7, Appendix 8-3 Marine Physical Processes Modelling Technical Report (application ref: 7.8.8.3)**) the majority of sediment plumes created from Array Area installation works are expected to settle rapidly and within 5km of the point of disturbance. Whereas, due to a greater variability in tidal currents along the entire length of the Offshore Export Cable Corridor, sediment plumes due to construction activities resulting in changes >1% of baseline conditions could occur within 8km of the Projects' Offshore Development Area.

9. However, the maximum tidal excursion ellipse is 14 km offshore of Flamborough Head. Therefore, the ZOI is conservatively defined as 14km from the Offshore Development Area. The use of this ZOI is supported by site-specific data and the assessment provided in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**, which describes that outside the area of foundation installation, sediment deposition reduces to an average of 0.5-5mm within 10km of the disturbance.

10. The study area for the intertidal assessment is focused on the landfall area for the Projects. As detailed in section 9.3.3, trenchless techniques will be used to install the export cables at the landfall for the Projects.

9.3.2 Realistic Worst Case Scenario

9.3.2.1 General Approach

11. The realistic worst case design parameters for likely significant effects scoped into the ES for the benthic and intertidal ecology assessment are summarised in **Table 9-1**. These are based on the design parameters described in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**, which provides further details regarding specific activities and their durations.

12. In addition to the design parameters set out in **Table 9-1**, consideration is also given to the different development scenarios still under consideration as set out in sections 9.3.2.2 to 9.3.2.4.

Table 9-1 Realistic Worst Case Design Parameters

	Maximum 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.				
Impact 1 - Temporary physical disturbance **and Impact 3 - Remobilisation of Contaminated Sediments**	**Array Areas** **Total Array Area assessed for ES – 427km²** (349km² for Array Area + 78km² Construction Buffer Zone) **Total area of disturbance within Array Areas – 11,207,499m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 9,900,000m²** Array cable trench area (325,000m x 20m boulder plough width) – 6,500,000m² Inter-platform cable trench area (115,000m x 20m disturbance width) – 2,300,000m² Maximum seabed area disturbed by sandwave levelling – 1,100,000m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,307,499m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for four offshore platforms (monopile foundations), including scour protection – 24,889m²	**Array Areas** **Total Array Area assessed for ES – 434km²** (355km² for Array Area + 79km² Construction Buffer Zone) **Total area of disturbance within Array Areas – 11,517,999m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 10,210,500m²** Array cable trench area (325,000m x 20m boulder plough width) – 6,500,000m² Inter-platform cable trench area (129,000m x 20m disturbance width) – 2,576,000m² Maximum seabed area disturbed by sandwave levelling – 1,134,500m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,307,499m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for four offshore platforms (monopile foundations), including scour protection – 24,889m² 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	**Array Areas** **Total Array Area assessed for ES – 1008km²** (874km² for Array Areas and Inter-Platform Cabling Area + 134km² Construction Buffer Zone) **Total area of disturbance within Array Areas – 24,924,843m²** Array and Inter-platform Cables **Maximum area disturbed (trenching + sandwave levelling) – 22,309,875m²** Array cable trench area (650,000m x 20m boulder plough width) – 13,000,000m² Inter-platform cable trench area (342,000m x 20m disturbance width) – 6,831,000m² Maximum seabed area disturbed by sandwave levelling – 2,478,875m² Foundations and Vessel Impacts **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 2,614,968m²** Seabed preparation area for 200 small turbine monopile foundations (including scour protection) – 716,966m² Seabed preparation area for eight offshore platforms (monopile foundations), including scour protection – 49,778m²	Construction buffer Zone measures 1km surrounding each Array Area, and 500m surrounding the Inter-Platform Cable Corridor. Construction vessels may occupy this area but no construction will occur within these areas. Total area disturbance includes Array and Inter-Platform Cables trenching, sandwave levelling, foundation installation and vessel 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 foundation installation + one activity for topside installation per turbine.

	Maximum Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	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 platform x four offshore platforms) – 22,000m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + four offshore platforms) – 242,112m²	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 platform x four offshore platforms) – 22,000m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + four offshore platforms) – 242,112m²	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 platform x eight offshore platforms) – 44,000m² Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 200 small turbines + eight offshore platforms) – 484,224m²	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 and one ESP 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 Cable Corridor **Total temporary area disturbed for export cable installation (trenching, sandwave levelling, anchoring and foundation installation) – 19,885,242m²** Total offshore cable length per cable – 188km Maximum number of cables required – Two Max. offshore cable length for all cables – 376km *Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.* Maximum temporary disturbance area for cable installation – 7,510,800m² (based	**Offshore Export Cable Corridor** **Total temporary area disturbed for export cable installation (trenching, sandwave levelling, anchoring and foundation installation) – 17,046,667m²** Total offshore cable length per cable – 153km Maximum number of cables required – Two Max. offshore cable length for all cables – 306km *Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.* Maximum temporary disturbance area for cable installation – 6,120,400m² (based on 306,000m distance x 20m width of temporary disturbance)	**Offshore Export Cable Corridor** **Total temporary area disturbed for export cable installation (trenching, sandwave levelling, anchoring and foundation installation) – 36,861,507m²** Total offshore cable length per cable – 188km for DBS East, 153km for DBS West. Maximum number of cables required – Four Max. offshore cable length for all cables – 682km *Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.* Maximum temporary disturbance area for cable installation – 13,631,200m² (based	Maximum export cable length assumes worst case that cable circuits are laid and buried in separate trenches rather than bundled. Sandwaves were divided into three categories: small bedforms (maximum height <0.4 m); medium bedforms (maximum height <0.4 m to 0.75 m); and large or very large bedforms (maximum height 5 m), 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

	Maximum Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	on 376,000m distance x 20m width of temporary disturbance) Maximum seabed area disturbed by sandwave levelling – 12,282,010m² Maximum total area impacted by anchoring – 22,061m² *Note - 10km stretch along the Offshore Export Cable Corridor <10m Lowest Astronomical Tide (LAT), may require use of anchoring.* Foundation disturbance area for up to one ESP within the Offshore Export Cable Corridor (Gravity Based Structures (GBS) foundations) – 64,871m² Vessel jack-up area for all platforms in Offshore Export Cable Corridor (1,100m² combined leg area x five operations per platform x one offshore platform) – 5,500m²	Maximum seabed area disturbed by sandwave levelling – 10,833,835m² Maximum total area impacted by anchoring – 22,061m² *Note - 10km stretch along the Offshore Export Cable Corridor <10m LAT, may require use of anchoring.* Foundation disturbance area for up to one ESP within the Offshore Export Cable Corridor (GBS foundations) – 64,871m² Vessel jack-up area for all platforms in Offshore Export Cable Corridor (1,100m² combined leg area x five operations per platform x one offshore platform) – 5,500m²	on 682,000m distance x 20m width of temporary disturbance) Maximum seabed area disturbed by sandwave levelling – 23,115,845m² Maximum total area impacted by anchoring – 44,091m² *Note – 10km stretch along the Offshore Export Cable Corridor <10m LAT, may require use of anchoring.* Foundation disturbance area for up to one ESP within the Offshore Export Cable Corridor (GBS foundations) – 64,871m² Vessel jack-up footprint for all platforms in Offshore Export Cable Corridor (1,100m² combined leg area x five operations per platform x one offshore platform) – 5,500m²	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.
	Landfall **Total volume of sediment disturbed by exit pits – 1,800m³** No. of exit pits – 3 Size of each exit pit – 20m length x 10m width x 3m depth Volume of displaced sediment per exit pit – 600m³ **Total volume of sediment disturbed by trenching in the intertidal - 990m³** Maximum temporary disturbance area for cable installation (based on 110m distance x 6m width) – 660m² Depth of cable – 1.5m	**Landfall** **Total volume of sediment disturbed by exit pits – 1,800m³** No. of exit pits – 3 Size of each cofferdam – 20m length x 10m width x 3m depth Volume of displaced sediment per exit pit – 600m³ **Total volume of sediment disturbed by trenching in the intertidal - 990m³** Maximum temporary disturbance area for cable installation (based on 110m distance x 6m width) – 660m² Depth of cable – 1.5m	**Landfall** **Total volume of sediment disturbed by exit pits – 3,600m³** No. of exit pits – 6 Size of each cofferdam – 20m length x 10m width x 3m depth Volume of displaced sediment per exit pit – 600m³ **Total volume of sediment disturbed by trenching in the intertidal - 990m³** Maximum temporary disturbance area for cable installation (based on 110m distance x 6m width) – 660m² Depth of cable – 1.5m	Technique for trenchless cable installation is not yet decided, however Horizontal Directional Drilling (HDD) is preferred. Number of exit pits assumes ducts for two power cables, one communications cable for each Project In Isolation Exit pits may be located within the intertidal area or subtidal. Length of trench assumes 160m based on the distance between MHWS and MLWS minus mitigation to place exit pits at least 50m from the toe of the cliff.

	Maximum Parameter			
	DBS East in isolation	DBS West in isolation	DBS West and DBS East concurrently and / or in sequence	Notes and rationale
Impact 2 - Increased suspended sediment concentrations (including sediment deposition and smothering)	**Total Displaced sediment during sandwave levelling (Array Cables, Inter-Platform Cables and Export Cables) - 33,567,300m³** Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 445,500m³ Maximum volume of sandwave material to be dredged / relocated for Export Cables – 33,121,800m³ **Maximum volume of displaced sediment during cable trenching – 6,369,000m³** Array cable – 1,950,000m³ (325,000m length x 6m width x 1m depth) Inter-platform cables – 1,035,000m³ (115,000m length x 6m width x 1.5m depth) Export cables – 3,384,000m³ (376,000m length x 6m width x 1.5m depth) **Maximum volume of drill arisings – 37,197m³** Drill arisings from 57 large wind turbines = 34,382m³ Drill arisings from four offshore platform monopile foundations = 2,815m³	**Total Displaced sediment during sandwave levelling (Array Area, Inter-Platform Cables and Offshore Export Cables) - 29,762,372m³** Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 459,473m³ Maximum volume of sandwave material to be dredged / relocated for Export Cables – 29,302,899m³ **Maximum volume of displaced sediment during cable trenching – 5,865,000m³** Array cable – 1,950,000m³ (325,000m length x 6m width x 1m depth) Inter-platform cables – 1,161,000m³ (129,000m length x 6m width x 1.5m depth) Export cable – 2,754,000m³ (306,000m length x 6m width x 1.5m depth) **Maximum volume of drill arisings – 37,197m³** Drill arisings from 57 large wind turbines = 34,382m³ Drill arisings from four offshore platform monopile foundations = 2,815m³	**Total Displaced sediment during sandwave levelling (Array Cables, Inter-Platform Cables and Export Cables) – 63,428,644m³** Maximum volume of sandwave material to be dredged / relocated for Array Cables and Inter-Platform Cables – 1,003,944m³ Maximum volume of sandwave material to be dredged / relocated for Export Cables – 62,424,700m³ **Maximum volume of displaced sediment during cable trenching – 13,116,000m³** Array cable – 3,900,000m³ (650,000m length x 6m width x 1m depth) Inter-platform cables – 3,078,000m³ (342,000m length x 6m width x 1.5m depth) Export cable – 6,138,000m³ (682,000m length x 6m width x 1.5m depth) **Maximum volume of drill arisings – 73,790m³** Drill arisings from 113 large wind turbines = 68,160m³ Drill arisings from eight monopile foundations = 5,630m³	Maximum burial depth for array and inter-platform cables is 1m. Maximum burial depth for offshore export cables is 1.5m. These depths have been assumed across the entire length of the each cable type to determine the worst-case volume of sediment disturbed. 6m trench width based on worst-case pre-lay ploughing width.
Impact 4 - Underwater noise and vibration	See worst-case parameters table presented in **Volume 7, Chapter 11 Marine Mammals (application ref: 7.11)**			

	Maximum Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Operation				
Impact 1 - Temporary physical disturbance	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan) 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 seabed disturbance from export cable repairs over Projects lifetime – **42,000m²** (Seven events x 6,000m² per event)	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan) 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 seabed disturbance from export cable repairs over Projects lifetime – **30,000m²** (Five events x 6,000m² per event)	**Array Areas and Inter-Platform Cable Corridor** 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 seabed disturbance from export cable repairs over Projects lifetime – **72,000m²** (12 events x 6,000m² per event)	N/A
Impact 2 - Increased suspended sediment concentration s (including sediment deposition and smothering)	**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	**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 –	**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	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.

	Maximum Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	– 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 – 84,000m³** Volume of displaced sediment from export cable repairs over Projects lifetime – 84,000m³ (seven events x 12,000m² per event)	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 – 60,000m³** Volume of displaced sediment from export cable repairs over Projects lifetime – 60,000m³ (Five events x 12,000m² per event)	– 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 – 144,000m³** Volume of displaced sediment from export cable repairs - over Projects lifetime – 144,000m³ (12 events x 12,000m² per event)	
Impact 5 - Permanent habitat loss	**Array Area** **Total area of habitat loss within the Array Area (foundations, scour protection, cable protection and cable crossings) – 890,879m²** Total worst case turbine foundation area, including scour protection – 311,725m² (100 small turbines x 3,117m² total protection per turbine) Total worst-case offshore platforms foundation area, including scour protection– 21,642m² Total area of array and inter-platform cable protection – 496,212m² (312,900m² array cable protection + 183,312m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 19 Total area of pipeline / cable crossing material (array + inter–platform cables) – 61,300m²	**Array Area** **Total area of habitat loss within the Array Area (foundations, scour protection, cable protection and cable crossings) – 922,971m²** Total worst case turbine foundation area, including scour protection - 311,725m² (100 small turbines x 3,117m² total protection per turbine) Total worst-case offshore platforms foundation area, including scour protection – 21,642m² Total area of array and inter-platform cable protection – 516,004m² (310,500m² array cable protection + 205,504m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 27 Total area of pipeline / cable crossing material (array + inter–platform cables) – 73,600m²	**Array Areas** **Total area of habitat loss within the Array Area (foundations, scour protection, cable protection and cable crossings) – 2,053,218m²** Total worst case turbine foundation area, including scour protection – 623,449m² (200 small turbines x 3,117m² total protection per turbine) Total worst-case offshore platforms foundation area, including scour protection – 43,285m² Total area of array and inter-platform cable protection – 1,159,884m² (623,400m² array cable protection + 536,484m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 61 Total area of pipeline / cable crossing material (array + inter–platform cables) – 226,600m²	N/A

	Maximum Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	Offshore Export Cable Corridor **Total area of habitat loss within the Offshore Export Cable Corridor – 1,203,825m²** Total area of export cable protection – 1,000,282m² Total worst case area of scour protection for ESP in Offshore Export Cable Corridor – 56,410m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 24 Total area of pipeline / cable crossing material – 147,133m²	**Offshore Export Cable Corridor** **Total area of habitat loss within the Offshore Export Cable Corridor – 992,484m²** Total area of export cable protection – 788,941m² Total worst case area of scour protection for ESP in Offshore Export Cable Corridor – 56,410m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 24 Total area of pipeline / cable crossing material – 147,133m²	**Offshore Export Cable Corridor** **Total area of habitat loss within the Offshore Export Cable Corridor – 2,139,899m²** Total area of export cable protection – 1,789,222m² Total worst case area of scour protection for ESP in Offshore Export Cable Corridor – 56,410m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 48 Total area of pipeline / cable crossing material – 294,267m²	
Impact 6 - Interactions of Electromagnetic Field (EMF) (including potential cumulative EMF effects)	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.*			
Impact 7 - Colonisation of introduced substrate, including non-native species	**Vessels** Maximum number of operation & maintenance (O&M) vessels on site at any one time – **20** (See permanent habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **20** (See permanent habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **21** (See permanent habitat loss row for infrastructure that could be colonised)	The risk of introducing Invasive Non-Native Species (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.
Landfall	All cables will be buried below landfall, assumed no maintenance activities required during the operational stage. As such no operational impacts predicted to occur at landfall.			

	Maximum 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.				

9.3.2.2 Development Scenarios

13. Following Statutory Consultation High Voltage Alternating Current (HVAC) technology (previously assessed in PEIR) was removed from the Projects' Design Envelope (see **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** for further information). As a result, only High Voltage Direct Current (HVDC) technology has been taken forward for assessment purposes. The ES considers the following development scenarios:

- Either DBS East or DBS West is built In Isolation (the In Isolation Scenario);
- DBS East and DBS West are developed concurrently (the Concurrent Scenario); or
- Both DBS East and DBS West are developed sequentially (the Sequential Scenario).

14. An In Isolation scenario has been assessed within the ES on the basis that theoretically one Project could be taken forward without the other being built out. If an In Isolation project is taken forward, either DBS East or DBS West may be constructed. As such the offshore assessment considers both DBS East and DBS West in isolation.

15. In order to ensure that a robust assessment has been undertaken, all development scenarios have been considered to ensure the realistic worst case scenario for each topic has been assessed. A summary is provided here, and further details are provided in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**.

16. The three development scenarios to be considered for assessment purposes are outlined in **Table 9-2**:

Table 9-2 Development Scenarios and Construction Durations

Development scenario	Description	Overall Construction Duration (Years)	Maximum construction Duration Offshore (Years)	Maximum construction Duration Onshore (Years)
In Isolation	Either DBS East or DBS West is built In Isolation	Five	Five	Four

Development scenario	Description	Overall Construction Duration (Years)	Maximum construction Duration Offshore (Years)	Maximum construction Duration Onshore (Years)
Sequential	DBS East and DBS West are both built Sequentially, either Project could commence construction first with staggered / overlapping construction	Seven	A five year period of construction for each project with a lag of up to two years in the start of construction of the second project (excluding landfall duct installation) – reflecting the maximum duration of effects of seven years.	Construction works (i.e. onshore cable civil works, including duct installation) to be completed for both Projects simultaneously in the first four years, with additional works at the Landfall Zone, Onshore Substation Zone and cable joint bays in the following two years. Maximum duration of effects of six years.
Concurrent	DBS East and DBS West are both built Concurrent reflecting the maximum peak effects	Five	Five	Four

17. The In Isolation, Concurrent and Sequential Development Scenarios all allow for flexibility to build out either or both Projects using a phased approach offshore. Under a phased approach the maximum timescales for individual elements of the construction are assessed.

18. Any differences between the Projects, or differences that could result from the manner in which the first and the second Projects are built (Concurrent or Sequential and the length of any lag) are identified and discussed where relevant in section 9.6. For each potential impact, the worst case construction scenario for the in isolation scenario and the concurrent or sequential scenario is presented. The worst case scenario presented for the concurrent or sequential scenario will depend on which of these is the worst case for the potential impact being considered. The justification for what constitutes the worst case is provided, where necessary, in section 9.6.

9.3.2.3 Operation Scenarios

19. Operation scenarios are described in detail in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. The assessment considers the following scenarios:

- Only DBS East in operation;
- Only DBS West in operation; and
- DBS East and DBS West operating Concurrently with or without a lag of up to two years between each Project commencing operation.

20. If the Projects are built out using a phased approach, there would also be a phased approach to starting the operational stage. The worst case scenario for the operational phases for the Projects have been assessed. See section 5.1.1 of **Volume 7, Chapter 5 Project Description (application ref: 7.5)** for further information on phasing scenarios for the Projects.

21. The operational lifetime of each Project is expected to be 30 years.

9.3.2.4 Decommissioning Scenarios

22. Decommissioning scenarios are described in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Programme prior to construction, however for the purpose of this assessment it is assumed that decommissioning of the Projects could be conducted separately, or at the same time.

9.3.3 Embedded Mitigation

This section outlines the embedded mitigation relevant to the benthic and intertidal ecology assessment, which has been incorporated into the design of the Projects or constitutes standard mitigation measures for this topic (**Table 9-3**). Mitigation is also detailed within **Volume 8**, **Commitments Register (application ref: 8.6)** and cross-referenced within **Table 9-3**. Where additional mitigation measures are proposed, these are detailed in the impact assessment (section 9.6).

Table 9-3 Embedded Mitigation

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 Holderness Inshore Marine Conservation Zone (MCZ) and the Annex I Smithic Bank sandbank, as well as avoiding overlaps with the Flamborough Head SAC and Holderness Offshore MCZ. 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	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?
	updated in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1)**.	
Cable Protection	Any offshore export cables associated with the Projects will be buried within the intertidal zone at landfall, and 350m seaward of 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.	DML 3 & 4 - Condition 3
Cable Burial	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 **Cable Statement (application ref: 8.20)**).	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 – Condition 13 DML 5 - Condition 11
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 Statement DML 1 & 2 - Condition 15

Parameter	Embedded Mitigation Measures	Where commitment is secured?
	cable burial risk assessment (see **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 **Cable Statement (application ref: 8.20)**).	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
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 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	PEMP MPCP DML 1 &2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
	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.	
Trenchless Landfall	A trenchless technique will be used to install the export cables at the landfall for the Projects Any trenchless landfall exit pits located between MHWS and MLWS will be located a minimum of 50m seaward from the toe of the cliff line. If sediment begins to accumulate in the pits, it will be excavated and returned to the beach where it can be transported alongshore to the south, as per the prevailing sediment transport regime.	DML 3 & 4 - Condition 13
Pre-construction surveys and micro-siting	As secured through the DMLs in the **Draft DCO (application ref: 3.1)**, pre-construction surveys will be undertaken to determine the presence of potential Annex I / UK BAP Priority Habitats within the proposed wind turbine locations or the Offshore Export Cable Corridor. The pre-construction survey methodology would be agreed with the MMO in consultation with Natural England. The survey design would be based on best practice at the time and is anticipated to consist of a mixture of geophysical, drop-down video (DDV) and grab surveys (as applicable) to ensure a comprehensive ground-truthing of the proposed final wind turbine locations and cable route design. Initial geophysical surveys will be reviewed with DDV ground truthing surveys to confirm presence as appropriate. This shall then be used to inform detailed layout design in the design plan and will inform the mitigation scheme requirements.	DML 1 & 2 – Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
	If potentially sensitive benthic features are identified, the results of the survey will be discussed at that time with the MMO and Natural England to agree whether the features constitute Annex I / UK BAP Priority Habitat features and whether they are required to be avoided through micro-siting. No benthic sampling is proposed for the section of the Offshore Export Cable Corridor that lies outside the Dogger Bank SAC.	
Jack Up Vessels	Jack-up vessels will not be used within the area of the 1km Construction Buffer Zone which overlaps with the Holderness Inshore MCZ or the Smithic Bank sandbank without agreement of MMO in consultation with Natural England.	DML 3 & 4 - Condition 13

23. 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 Habitats Regulations Assessment (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.

9.4 Assessment Methodology

9.4.1 Policy, Legislation and Guidance

9.4.1.1 National Policy Statements

24. The assessment of potential impacts upon benthic and intertidal ecology has been made with specific reference to the current National Policy Statement (NPS) including the Overarching NPS for Energy (EN-1), the NPS for Renewable Energy Infrastructure (EN-3) and the NPS for Electricity Networks Infrastructure (EN-5) (DESNZ, 2023a-c). These were published in November 2023 and were designated in January 2024.The specific assessment requirements for benthic and intertidal ecology, as detailed in the NPS, are summarised in **Table 9-4** together with an indication of the section of this chapter where each is addressed.

Table 9-4 NPS Assessment Requirements

NPS Requirement	NPS Reference	ES Section Reference
NPS EN-3 for Renewable Energy Infrastructure		
Applicant assessment of the effects of installing offshore transmission infrastructure across the intertidal/coastal zone should demonstrate compliance with mitigation measures in any relevant plan-level HRA including those prepared by The Crown Estate as part of its leasing round, and include information, where relevant, about: • Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice; • Any alternative cable installation methods that have been considered by the applicants during the design phase and an explanation for the final choice; • Potential loss of habitat;	2.8.119	**Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** provides the rationale for the location of the landfall sites and Offshore Development Area. Alternative cable installation methods have been discussed in **Volume 7, Chapter 5 Project Description (application ref: 7.5)** (section 5.5.7). Potential loss of habitat is assessed in section 9.6.3.3 and cumulatively within the Dogger Bank SAC in section 9.8.3.3. The potential impact of temporary physical disturbance on the intertidal zone as a result of landfall construction works is assessed in section 9.6.2.1.2. Temporary physical disturbance due to cable installation or

NPS Requirement	NPS Reference	ES Section Reference
• Disturbance during cable installation, maintenance/repairs and removal (decommissioning); • Increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs; • Potential risk from invasive and non-native species; • Predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data; and • Protected sites.		maintenance has been assessed in section 9.6.2.1 and 9.6.3.1. Increased in suspended sediment concentrations in the intertidal zone during construction and operation has been assessed in section 9.6.2.2.2. The potential risk of non-native species has been considered in section 9.6.3.5, and cumulatively within section 9.8.3.4. The resilience or ability of a receptor to recover has been considered when defining the sensitivity of receptor in the assessment of significance, section 9.6 (also see impact assessment methodology 9.4.3). Protected sites have been included as a sensitive receptor within this chapter and therefore potential impacts on protected sites have been considered (see section 9.5.3).
Effects on intertidal habitat cannot be avoided entirely. Landfall and cable installation and decommissioning methods should be designed appropriately to minimise effects on intertidal/coastal habitats, taking into account other constraints. Where applicable, use of horizontal directional drilling (HDD) should be considered as a method to avoid impacts on sensitive habitats and species.	2.8.226 2.8.227 2.8.228	**Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** provides the rationale for the location of the Offshore Development Area. The potential impact of temporary physical disturbance on the intertidal zone as a result of the construction of exit pits are assessed in section 9.6.2.1.2. Although it is the Applicant's preference that a long trenchless landfall is used, thereby reducing impacts to the intertidal zone. A

NPS Requirement	NPS Reference	ES Section Reference
		short trenchless landfall is currently within the Design Envelope and has therefore been assessed as the worst-case scenario.
Where cumulative effects on intertidal habitats are predicted as a result of the cumulative impact of multiple cable routes, applicants of various schemes are encouraged to work together to ensure that the number of cables crossing the intertidal/coastal zone are minimised and installation and decommissioning phases are coordinated to ensure that disturbance is also reasonably minimised. It is expected that a more co-ordinated approach to offshore-onshore transmission will be delivered. See paragraphs 2.8.24 of this NPS. As identified in paragraphs 3.3.65 – 3.3.83 and section 4.11 of EN-1, and section 2.12 of EN-5, a more co-ordinated approach to offshore-onshore transmission is required.	2.8.231 2.8.232 2.8.34	Potential cumulative impacts are assessed in section 9.8. The site selection process described in **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** sought to minimise the number of cable crossings. The chapter also discusses the coordinated multi-disciplinary approach to refinement of landfall (section 4.9). Both Projects share a landfall with the majority of the Offshore Export Cable Corridor combined and serving both Projects. Whereas **Volume 7, Chapter 5, Project Description (application ref: 7.5)** discusses the landfall zone works (section 5.6.2) .
Applicant assessment of the effects on the subtidal environment should include:	2.8.126	Assessment of the effects on the subtidal environment are discussed within section 9.6, with specific sections for: • Permanent habitat loss – sec-tions 9.6.3.3 and 9.8.3.3;

NPS Requirement	NPS Reference	ES Section Reference
• Loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes e.g. sandwave/boulder/ Unexploded Ordnance (UXO) clearance; • Environmental appraisal of inter-array and other offshore transmission and installation/maintenance methods, including predicted loss of habitat due to predicted scour and scour/cable protection and sandwave/boulder/UXO clearance; • Habitat disturbance from construction and maintenance/repair vessels' extendible legs and anchors; • Increased suspended sediment loads during construction and from maintenance/repairs; • Predicted rates at which the subtidal zone might recover from temporary effects; • Potential impacts from EMF on benthic fauna; • Potential impacts upon natural ecosystem functioning; • Protected sites; and • Potential for invasive/non-native species introduction.		• Habitat disturbance – sections 9.6.2.1 (construction and 9.6.3.1 (operation); • Increased suspended sediment concentrations – sections 9.6.2.2 (construction) and 9.6.3.2 (operation); • The resilience or ability of a receptor to recover has been considered when defining the sensitivity of receptor in the assessment of significance, section 9.6 (also see impact assessment methodology 9.4.3) Interactions of EMF – section 9.6.3.4; • Potential impacts upon natural ecosystem functioning has been considered through assessing for potential impacts using MarESA, on existing habitats and species within section 9.6; • Protected sites have been included as a sensitive receptor within this chapter and therefore potential impacts on protected sites have been considered (see section 9.5.3); and • Colonisation of introduced substrate (including invasive/non native species) – section 9.6.3.4.
Applicants should design construction, maintenance and decommissioning methods appropriately to minimise	2.8.233	Embedded mitigation measures are set out in section 9.3.3 and summarised in **Table 9-3** above.

NPS Requirement	NPS Reference	ES Section Reference
effects on subtidal habitats, taking into account other constraints. Mitigation measures which applicants are expected to have considered include: • Surveying and micro-siting of the turbines, designing array layout, or re-routing of the export and inter-array cables to avoid adverse effects on sensitive/protected habitats, biogenic reefs or protected species; and • Reducing as much as possible the amount of infrastructure that will cause habitat loss in sensitive/protected habitats • Burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and • The use of anti-fouling paint could be minimised on subtidal surfaces in certain environments, to encourage species colonisation on the structures, unless this is within a soft sediment Marine Protected Area (MPA) and thus would allow colonisation by species that would not be normally present.	2.8.234	Pre-construction surveys will be undertaken to identify any potential conservation features and the results discussed with the MMO and Natural England. The Applicants will make reasonable endeavours to bury offshore cables, minimising the requirement for external cable protection measures and thus minimising habitat loss impacts on benthic ecology receptors. The Projects' design has evolved so as it minimises the amount of infrastructure that will cause habitat loss. The Applicants will make reasonable endeavours to bury offshore cables, minimising the requirement for external cable protection measures and thus minimising habitat loss impacts on benthic ecology receptors. Anti-fouling paint used on subtidal structures where necessary will be approved for use in the marine environment by the relevant bodies.
Where cumulative impacts on subtidal habitats are predicted as a result of multiple cable routes, applicants for various schemes are encouraged to work together to ensure that the number of cables crossing the subtidal zone is minimised and installation/ decommissioning phases are coordinated to ensure that disturbance is reasonably minimised.	2.8.235	The Applicants would develop DBS East and DBS West transmission infrastructure as co-ordinated projects in accordance with the high-level intentions of the Holistic Network Design as presented by National Grid Electricity System Operator (ESO). The Offshore Export Cable Corridor will not be joint with other

NPS Requirement	NPS Reference	ES Section Reference
It is expected that a more co-ordinated approach to offshore-onshore transmission will be delivered. See paragraphs 2.8.24 of this NPS.	2.8.232	projects. However, construction and decommissioning phases may coincide with other offshore wind farms within the Dogger Bank and wider North Sea. The Projects Design Envelope has been refined to reduce the impacts on subtidal habitats as much as reasonably possible. The Offshore Export Cable Corridor has been routed to minimise the number of crossings of existing offshore cables and pipelines. Both Projects have one landfall with the majority of the Offshore Export Cable Corridor combined and serving both Projects.
As identified in paragraphs 3.3.65 – 3.3.83 and Section 4.11 of EN-1, and Section 2.12 of EN-5, a more co-ordinated approach to offshore-onshore transmission is required.	2.8.34	The site selection process described in **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** discusses the coordinated multi-disciplinary approach to refinement of landfall (section 4.9). Whereas **Volume 7, Chapter 5, Project Description (application ref: 7.5)** discusses the landfall zone works (section 5.6.2)

9.4.1.2 Other

25. In addition to the NPS, there are a number of pieces of policy and guidance applicable to the assessment of benthic and intertidal ecology. These include:

- The Marine Policy Statement (MPS) (HM Government, 2011);
- East Inshore and East Offshore Marine Plans (DEFRA, 2014); and
- North East Inshore and North East Offshore Marine Plan (DEFRA, 2021).

26. The Marine Policy Statement (HM Government, 2011) (discussed further in **Volume 7, Chapter 3 Policy and Legislative Context (application ref: 7.3)**) provides a high-level approach to marine planning and general principles for decision making that contribute to the NPS objectives. It also sets out the framework for environmental, social and economic considerations that need to be taken into account in marine planning. The high-level objective 'Living within environmental limits' covers points relevant to benthic ecology, and requires that:

- Biodiversity is protected, conserved and where appropriate recovered and loss has been halted;
- Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems; and
- Our oceans support viable populations of representative, rare, vulnerable, and valued species.

27. England currently has eleven marine plan areas (MMO, 2014a); those relevant to the Projects are the East Inshore, North East Inshore, East Offshore and North East Offshore. The East Inshore and East Offshore Marine Plans (DEFRA, 2014) contain two objectives stated below, which are of relevance to benthic ecology, as they cover policies and commitments on the wider ecosystem set out in the MPS:

- Objective 6: 'To have a healthy, resilient and adaptable marine ecosystem in the East Marine Plan areas'; and
- Objective 7: 'To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas'.

28. The North East Inshore and Offshore Marine Plan also contains objectives that help deliver the high level objectives set out in the MPS:

- Objective 2: 'The marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future';
- Objective 3: 'Marine businesses are taking long-term strategic decisions and managing risks effectively. They are competitive and operating efficiently';
- Objective 4: 'Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the market place';

- Objective 6: 'The use of the marine environment is benefiting society as a whole, contributing to resilient and cohesive communities that can adapt to coastal erosion and flood risk, as well as contributing to physical and mental wellbeing';
- Objective 7: 'The coast, seas, oceans and their resources are safe to use';
- Objective 11: 'Biodiversity is protected, conserved and, where appropriate, recovered, and loss has been halted';
- Objective 12: 'Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems'; and
- Objective 13: 'Our oceans support viable populations of representative, rare, vulnerable, and valued species'.

29. How these objectives have been considered within the ES are discussed within **Volume 8, Planning Statement (application ref: 8.1)** submitted with the DCO application.

30. The principal guidance documents used to inform the baseline characterisation and the assessment of impacts are as follows:

- Cefas (2012) Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects;
- Wyn & Brazier (2001); Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook;
- Ware & Kenny (2011) Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites;
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine; and
- The British Standards Institution (2015) Environmental impact assessment for offshore renewable energy projects – Guide. PD 6900:2015.

31. Other guidance on the requirements for wind farm studies is provided in the documents listed below:

- Cefas (2004) Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA requirements: Version 2;

- Marine Management Organisation (MMO) (2014b) Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Licence Conditions, with input from the British Trust for Ornithology (BTO), National Physical Laboratory (NPL) and the SMRU;
- Natural England's advice on 'Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications' (Parker *et al*, 2022)
- Defra (2005) Nature Conservation Guidance on Offshore Windfarm Development. A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore wind farm developments. Version R1.9. 13.

32. Further detail is provided in **Volume 7, Chapter 3 Policy and Legislative Context (application ref: 7.3)**.

9.4.2 Data and Information Sources

9.4.2.1 Site-Specific Surveys

33. In order to provide site-specific and up to date information on which to base the impact assessment, several site-specific surveys were conducted in 2022 to help inform this assessment. **Table 9-5** below provides details of each survey conducted. The method statements outlining the methodology to be followed for each survey were shared with external stakeholders prior to the surveys being undertaken to ensure they were fit for purpose. Comments resulting from these consultations were taken into account prior to the surveys being undertaken. The relevant guidelines to each research area were referenced and followed in each method statement, with the methods for the surveys below being detailed in the relevant appendices to this chapter.

Table 9-5 Site-Specific Data

Data set	Spatial Coverage	Survey Date	Survey Techniques
Geophysical surveys	DBS East and DBS West Array Areas, and Offshore Export Cable Corridor options.	March – October 2022	Multibeam echosounder, side-scan sonar, sub-bottom profiler and magnetometer.

Data set	Spatial Coverage	Survey Date	Survey Techniques
Benthic survey	DBS East and DBS West Array Areas, and Offshore Export Cable Corridor options.	6 – 19th August 2022	Drop-down video, grab sampling (including one macrofaunal sample and one particle size distribution (PSD) sample at each station), sediment chemistry samples and beam trawl.
Intertidal survey	DBS landfall search area	28th September 2022	Phase 1 biotope mapping.

9.4.2.2 Other Available Sources

34. Other sources that have been used to inform the assessment are listed in **Table 9-6**. These sources have been reviewed for impacts and cumulative effects to provide context for the Projects' own assessments and understanding of the baseline environment.

Table 9-6 Other Available Data and Information Sources

Data Set	Spatial Coverage	Year	Notes
Hornsea Project Four ES Volume A2 Chapter 2 Benthic and Intertidal Ecology	Hornsea Project Four array area and export cable corridor	2022	Assessment of the impacts of Hornsea Project Four on benthic and intertidal ecology. Of relevance due to the close proximity between the export cable corridor of the Projects and Hornsea Project Four.
Dogger Bank Teesside A & B Environmental Statement Chapter 12 - Marine and Intertidal Ecology	Dogger Bank Teesside A & B array area	2014	Assessment of the impacts of the Dogger Bank Teesside A & B (now Dogger Bank C and Sofia) offshore wind farms on benthic and intertidal ecology.
Dogger Bank Creyke Beck Environmental Statement Chapter 12 - Marine and Intertidal Ecology	Dogger Bank Creyke Beck array area	2013	Assessment of the impacts of the Dogger Bank Creyke Beck (now Dogger Bank A & B) offshore wind

Data Set	Spatial Coverage	Year	Notes
			farms on benthic and intertidal ecology.
Dogger Bank SAC Selection Assessment Document	Dogger Bank SAC	2011	Assessment detailing information about the Dogger Bank candidate Special Area of Conservation and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles.
JNCC Report No. 429 - Understanding the marine environment – seabed habitat investigations of the Dogger Bank offshore draft SAC	Boundary of the draft Dogger Bank SAC	2009	Report providing evidence on the distribution and extent of Annex I habitat (including variations of these features) on the Dogger Bank, prior to its designation as an SAC.

9.4.3 Impact Assessment Methodology

35. **Volume 7, Chapter 6 EIA Methodology (application ref: 7.6)** provides a summary of the general impact assessment methodology applied. The following sections describe the methods used to assess the likely significant effects on benthic and intertidal ecology.

36. A matrix approach has been used to assess impacts following best practice, EIA guidance and the approach outlined in the Projects Scoping Report. An explanation of how this is applied within the benthic and intertidal ecology assessment is set out below.

37. The data sources summarised in section 9.4.2 were used to characterise the existing environment, the description of which is presented in section 9.5. Each impact, which has been identified using expert judgement and agreed through the scoping process, is then assessed in terms of its significance using the methods described below.

9.4.3.1 Definitions

38. For each potential impact, the assessment identifies receptors sensitive to that impact and implements a systematic approach to understanding the impact pathways and the level of impacts (i.e. magnitude) on given receptors. The definitions of sensitivity and magnitude for the purpose of the benthic and intertidal ecology assessment are provided in the below sections.

9.4.3.1.1 Sensitivity

39. The assessment identifies receptors for which there is a pathway for effect, and the sensitivity of those receptors to each effect.

40. The definitions of sensitivity are based on The Marine Life Information Network's (MarLIN) Marine Evidence based Sensitivity Assessment (MarESA), (MarLIN, 2021) which determines sensitivity based on resistance (tolerance) and resilience (recoverability) which are defined as (**Table 9-7**):

- Resistance: the likelihood of damage (termed intolerance or resistance) due to a pressure; and
- Resilience: the rate of (or time taken for) recovery (termed recoverability, or resilience) once the pressure has abated or been removed.

41. The MarESA assessment of sensitivity is guided by the presence of key structural or functional species/assemblages and/or those that characterise the biotope groups. Physical and chemical characteristics are also considered where they structure the community. MarESA has been used in order to determine sensitivity of specific biotopes and dominant macrofauna recorded during the site-specific benthic characterisation surveys.

42. For the purpose of this assessment, 'tolerance' has been used in place of 'resistance', and 'recoverability' has been used in place of 'resilience'. This terminology is in line with the recent Natural England best practice advice for evidence and data standards, which utilises the definitions provided by MarESA (Natural England, 2022).

Table 9-7 Tolerance and Recoverability Scale Definitions

Level	Description
Tolerance (Resistance)	
None	Key functional, structural, characterising species severely decline and/or physicochemical parameters are also affected e.g. removal of habitats causing a change in habitats type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat component e.g. loss of 75% substratum (where this can be sensibly applied).
Low	Significant mortality of key and characterising species with some effects on the physicochemical character of habitat. A significant decline/reduction relates to the loss of 25-75% of the extent, density, or abundance of the selected species or habitat component e.g. loss of 25-75% of the substratum.
Medium	Some mortality of species (can be significant where these are not keystone structural/functional and characterising species) without change to habitats relates to the loss <25% of the species or habitat component.
High	No significant effects on the physicochemical character of habitat and no effect on population viability of key/characterising species but may affect feeding, respiration and reproduction rates.
Recoverability (Resilience)	
Very Low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function.
Low	Full recovery within 10-25 years.
Medium	Full recovery within 2-10 years.
High	Full recovery within 2 years.

43. MarESA uses a matrix approach using both recovery and resilience to determine sensitivity. The sensitivity matrix used in this assessment, based on MarESA, is presented in **Table 9-8**. Where MarESA uses 'not sensitive', this has been interpreted as negligible in terms of this assessment.

Table 9-8 Sensitivity Matrix

Recoverability (Resilience)	Tolerance (Resistance)				
		None	**Low**	**Medium**	**High**
	Very Low	High	High	Medium	Low
	Low	High	High	Medium	Low
	Medium	Medium	Medium	Medium	Low
	High	Medium	Low	Low	Negligible

44. MarESA sensitivities are not available at the habitat level (European Nature Information System (EUNIS)[1] level 3). As such, in instances where biotope identification was not possible and where sensitivity at the habitat level is assessed, it is based on the worst case sensitivity of biotopes identified within the relevant habitat.

45. It is important to note that where local evidence is available about habitat tolerance and recovery, sensitivities are modified accordingly.

9.4.3.1.2 Value

46. In addition, the 'value' of the receptor forms an important element within the assessment, for instance if the receptor is a protected species or habitat it is considered to be of higher value than a habitat or species that is not protected. It is important to understand that high value and high sensitivity are not necessarily linked within a particular effect. A receptor could be of high value (e.g. Annex I habitat) but have a low or negligible physical / ecological sensitivity to an effect. Similarly, low value does not equate to low sensitivity and is judged on a receptor-by-receptor basis. The value will be considered, where relevant, as a modifier for the sensitivity assigned to the receptor, based on expert judgement. **Table 9-9** states the definitions of value levels for benthic and intertidal ecology.

[1] *The European Nature Information System (EUNIS) habitat classification is a comprehensive pan-European system for habitat identification. More information is available at:* *https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1*

Table 9-9 Definition of Value for Benthic and Intertidal Ecology Receptors

Value	Definition
High	Habitats (and species) protected under international law (e.g. Annex I habitats within an SAC boundary).
Medium	Habitats protected under national law (e.g. Annex I habitats within an MCZ boundary). Species/habitat that may be rare or threatened in the UK.
Low	Habitats or species that provide prey items for other species of conservation value.
Negligible	Habitats and species which are not protected under conservation legislation and are not considered to be particularly important or rare.

9.4.3.1.3 Magnitude

47. The definitions of magnitude of impact for the purpose of the benthic and intertidal ecology assessment are provided in **Table 9-10** below.

Table 9-10 Definition of Magnitude of Impacts

Magnitude	Definition
High	Fundamental, permanent / irreversible changes, over the majority of the receptor, and / or considerable alteration to medium or high value receptors.
Medium	Considerable, long term changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Low	Discernible, long term change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness.

48. In terms of timescales for the duration of effect, these are aligned with the MarESA recoverability criteria provided in **Table 9-7**. Temporary effects would have full recovery within two years (high recoverability), and long-term would equate to an effect for the project duration (equating to low or very low recoverability).

9.4.3.2 Significance of Effect

49. The assessment of significance of an effect is informed by the sensitivity of the receptor and the magnitude of the impact. The determination of significance is guided by the use of an impact significance matrix presented in **Volume 7, Chapter 6 EIA Methodology (application ref: 7)**. Definitions of each level of significance are provided in **Table 9-11**. For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse or beneficial. Any effect that has a significance of minor or negligible is not significant in EIA terms.

Table 9-11 Definition of Effect Significance

Significance	Definition
Major	Very large or large change in receptor condition, which is likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore, no change in receptor condition.

9.4.4 Cumulative Effects Assessment Methodology

50. The Cumulative Effects Assessment (CEA) considers other schemes, plans, projects and activities that may result in significant effects in cumulation with the Projects. **Volume 7, Chapter 6 EIA Methodology (application ref: 7.6)** (and accompanying **Volume 7, Appendix 6-2 Offshore Cumulative Assessment (application ref: 7.6.6.2)**) provides further details of the general framework and approach to the CEA.

51. Further detail on potential cumulative effects is provided in section 9.8.

9.4.5 Assumptions and Limitations

52. Large amounts of data have been collected during the 2022 site-specific surveys with this data being used to generate a benthic ecology monitoring report **(Volume 7, Appendix 9-3 (application ref: 7.9.9.3))**. These data have also been used to inform this chapter. This is in addition to information available from neighbouring wind farms in the wider Dogger Bank area, site designation data for the Dogger Bank SAC and data available on the Cefas One Benthic data portal. Datasets for the neighbouring projects include those from the characterisation (EIA) stages of development (**Table 9-6**). As a result, the benthic ecology of the Projects areas has been thoroughly characterised and there is a high degree of confidence in the data for the purpose of informing the impact assessment.

53. During the analysis of benthic habitat maps, the EUNIS habitat classification (EEA, 2022) was used. Classifying benthic communities, biotopes or EUNIS levels may be subject to recorder bias due to the potential for confusion between biotopes which occupy similar habitats e.g. Infralittoral sands (MB523) mapped as Sublittoral sands (MB52) or where the characteristic species could allow classification of multiple biotopes. However, this is a known characteristic of the habitat mapping process and is not considered to materially affect the overall confidence in it for the purpose of informing the assessment.

54. The impact assessments in section 9.6 describe the level of confidence in each assessment. There is high confidence in the understanding of the magnitude of impact based on the worst case scenarios provided in section 9.3.2, and therefore confidence in the conclusions of effect significance is primarily driven by the level of confidence in the sensitivity of receptors. MarLIN provides information on the confidence associated with sensitivity classifications based on the following definitions:

- High confidence - “based on peer reviewed papers (observational or experimental) or grey literature reports by established agencies on the feature, assessment based on the same pressures acting on the same type of feature in the UK, and studies agree on the direction and magnitude of impact or recovery".

- Medium confidence - "based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature or similar features, assessment based on similar pressures on the feature in other areas, and studies agree on the direction but not the magnitude of impact or recovery".
- Low confidence - "based on expert judgement, assessment based on proxies for pressures e.g. natural disturbance events, studies do not agree on concordance or magnitude of impact or recovery".

55. Information from MarLIN, and specifically the MarESA method, provides a robust resource for the fundamentals of the significance of effect assessment. As taken from their online database "*MarLIN provides information to support marine conservation, management and planning. Our resources are based on available scientific evidence and designed for all stakeholders, from government agencies and industry to naturalists and the public. MarLIN hosts the largest review of the effects of human activities and natural events on marine species and habitats yet undertaken*." It is supported by a number of organisations including Defra, JNCC and Natural England.

9.5 Existing Environment

56. This section summarises the benthic and intertidal ecology existing environment in the study area. For the PEIR submission, a draft Benthic Ecology Characterisation Report was provided. This has since been updated with further analysis of benthic grab samples and the biotopes across the Development Area, taking into account the revised boundaries of the Array Area, Inter-Platform Cabling Corridor, and the Offshore Export Cable Corridor (see **Volume 7, Appendix 9-3 (application ref: 7.9.9.3)**).

57. The environmental baseline, including descriptions of sediment type, infauna and epifauna, is presented for the Array Areas, Inter-Platform Cabling Corridors, and the Offshore Export Cable Corridor. A description of protected areas and important species in the vicinity of the Projects is also provided. Further details are provided in **Volume 7, Appendix 9-2 Intertidal Survey Report (application ref: 7.9.9.2)**, **Volume 7, Appendix 9-3 Benthic Ecology Monitoring Report (application ref: 7.9.9.3)** and **Volume 7, Appendix 9-4 Environmental Features Report (application ref: 7.9.9.4)**.

9.5.1 Offshore

9.5.1.1 Sediment Characterisation

58. Grab samples were successfully acquired at 154 of the 155 grab sampling stations across the Offshore Development Area. One sample station (station (ST) 097) in DBS West was abandoned due to coarse substrate resulting in an insufficient sample being acquired[2]. Sediments were classified using the using The Folk (British Geological Survey (BGS) modified) classification (Long, 2006) and the Wentworth sediment classification (Wentworth, 1922). **Volume 7, Figure 9-2** and **Figure 9-3 (application ref: 7.9.1)** detail the spatial variations of percentage of sand, gravel and fines found within the Array Areas, and Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor respectively.

59. The seabed observed across the survey area primarily comprised sand and muddy sand with varying proportions of gravel / shell fragments.

60. The sample stations within the Array Areas, and Inter-Platform Cabling Corridor were predominantly composed of sand and fine materials. However, a higher proportion of gravel was found to the west of the DBS West Array Area, and in a small number of stations to the south of the DBS East Array Area. In general, these were areas of greater bathymetry (**Volume 7, Figure 9-2 (application ref: 7.9.1)**) than other stations within the Array Areas and Inter-Platform Cabling Corridor.

61. As with the Array Areas and Inter-Platform Cabling Corridor, sand typified most of the stations along the Offshore Export Cable Corridor). However, the sediment composition along the Export Cable Corridor near the coast, inshore of ST161, composed of greater proportions of mud and / or gravel **(see Volume 7, Figure 9-2 and Figure 9-3 (application ref: 7.9.1))**.

62. These results are typical of this region of the North Sea where the offshore seabed is reported to comprise predominantly 'sand', with 'gravelly sand' and 'muddy sand' patches (Jones *et al.*, 2004). Closer inshore, the proportion of mud and mixed sediment increases resulting in a patchy distributions of sediment assemblages. (Jones *et al.*, 2004).

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[2] *The three sampling attempts made failed to recover more than 5 litres of sediment from the Hamon grab, as required by the Benthic Survey Method Statement (document ref: 004177105-02)*

63. These results are also in line with the results of other surveys undertaken within the Dogger Bank SAC and wider area, such as those for Dogger Bank A and B (formerly Dogger Bank Creyke Beck) (Forewind, 2014) and the recent MMO Dogger Bank SAC Fisheries Assessment undertaken in 2020 (MMO, 2021).

9.5.1.2 Contaminants

64. A subset of sediment samples collected during the survey campaign was analysed by an MMO approved laboratory for their hydrocarbon, heavy metal, polychlorinated biphenyls (PCB) and organotin content.

65. Total Hydrocarbon Content (THC) values were below marine sediment quality guidelines (SQGs) for all stations except for station ST161, along the export cable corridor, where the THC was above the Cefas Action Level 1 (AL1) of 100mg/kg. THC concentrations in the Array Areas and Inter-Platform Cabling Corridor were generally lower than THC concentrations along the Offshore Export Cable Corridor.

66. Concentrations of all poly-aromatic hydrocarbons (PAHs) analysed were below the marine SQGs at all stations, except for naphthalene at station ST168, located inshore along the Offshore Export Cable Corridor which exceeded the Canadian thresholds effect level (TEL).

67. Arsenic concentrations were above the Canadian SQG TEL at 11 stations, with station ST164 also above the Canadian SQG probable effects level (PEL). Two stations along the Offshore Export Cable Corridor (ST161 and ST164) and one station (ST125) in the north of DBS West Array Area were above the Cefas AL1 concentration. Station ST164 was also above the National Oceanic and Atmospheric Administration (NOAA) effects range median (ERM). However, the arsenic concentrations were within the range reported previously from the region.

68. The lead concentration at station ST164 was above the Canadian SQG TEL. All other metal concentrations were lower than all environmental quality standards.

69. The concentrations of the sum of the 25 PCB congeners analysed, and the organotins (dibutyltin (DBT) and tributyltin (TBT)) were below the Cefas ALs at all stations.

70. Comparing metal concentrations between the Projects and those detailed in previous reports, concentrations were higher nearshore in the Dogger Bank A and B samples (Forewind, 2014) when compared with the samples for the Projects. Arsenic, chromium, copper, lead and lithium exceeded the Canadian SQG TEL at the majority of 21 sites sampled along Dogger Banks A & B's cable corridor. For the Projects, there were only exceedances of the Canadian SQG TEL for arsenic at eleven stations, and for lead at one station.

71. Further analysis of sediment chemistry within the Offshore Development Area is detailed in **Volume 7, Appendix 9-3 (application ref: 7.9.9.3)**.

9.5.1.3 Habitat and Biotope Classification

72. The physical and biological characteristics of the sediment were evaluated in conjunction with the results of the video and photographic analysis, detailed in the Environmental Features Report (**Volume 7, Appendix 9-4 (application ref: 7.9.9.4)**, to provide a comprehensive habitat assessment.

73. **Table 9-12** presents the classification hierarchy for the biotopes observed within the survey area. It should be noted that the habitat 'Circalittoral coarse sediment' was also identified within the survey area, but stations representing this classification could not be identified to the biotope level. **Volume 7, Figure 9-4** and **Figure 9-5 (application ref: 7.9.1)** present the biotopes / habitat surveyed within the proposed Array Areas, Inter-Platform Cabling Corridor, and along the Offshore Export Cable Corridor respectively.

Table 9-12 Biotope Classifications

EUNIS (EEA, 2022) Habitat Classification		**Equivalent JNCC Classification (JNCC, 2023)**
Biotope Complex Level 4	**Biotope Level 5**	
MB523 Faunal communities of full salinity Atlantic infralittoral sand	MB5233 *Nephtys cirrosa* and *Bathyporeia* spp. in Atlantic infralittoral sand	SS.SSa.IFiSa.NcirBat *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand
MC125 Communities on Atlantic circalittoral soft rock	MC1251 Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	CR.MCR.SfR.Pid Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay

EUNIS (EEA, 2022) Habitat Classification		**Equivalent JNCC Classification (JNCC, 2023)**
Biotope Complex Level 4	**Biotope Level 5**	
MC321 Faunal communities of Atlantic circalittoral coarse sediment	MC3212 *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	SS.SCS.CCS.MedLumVen *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel
	MC3215 *Branchiostoma lanceolatum* in Atlantic circalittoral coarse sand with shell gravel	SS.SCS.CCS.Blan *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel
MC521 Faunal communities of Atlantic circalittoral sand	MC5212 *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	SS.SSa.CFiSa.ApriBatPo *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand
	MC5214 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	SS.SSa.CMuSa.AalbNuc *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment

74. In summary, the six biotopes and one habitat identified within the Offshore Development Area were distributed as follows, from most to least commonly identified:

- *Nephtys cirrosa* and *Bathyporeia* spp. In Atlantic infralittoral sand (MB5233) – 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 DBS West;
- *Abra prismatica, Bathyporeia elegans and polychaetes in circalittoral fine sand (MC5212)* – Located 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;

- *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214) – Found 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 and in two samples near landfall;
- *Branchiostoma lanceolatum* in Atlantic circalittoral coarse sand with shell gravel (MC215) – Found primarily towards the western edge of the DBS West Array Area and isolated locations within DBS East;
- Circalittoral coarse sediment (MC3) – Found in eight isolated samples primarily in the DBS West Array Area, two locations in the southern extent of the DBS East Array Area and in two locations along the eastern and western extremes of the Offshore Export Cable Corridor; and
- *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel (MC3212) – Found in five locations within a stretch of the Offshore Export Cable Corridor from approximately 18km – 40km offshore from the landfall.

75. Piddocks with sparse associated fauna in sublittoral very soft chalk or clay (MC1251) was found from seabed video and photographic analysis only, at two locations at the southerly extent 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. The following sections describe these biotopes in more detail. **Volume 7, Figures 9-3** and **9-4 (application ref: 7.9.1)** illustrate the EUNIS habitat and biotope distribution in the Array Areas, Inter-Platform Cabling Corridor, and along the Offshore Export Cable Corridor, respectively.

9.5.1.3.1 Nephtys cirrosa and Bathyporeia spp. in Atlantic Infralittoral Sand (MB5233)

76. The most prevalent biotope across the Array Areas, this biotope is described as well sorted medium and fine sands characterised by polychaetes such as *Nephtys cirrosa* and amphipods of the genus *Bathyporeia*, which occur in the shallow sublittoral. Sandeels of the genus *Ammodytes* may be present (EEA, 2022).

77. This biotope is characterised by moderately well sorted sand. Fauna comprised amphipods such as *B. guilliamsoniana* and *B. elegans* and polychaetes such as *Spiophanes bombyx* agg., *N. cirrosa*, and species of *Owenia*, and, to a lesser extent, bivalves such as *Chamela striatula*, *Fabulina fabula*, and *Mactra stultorum*.

78. The seabed video and photographic analysis of sample stations associated with this biotope indicated a seabed comprising rippled sand and/or muddy sands with shell fragments and pebbles. Epibiota included starfish, such as *Luidia sarsi*, *Astropecten irregularis*, and *Asterias rubens*, hermit crabs including *Pagarus bernhardus* and associated hydroids of the genus *Hydractinia*, the bryozoan *Flustra foliacea*, sandeels of the genus *Ammodytes*, the soft coral *Alcyonium digitatum*, and the urchin *Echinocardium cordatum*. Faunal burrows were also recorded at several stations in the Array Areas and Inter-Platform Cabling Corridor.

79. The prevalence of this biotope within the Offshore Development Area falls in line with the findings of site-specific surveys conducted for the Dogger Bank Creyke Beck A and B offshore wind farms, which determined that it was present across the survey area for those projects and the wider Dogger Bank as a whole (Forewind, 2014).

9.5.1.3.2 Abra prismatica, Bathyporeia elegans and Polychaetes in Circalittoral Fine Sand (MC5212)

80. This biotope is described as circalittoral and offshore medium to fine sands characterised by the bivalve *A. prismatica*, the amphipod *B. elegans* and polychaetes such as *S. armiger*, *S. bombyx* and *O. borealis*. The brittlestar *A. filiformis* may also be common at some sites (EEA, 2022).

81. This biotope was assigned to stations characterised by moderately sorted and moderately well sorted sand, respectively. Analysis of the data indicated that differences between the stations were associated mainly with the abundance of taxa such as *N. cirrosa*, *Sthenelais limicola*, *A. filiformis*, *Bathyporeia guilliamsoniana*, *O. borealis*, *F. fabula*, and *E. pusillus*. Differences in taxa composition were associated with taxa such as *Diastylis rugosa* and *Hermania scabra / indistincta*.

82. The prevalence of this biotope within the Offshore Development Area falls in line with the findings of site-specific surveys conducted for the Dogger Bank Creyke Beck A and B offshore wind farms, which determined that the biotope was present across the survey area for those projects and the wider Dogger Bank as a whole (Forewind, 2014).

9.5.1.3.3 *Abra alba and Nucula nitidosa in Circalittoral Muddy Sand or Slightly Mixed Sediment' (MC5214)*

83. This biotope is described as non-cohesive muddy sands or slightly shelly / gravelly muddy sand characterised by the bivalves *A. alba* and *N. nitidosa*. Other important taxa include *S. bombyx* and *F. fabula*, whereas the echinoderm *A. rubens* may be present (EEA, 2022).

84. This biotope was assigned to stations characterised by poorly sorted muddy sand. Analysis of the survey data indicated that differences between the stations associated with this biotope were mainly due to the abundance of taxa such *Galathowenia oculata*, *Lanice conchilega*, *S. bombyx* agg., *Harpinia antennaria*, and *Spisula subtruncata*. Differences in taxa composition were associated with taxa such as *A. filiformis* and polychaetes of the genus *Leiochone*.

85. The seabed video and photographic analysis of stations associated with this biotope indicated a seabed comprising rippled sand and muddy sand with shell fragments and pebbles. Epibiota included *A. digitatum*, *A. rubens*, *A. irregularis*, and crabs of the family Paguridae with associated hydroids of the genus *Hydractinia*, anemones of the order Actiniaria, and fish of the infraorder Pleuronectiformes and the families Triglidae and Gadidae. Faunal burrows and mounds were recorded at stations ST009 and ST010, whereas piddocks (Imparidentia) were recorded at stations ST001 and ST003, one within DBS East Array Area and the other within the 1km Array Area Construction Buffer Zone, respectively.

9.5.1.3.4 *Branchiostoma lanceolatum in Atlantic Circalittoral Coarse Sand With Shell Gravel (MC3215)*

86. This biotope is described as gravel and coarse sand sediments with shell gravel. Faunal communities are typified by significant population of the European lancelet, *Branchiostoma lanceolatum*. Other conspicuous infauna may include *E. pusillus*, and *Glycera lapidum*, while sessile epifauna are a minor component of this community (EEA, 2022).

87. This biotope was assigned to stations characterised by very poorly sorted sandy gravel with patches of pebbles and shell fragments. Epifauna comprised *B. lanceolatum* which was amongst the top ten characterising taxa, along with *G. lapidum*, *E. pusillus*, *S. bombyx* agg. and species of *Notomastus* and *Polycirrus*. Epibiota included Paguridae, *F. foliacea* and *Securiflustra securifrons*, *A. digitatum*, *A. irregularis*, and *A. rubens*.

9.5.1.3.5 *Circalittoral Coarse Sediment (MC3)*

88. This habitat is described as coarse sediments in the circalittoral zone on the open coasts and in areas with strong hydrodynamics. This habitat is characterised by robust fauna including venerid bivalves (EEA, 2022).

89. This habitat was assigned to sample stations characterised by gravelly sand. Fauna comprised polychaetes such as *S. bombyx* agg., *O. borealis*, *S. armiger*, and *N. cirrosa*, bivalves, notably *Abra prismatica*, the cumacean *Diastylis rugosa*, and the echinoderms *Amphiura filiformis* and *Echinocyamus pusillus*.

90. The seabed video and photographic analysis of the six sample stations characterised by this habitat in the Array Areas indicated a seabed which ranged from rippled sand to gravelly sand and sandy gravel with shell fragments, pebbles, and occasional cobbles and boulders. Epibiota included *A. digitatum, A. rubens, C. pagurus, N. puber, A. irregularis,* and species of Actiniaria, Pleuronectiformes, Serpulidae, Gadidae, Paguridae and Callionymidae.

91. This habitat was assigned also to stations ST135 and ST167 along the Offshore Export Cable Corridor, both characterised by very poorly sorted sandy gravel. The infaunal community of station ST135, in water depth of 67.7m Below Sea Level (BSL) was typified by the polychaetes *Paramphinome jeffreysii, Scoloplos armiger, S. bombyx* agg. *Goniada maculata,* and the bivalve *Abra alba.* Station ST167, in water depth of 20.5m BSL, had the lowest species richness and abundance of all stations classified as this biotope, with only five individuals of the most abundant species (*A. prismatica*) being recorded. Each of the remaining six taxa at this station (*S. foliosa, Chaetozone christiei, Travisia forbesii, S. spinulosa, Centraloecetes kroyeranus* and *D. rugosa*) comprised one individual.

9.5.1.3.6 *Mediomastus fragilis, Lumbrineris spp. and Venerid Bivalves in Atlantic Circalittoral Coarse Sand or Gravel (MC3212)*

92. This biotope is described as gravels, coarse to medium sands, and shell gravels with small percentage of silt in the circalittoral zones. Faunal communities are characterised by polychaetes such as *M. fragilis*, species of *Lumbrineris*, *G. lapidum*, and *E. pusillus*. Other taxa may include Nemertea, *S. bombyx*, *Ampelisca spinipes*, and venerid bivalves, although the latter are often under-sampled in benthic grab surveys (EEA, 2022).

93. This biotope was assigned to stations characterised by very poorly sorted muddy sandy gravel. Fauna comprised polychaetes such *as Lumbrineris cf. cingulata*, *M. fragilis*, *Spiophanes kroyeri* agg., and *G. lapidum*, the amphipod *A. spinipes*, and bivalves such as *Nuculana minuta*, *Phaxas pellucidus*, *Timoclea ovata*, and species of *Abra.*

94. Of the five stations designated for this biotope along the Offshore Export Cable Corridor, seabed video and photography were undertaken at station ST161, and the results indicated a seabed comprising muddy sandy gravel with shell fragments and pebbles. Epibiota were represented by the coral *A. digitatum*, the starfish *A. rubens,* crustaceans such as *Atelecyclus rotundatus* species of *Ebalia* and Paguridae, as well as bivalves of the family Pectinidae and fish of the families Callionymidae and Gadidae.

9.5.1.3.7 Piddocks With a Sparse Associated Fauna in Atlantic Circalittoral Very Soft Chalk or Clay (MC1251)

95. 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251) occurs on circalittoral soft rock, which is sufficiently soft to be bored by bivalves, with the piddock *Pholas dactylus* the most widespread borer recorded. While it is typically too soft for rich epifaunal communities to establish, sessile fauna may include sponges and mobile fauna often includes crabs, *Necora puber* and *Cancer pagurus* (EEA, 2022). This habitat has most frequently been reported from tide-swept areas off the south-east of England (Tillin & Hill, 2016).

96. This habitat type was assigned to areas of firm clay, in some cases overlain by a veneer of sand, observed at two stations (ST001 and ST003), showing the characteristic round burrows of piddocks. These stations were found around the edge of the DBS East proposed Array Area (**Volume 7, Figure 9-4 (application ref: 7.9.1)**).

97. As is typical of this biotope, the clay seabed itself had little or no attached epifauna with piddock burrows (Imparidentia) evident and abundances ranging from 'Frequent' to 'Abundant'. The most commonly occurring mobile epifauna recorded in this biotope were starfish (*A. rubens* and *A. irregularis*) and crabs (Brachyura, including *Necora puber*). In areas of coarser sediment, faunal turf (Hydrozoa/Bryozoa, including *Halecium* sp., *Alcyonidium diaphanum*, *F. foliacea* and *Nemertesia* sp.) and additional crustaceans, including lobster *Homarus gammarus* and shrimp (Caridea), were also observed. This biotope complex occurred in patches within mixed sediment areas classified as 'Faunal communities of Atlantic circalittoral sand' (MC521). Therefore, there is likely to be some overlap of epifauna with the adjacent habitats, including the presence of soft coral.

98. This biotope has not been commonly identified within the Dogger Bank or the wider North Sea, with the biotope not being noted as present within surveys for the Hornsea Four or Dogger Bank A and B offshore wind farms.

9.5.1.4 Potential Sensitive Habitats and Species

9.5.1.4.1 Sandbanks

99. The Array Areas, Inter-Platform Cabling Corridor and part of the Offshore Export Cable Corridor fall within the Dogger Bank SAC, a site designated for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (see **Volume 7, Figure 9-6 (application ref: 7.9.1)**). It is therefore assumed that all of the seabed within these areas which overlaps the SAC comprises this Annex I habitat. Species that act as indicators of sandbanks recorded during the survey included the lesser weever *Echiichthys vipera*, the shrimp *Philocheras trispinosus*, common hermit crab *P. bernhardus* and the lesser sandeel *A. marinus*.

9.5.1.4.2 Peat and Clay Exposures with Piddocks

100. The biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251) was identified at two stations within the DBS East Array Area (**Volume 7, Appendix 9-4 (application ref: 7.9.9.4)**) and may occur in the habitat 'Peat and clay exposure',

101. Under the Natural Environment and Rural Communities Act 2006 (NERC), Section 41, Peat and clay exposures with piddocks are classified as a UK Biodiversity Action Plan (BAP) priority habitat ('Peat and clay exposures with piddocks'). The habitat is also classified as a Habitat Feature of Conservation Interest (FOCI) ('Peat and clay exposures') for Marine Conservation Zones (MCZ). Piddocks are elongated burrowing bivalves and include *P. dactylus*, *Barnea candida* and *Barnea parva*. These are capable of boring into substrates, such as peat and soft rock or clay (JNCC, 2008a).

102. Peat and clay exposures with either existing or historical evidence of piddock activity have been reported intertidally on coasts arounds the United Kingdom (UK), from the north-west coast to the south and east coasts of England, around the north and south coasts of Wales. Although the distribution of the subtidal element of this habitat is relatively unknown, due to the common nature of *P. dactylus* around the coastlines of England and Wales the priority habitat is likely to form where sufficient areas of peat or clay exposures allow (Tillin & Hill, 2016).

103. Clay exposures, potentially representing 'Peat and clay exposures' habitat, were observed from the seabed video and photographic data at five stations, although Piddocks were only sampled at two stations (ST001 & ST003). Of these five stations, one was located within DBS East Array Area (ST003), one was located with the nearshore Offshore Export Cable Corridor (ST181), and four (ST001, ST048, ST061) were located within the Construction Buffer Zone. No peat was observed from the seabed photographic data or grab samples.

9.5.1.4.3 Subtidal Sands and Gravel

104. Most of the biotopes recorded across the survey area are part of the broadscale habitat 'subtidal sands and gravel' and are classified as a priority habitat and a MCZ Habitat FOCI. However, although identified as a priority habitat, it is recognised that this habitat is the most common habitat present subtidally around the coast of the UK (JNCC, 2008b) and is well represented within the Marine Protected Area (MPA) network (JNCC, 2023).

105. 'Sublittoral sand and gravel' habitats occur in a wide variety of environments and range from mainly sand, through various combinations of sand and gravel, to mainly gravel. Therefore, the majority of the biotopes identified within the current survey area may be considered to fall within this habitat type.

9.5.1.4.4 Stony Reef

106. Due to the presence of cobbles, and occasional boulders in the photographic data, a stony reef assessment (Irving, 2009) was required at 16 stations. The overall assessment indicated 'no resemblance' to a stony reef at most stations. The habitat type 'Faunal communities of Atlantic circalittoral mixed sediment' (MC421), which includes mosaics of shell, cobbles and pebbles, was identified from five stations within the survey area and aggregations of cobble and / or boulder sized material were seen at a further 11 stations which surveyed other habitat types. Two stations (ST167 and ST181) were classified as having 'low resemblance' to a stony reef. These areas form a component part of the mixed sediment seabed type that characterises this region of the North Sea and are unlikely to be considered to represent Annex I habitats, in line with Irving (2009) guidelines whereby if a 'low' is scored in composition, elevation, extent, or biota, then a strong justification would be required for this area to qualify as Annex I habitat 'Reefs' under the current marine nature conservation legislation.

9.5.1.4.5 Other Potentially Sensitive Habitats and Species

107. Sandeels were observed at 26 stations comprising sandy sediments. In this instance, it was not possible to identify sandeels to species level. It should be noted that of the five sandeel species found in the North Sea (NatureScot, 2023), only the lesser sandeel *Ammodytes marinus* is a UK BAP priority species.

108. No other Annex I habitats or Annex II species, OSPAR threatened and / or declining species and habitats or UK BAP priority habitats and species were observed within the survey area.

9.5.2 Intertidal Zone

109. A Phase I qualitative intertidal ecology survey was undertaken on 28th September 2022 at two possible landfall locations for the Projects (see **Volume 7, Appendix 9-2 (application ref: 7.9.9.2)**.

110. Five transects across the two landfalls were surveyed to determine the habitat present within each landfall area and the presence/absence of any fauna. Subsequent refinement of the Offshore Export Cable Corridor and the approach to landfall led to the removal of Landfall 9 from the Projects design envelope.

111. Three distinct habitats were identified within Landfall 8. Instances of *Arenicola marina* worm casts and *Lanice conchilega* tubes were found along the lower shore. While distinct differences in habitat and species composition were identified across the tidal range, such differences were not significant enough to constitute a change in biotope present. As such, the entirety of the survey area was classified as the biotope '*Barren Atlantic littoral coarse sand*' (EUNIS biotope MA5231).

112. The biotope MA5231 is described as freely draining sandy beaches, particularly on the upper and mid shore, which lack a macrofaunal community due to their continual mobility.

113. See **Volume 7, Appendix 9-2 (application ref: 7.9.9.2)** for further details on the methodology and results of this survey.

9.5.3 Designated Sites

114. The Offshore Development Area lies within and / or in the vicinity of sites designated for the protection of benthic habitats and species. These sites are detailed in the following sections and summarised in **Table 9-13**, which includes their distance from the Projects.

115. Note that effects on the SACs are considered in **Volume 6, Report to Inform Appropriate Assessment (RIAA) (application ref: 6.1)** and effects on MCZs in **Volume 8, Stage 1 Marine Conservation Zone (MCZ) assessment (application ref: 8.17)**.

9.5.3.1 Dogger Bank SAC

116. The Dogger Bank SAC is designated for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'. 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 typically no deeper than 20m below chart datum. The bank is non-vegetated and comprises moderately mobile, clean sandy sediments (JNCC, 2019).

9.5.3.2 Holderness Inshore MCZ

117. The Holderness Inshore MCZ is located north of the Humber estuary mouth (DEFRA, 2016). The seabed in this site is made up 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, dab and wrasse, as well as commercially significant crustaceans such as edible and velvet swimming crabs and lobster.

118. 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.

119. The Offshore Export Cable Corridor is located 0.25km from the Holderness Inshore MCZ although the Construction Buffer Zone overlaps by approximately 400m. Construction vessels may occupy this area, but no construction would occur within these areas. The Applicants have also committed to not using jack-up vessels within the MCZ **(Table 9-3)**.

9.5.3.3 Holderness Offshore MCZ

120. The Holderness Offshore MCZ is located approximately 11km offshore from the Holderness coast (JNCC, 2021) and 0.7km from the Offshore Export Cable Corridor. 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 for example lemon sole *Microstomus kitt*, plaice *Pleuronectes platessa* and European sprat *Sprattus*. Therefore, the species living both in and on the sediment may benefit from the protection afforded to the habitat features within this site.

121. 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 6 years to reach maturity and can live for over 500 years.

9.5.3.4 Flamborough Head SAC

122. 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 site, those of interest in relation to potential indirect 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, 2022).

9.5.3.5 Humber Estuary SAC

123. The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. There exists the potential for cable protection to be installed in the nearshore zone. This could potentially cause changes to nearshore sediment transport processes and result in impacts to the Humber Estuary SAC, designated for the following Annex I habitats:

- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;

- Sandbanks which are slightly covered by seawater all the time;
- Coastal lagoons; and
- *Salicornia* and other annuals colonising mud and sand Atlantic salt meadows (*Glauco Puccinellietalia maritima*).

9.5.3.6 Summary of Designated Sites

Table 9-13 Designated Sites for Benthic Features Within/In the Vicinity of the Offshore Development Area

Site	Distance from the Offshore Development Area	Designated Features
Dogger Bank SAC	0km (Array Areas and part of Offshore Export Cable Corridor fall within the SAC)	Annex I Sandbanks which are slightly covered by sea water all the time
Holderness Inshore MCZ	0km (only the Construction Buffer Zone overlaps MCZ near the landfall area by approximately 0.4km, the Offshore Export Cable Corridor is 0.1km from the MCZ)	EUNIS Habitat Features • Intertidal sand and muddy sand (A2.2) • High energy circalittoral rock (A4.1) • Moderate energy circalittoral rock (A4.2) • Subtidal coarse sediment (A5.1) • Subtidal sand (A5.2) • Subtidal mud (A5.3) • Subtidal mixed sediments (A5.4) • Spurn head (subtidal) **Geological feature*
Holderness Offshore MCZ	Approximately 0.7km south-east of the Offshore Export Cable Corridor	Broad scale habitat: • Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediments Species feature of conservation importance: Ocean quahog *Arctica islandica*
Flamborough Head SAC	Approximately 3km north-west of the Offshore Export Cable Corridor	Annex I Reefs Vegetated sea cliffs of the Atlantic and Baltic Coasts Submerged or partially submerged sea caves

Site	Distance from the Offshore Development Area	Designated Features
Humber Estuary SAC	45km south of the proposed landfall location	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 maritima*).

9.5.4 Invasive / Non-Native Species

124. Invasive Non-native species (INNS) are those that have reached the UK by accidental human transport, deliberate human introduction, or which have arrived by natural dispersion from a non-native population in Europe (Government Digital Service (GDS), 2021). Once introduced, some INNS can become established and their subsequent dispersal from the point of introduction can result in environmental and economic impact (Cottier-Cook *et al*., 2017). The INNS that have a negative impact on biodiversity, through the spread of disease, competition for resources, or by direct consumption, parasitism, or hybridisation, are termed 'invasive' (GDS, 2021).

125. The INNS recorded in the grab samples included the polychaete *Goniadella gracilis*. This species was first recorded in 1970 in Liverpool Bay and had been previously reported from South Africa and North America, from where it was originally described. Although the method of introductions is unknown, this species is likely to have been introduced from the United States east coast through trans-Atlantic shipping. In the British Isles, this species is common in Liverpool Bay in sandy gravel at depths greater than 15m and widespread in the southern Irish Sea (Eno *et al*., 1997) and in Europe it has been recorded in the bay of Douarnenez in France (Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer), 2004). The Projects -specific benthic survey recorded 15 individuals of *G. gracilis*, including six individuals at station ST131, three individuals at station ST012, two individuals at station ST063 and one individual at stations ST015, ST080, ST107, and ST133.

126. In addition, cryptogenic species (species of unknown origin) were recorded in the grab samples. These included the polychaetes *Polydora cornuta* and ascidians of the genus *Molgula*, the latter potentially including the cryptogenic species *Molgula manhattensis*.

127. The polychaete *P. cornuta* is reported to be widely distributed from the Atlantic to the Pacific and reported for the first time in the Mediterranean in 2008 in organically enriched and polluted environments (Simboura *et al*., 2008). In this study, one individual of *P. cornuta* was recorded in the grab sample from station ST001. Two individuals of the genus *Molgula* were recorded, including one from station ST106 and one from station ST164.

128. The INNS recorded are not included in the invasive species UK Biodiversity Indicators for 2023 (Harrower *et al*., 2023).

9.5.5 Future Trends

129. In the event that the Projects are not developed, an assessment of future conditions for benthic and intertidal ecology has been carried out and is described within this section.

130. The baseline conditions for benthic ecology are considered to be relatively stable within the Dogger Bank. Datasets from the last three decades in the area, including surveys for the Dogger Bank A and B offshore wind farm (Forewind, 2014), the original Dogger Bank SAC selection assessment (JNCC, 2011) and a 1995 review of the Dogger Bank by Kröncke & Knust (1995), detail a similar habitat and species composition to that identified by the site-specific surveys for the Projects.

131. The existing environment within the Dogger Bank is influenced by the physical processes which exist within the southern North Sea, including waves and tidal currents driving changes in sediment transport and then seabed morphology (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**). Long term established patterns may be affected by climate change driven sea-level rise, however this will have a reduced impact offshore compared to along the coastline. Warming sea temperatures and ocean acidification are leading to changes in the composition and geographical distribution of benthic communities, with a general north westerly shift (Hiddink *et al*, 2015) in the latitudinal ranges of many species.

132. Long term analyses of the current communities of North Sea benthos have led to the conclusions that they are under severe threat from climate change. Sea bottom temperature has increased by 1.6°C between 1980 and 2004 (Dulvy *et al*., 2008) and sea surface temperature (SST) has increased by ~0.06°C yr^{-1} when the average global SST rise is 0.017±0.005 (Good *et al*., 2007). Using predictions for increasing ocean temperature, the populations of key benthic species will change over time, with key indicator species such as *A. filiformis* being replaced completely by species more suited to the warming of bottom water temperature predicted to occur (Weinert *et al*., 2021).

133. As a result of The Dogger Bank SAC (Specified Area) Bottom Towed Fishing Gear Byelaw 2022, enacted to protect the entirety of the Dogger Bank SAC from the impacts of bottom-towed fishing gear (MMO, 2022), impacts from fishing will be significantly reduced as long as the byelaw remains in place. It is expected that the prohibition of fishing with bottom-towed gear will result in changes to the benthic and fish communities within the SAC through their recovery from the effect of bottom-towed fishing gear. The assessment underpinning the enactment of the byelaw is scheduled to be reviewed every five years, or if significant new information supports its review at an earlier date[3].

[3] 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. https://www.gov.uk/government/consultations/consultation-on-spatial-management-measures-for-industrial-sandeel-fishing/outcome/government-response

134. As such, it can be reasonably expected that populations of benthic species that have been negatively impacted by bottom-towed gear, such as the long-lived, slow growing mollusc *A. islandica*, will recover in the absence of this pressure.

9.6 Assessment of Significance

135. The likely significant effects on benthic and intertidal ecology that may occur during construction, O&M, and decommissioning of the Projects are assessed in this section. The worst case scenarios listed in **Table 9-1** for each impact are assessed. Impacts scoped in and out of this assessment are presented within **Table 9-14**. This was presented within the scoping report and approved in the scoping opinion. Following the scoping opinion and stakeholder consultation:

- Increased suspended sediment has been assessed for operation with sediment depositions and smothering aligning with this impact rather than temporary physical disturbance;
- Remobilisation of contaminated assessments has been assessed for construction and decommissioning;
- Pollution events resulting from the accidental release of pollutants, interactions of heat generated by cables, and the introduction of marine non-native species due to vessel traffic were agreed to be scoped out of the assessment; and
- Long-term habitat loss has been changed to permanent habitat loss.

Table 9-14 Impacts scoped in and out of assessment

Potential Impact	Construction	Operation	Decommissioning
Impact 1 - Temporary Physical Disturbance	✓	✓	✓
Impact 2 – Increased Suspended Sediment Concentrations (Including Sediment Deposition and Smothering)	✓	✓	✓
Impact 3 - Remobilisation of Contaminated Sediments	✓	×	✓
Impact 4 - Underwater Noise and Vibration	✓	×	✓

Potential Impact	Construction	Operation	Decommissioning
Impact 5 - Permanent Habitat Loss	×	✓	×
Impact 6 - Interactions of EMF (Including Potential Cumulative EMF Effects)	×	✓	×
Impact 7 - Colonisation of Introduced Substrate, Including Invasive / Non-native Species	×	✓	×

136. As described in section 9.4.3.1.1, the sensitivities of benthic receptors have been assessed using the MarESA method. The MarESA method assesses sensitivity of biotopes identified in the survey area in relation to different MarESA pressures. Where habitats or biotope complexes have been identified at high-level EUNIS classifications based on physical parameters only, biotopes commonly found within these habitats have been used to assess the sensitivities as a proxy.

137. Potential impacts from airborne pollutants (i.e. NOx and NH3) to areas of mudflats and sandflats not covered by seawater at low tide by are addressed in section 18.6 of **Volume 7, Chapter 18 Terrestrial Ecology and Ornithology (application ref: 7.18**) and in part 2 of **Volume 6, Report to Inform Appropriate Assessment (RIAA) (application ref: 6.1)**.

9.6.1 Consideration of Potential Impacts on Designated Sites

138. As described in section 9.5.3, the Array Areas, Inter-Platform Cabling Corridor and part of the Offshore Export Cable Corridor lie within the Dogger Bank SAC. The Offshore Export Cable Corridor Construction Buffer Zone also overlaps the Holderness Inshore MCZ by approximately 0.4km. The Offshore Export Cable Corridor falls out with the MCZ by 100m. In addition, the Projects are in close proximity to the Holderness Offshore MCZ, Flamborough Head SAC and Humber Estuary SACs. The potential impacts on these designated sites are considered in the relevant assessments separate from the EIA:

- Impacts on the Dogger Bank SAC, Flamborough Head and Humber Estuary SACs are assessed in the Report to Inform Appropriate

Assessment (RIAA) - Habitats Regulations Assessment (application ref: 6.1).

- Impacts on the Holderness Inshore and Offshore MCZs are assessed in the Stage 1 Marine Conservation Zone Assessment (application ref: 8.17).

9.6.2 Potential Effects During Construction

9.6.2.1 Impact 1 - Temporary Physical Disturbance

9.6.2.1.1 Array Areas and Offshore Export Cable Corridor

139. During construction there will be disturbance within the Offshore Development Area due to cable laying operations, jack-up operations, construction works for foundations, and UXO clearance. This will cause temporary habitat loss and physical disturbance to the seabed.

140. Where disturbed sediments (e.g. preparation areas for foundations) are subsequently covered with infrastructure, habitat loss will be for the 30 year duration of each of the Projects. As such, habitat loss has been assessed as an operational impact in section 9.6.3.3, and is not considered further here.

9.6.2.1.1.1 Sensitivity of Receptor

141. The sensitivity of the biotopes identified within the Array Areas, Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor have been assessed in relation to MarESA pressures relevant to the construction phase and temporary habitat loss / physical disturbance:

- Habitat structure changes – removal of substratum (extraction);
- Abrasion/disturbance of the surface of the substratum or seabed; and
- Penetration or disturbance of the substratum subsurface.

142. The sensitivity of identified habitats and biotopes to temporary physical disturbance (pressures) are summarised in **Table 9-15** below. Note that the sensitivity definitions presented in **Table 9-15** (and following tables referring to the sensitivity of biotopes to potential impacts) have been taken directly from the assessments presented on the MarLIN website. It should also be noted that MarESA sensitivity information was not available for the habitat 'circalittoral coarse sediment' due to its high level classification. As such, the nearest available proxy biotope, '*Pomatoceros triqueter* with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles', was selected by expert judgement (detailed in **Table 9-15** below) to represent the sensitivity of this habitat.

Table 9-15 Sensitivity of Biotopes to Temporary Physical Disturbance

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Impact pressure pathway: Habitat structure changes – removal of substratum (extraction)				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	None	High	Medium	High
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles (MC3211)*	None	High	Medium	Low
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	None	Medium	Medium	Medium
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	None	Medium	Medium	Medium
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	None	Medium	Medium	High
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	None	Medium	Medium	High

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	None	Very Low	High	High
Impact pressure pathway: Abrasion/disturbance of the surface of the substratum or seabed				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	Low	High	Low	High
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles* (*MC3211)*	Low	High	Low	High
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	Medium	High	Low	Low
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	Medium	High	Low	Low
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	Medium	High	Low	Low

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	Medium	High	Low	Low
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	Medium	Very Low	Medium	Low
Impact pressure pathway: Penetration or disturbance of the substratum subsurface				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	Medium	High	Low	High
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles (MC3211)*	Low	High	Low	High
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	Low	Medium	Medium	Low
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	Medium	High	Low	Medium

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	Medium	High	Low	Medium
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	Medium	High	Low	Medium
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	Low	Very Low	High	Low

143. The most prevalent biotopes within the Offshore Development Area are characteristic of highly disturbed environments, and typically have medium to high recoverability and will therefore recover rapidly from disturbance as a result of construction impacts. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', only found on within the DBS East Array Area, is more sensitive to physical disturbance, being classed as highly sensitive to removal of substratum and penetration or disturbance of the substratum subsurface. As such, this biotope has the potential to be impacted in the long-term by construction activities. This biotope can be considered as being of medium value given its association with the UK BAP priority habitat 'Peat and clay exposures with piddocks'.

144. The remaining identified biotopes are considered as being of low value as they are not specifically designated as requiring protection under national or international law. It should be noted that the determination of value for these biotopes remains the same for the entirety of this assessment.

9.6.2.1.1.2 Magnitude of Impact – DBS East or DBS West in Isolation

145. Together, installation of the array cabling and inter-platform cabling, turbine and OCP foundations, and vessel jack-up and anchoring will result in a worst case temporary disturbance of 11.2km² within DBS East and 11.5km² within DBS West (**Table 9-1**). It is worth noting that this disturbance would be episodic, associated with particular locations across the Array Areas at any one time and occur over the five-year duration of construction, not as a single event. As detailed previously in section 9.5.1.2, the biotopes present within the Array Areas are typical of those found within the wider Dogger Bank and wider North Sea. Given the Dogger Bank SAC itself measures 12,331km² in extent and does not cover the entirety of the Dogger Bank itself, the extent of disturbance within either Array Area is negligible in the context of the wider available habitat (designated and undesignated), representing <0.1% of the area of the Dogger Bank SAC.

146. Installation of the Offshore Export Cable Corridor will result in a worst case temporary disturbance of 19.9km² for the DBS East, and 17km² for DBS West. As with the Array Areas, disturbance would be localised and episodic and occur over the five-year duration of construction, not as a single event.

147. Studies on the potential size of depressions left behind after UXO clearance found that, in similar predominantly sandy conditions and water depths to that of the Dogger Bank, in the worst case the detonation of a German LMB (GC) Ground Mine (Hexanite) would lead to a crater 21.1m in diameter and 3.3m deep (Ordtek, 2018). While such a detonation would lead to a temporary loss of habitat, due to the dynamic nature of the underlying sediment and strong tidal currents within the Offshore Development Area (see section 8.5.7 **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**) craters would be expected to re-fill with sediment over the course of days (see section 8.7.4.10 in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** for further information on seabed recoverability regarding indentations). In addition, the overall spatial extent of any craters resulting from UXO clearance will be negligible in the context of the habitat present in the Dogger Bank and wider North Sea.

148. Due to the temporary, episodic and relatively localised nature of the impact, recoverability of the receptors and the extent of the receptors across the wider region, the impact of temporary physical disturbance for one project in isolation is considered to be of negligible magnitude.

9.6.2.1.1.3 Magnitude of Impact – DBS East and DBS West Together

149. Together, installation of the array and inter-platform cabling turbine and OCP foundations, and vessel jack-up and anchoring will create a worst case scenario total disturbance of 24.9km² within DBS East and DBS West together. Installation of the Offshore Export Cable Corridor will result in a worst-case temporary disturbance of 36.8km² for DBS East and DBS West combined.

150. As with the Projects in isolation, this represents a very small portion of the Dogger Bank and wider North Sea, and combined with the temporary nature of the disturbance, the impact of temporary physical disturbance of both Projects together is considered to be of negligible magnitude.

9.6.2.1.1.4 Significance of Effect – DBS East or DBS West in Isolation

151. As the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' was only identified within the DBS East Array Area, the significance of effect is addressed separately below for each project.

152. For DBS West, due to the negligible magnitude and low to medium sensitivity of biotopes to each impact pathway for physical disturbance, the effect is considered to be of negligible to minor adverse significance. As such, the overall significance of effect of DBS West in-isolation is assessed to be **minor adverse**.

153. For DBS East, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' was identified at two stations within the Array Area. This is a biotope with high sensitivity to temporary physical disturbance. While this biotope was rarely encountered within the survey area, and that these stations were all found on the periphery of the Array Area, there still exists the potential for temporary physical disturbance to this biotope. As such, the overall significance of effect for DBS East is assessed to be **minor adverse**, due to the high sensitivity of 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' and negligible magnitude of the impact.

154. No additional mitigation is proposed due to the minor adverse significance of effect of both Projects. The overall confidence in this assessment is medium, based on a balance of confidence levels provided by MarESA (see **Table 9-15**).

9.6.2.1.1.5 Significance of Effect – DBS East and DBS West Together

155. Due to the negligible magnitude and low to high sensitivity for the biotopes to each impact pathway for physical disturbance, the effect is considered to be of **minor adverse** significance from temporary physical disturbance. No additional mitigation is proposed due to the negligible to minor adverse significance of effect. The overall confidence in this assessment is medium as detailed in section 9.6.2.1.1.4 above.

9.6.2.1.2 Intertidal Zone

156. A trenchless technique will be used to install cables at landfall so most potential impacts upon the shore will be avoided. However, as the worst case scenario is a 'short trenchless' option there is potential for exit pits to be installed within the intertidal zone. A maximum of six exit pits may be required, separated by a distance of 50m, running in a line parallel to the shoreline. Installation of the exit pits will occur over a duration of 18 months, but each individual pit will be open for a maximum of four months within this period. The Projects have committed to not installing cofferdams within the exit pits to minimise any impact within the intertidal zone. The cable route between the exit pit and MLWS will be trenched. The excavated material will be disposed of directly adjacent to the location of the excavation and will comprise mostly of gravelly sandy beach sediments. As such, there is potential for temporary physical disturbance to occur.

157. As the location of the landfall exit pits will remain the same regardless of the Projects being built in isolation or concurrently, this assessment will cover both construction scenarios as one.

9.6.2.1.2.1 Sensitivity of Receptor

158. As detailed in section 9.5.2, the intertidal survey conducted at the proposed landfall areas for the Projects determined that the intertidal zone was characterised by the biotope '*Barren littoral coarse sand*'.

159. The sensitivity of the biotope identified within the intertidal zone has been assessed in relation to the following MarESA pressures relevant to the construction phase and temporary habitat loss / physical disturbance:

- Habitat structure changes – removal of substratum (extraction);
- Abrasion / disturbance of the surface of the substratum or seabed; and
- Penetration or disturbance of the substratum subsurface.

160. The sensitivity of 'Barren littoral coarse sand' to temporary habitat loss / disturbance pressures is summarised in **Table 9-16** below.

Table 9-16 The Sensitivity of Barren Littoral Coarse Sand to Temporary Physical Disturbance

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Impact pressure pathway: Habitat structure changes – removal of substratum (extraction)				
Barren littoral coarse sand (MA5231)	None	High	Medium	Low
Impact pressure pathway: Abrasion/disturbance of the surface of the substratum or seabed				
Barren littoral coarse sand (MA5231)	High	High	Not Sensitive	Low
Impact pressure pathway: Penetration or disturbance of the substratum subsurface				
Barren littoral coarse sand (MA5231)	High	High	Not Sensitive	Low

161. As shown in **Table 9-16** above, the only pressure for which 'Barren littoral coarse sand' is sensitive to is habitat structure changes – removal of substratum (extraction), for which it has a sensitivity of medium. The biotope is considered to be of negligible value, as it is not specifically designated as habitats requiring protection under national or international law and not considered to be particularly important or rare.

162. From previous evidence of beaches with a similar composition, recoverability is high for this biotope, with recovery from sediment extraction expected to occur within a year (Tillin & Budd, 2016).

9.6.2.1.2.2 Magnitude of Impact

163. The parameters of the exit pits are presented in **Table 9-1**. The maximum volume of disturbed sediment across both Projects is 3,600m^3 due to excavation of the exit pits. If the exit pits were placed 50m below the toe of the cliff, trenching within the intertidal area would disturb a further 990m^3 of sediment. The trenches and exit pits would be backfilled on completion of the works. Given the wide extent of the existing biotope across the north-east coast of England, with the beach stretching for approximately 58km from Bridlington to the mouth of the Humber estuary, any disturbance will be negligible in magnitude in the context of the wider available habitat.

9.6.2.1.2.3 Significance of Effect

164. With the existing biotope in the intertidal zone having a medium sensitivity in the worst case and noting the negligible magnitude of the impact, the significance of effect has been assessed as **minor adverse**. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is low as per Tillin & Budd (2016).

9.6.2.2 Impact 2 – Increased Suspended Sediment Concentrations (Including Sediment Deposition and Smothering)

9.6.2.2.1 Array Areas and Offshore Export Cable Corridor

165. Increases in suspended sediment concentrations (SSC) may occur as a result of seabed preparation for the installation of infrastructure in the Array Areas, Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor. Activities such as seabed disturbances from jack-up vessels and placement of cable protection are not expected to increase SSC to the extent which there could potentially be a significant effect to benthic ecology receptors. **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** provides details of changes to SSC and subsequent sediment deposition.

166. Increased SSC have the potential to affect benthic ecology receptors by causing physical damage or injury, blocking feeding apparatus and by smothering sessile species upon redeposition.

9.6.2.2.1.1 Sensitivity of Receptor

167. The sensitivity of the biotopes identified in the Offshore Development Area 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);
- Smothering and siltation rate changes (light); and

- Smothering and siltation rate changes (heavy).

168. The pressure 'smothering and siltation rate changes (light)' and 'smothering and siltation rate changes' (heavy) have been used to assess the significance of effect as the MarESA justification for light smothering and siltation is 'up to 5cm' whilst heavy smothering and siltation is 'up to 30cm'. In **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** the worst case level sediment smothering, and deposition is <5cm in localised areas adjacent to foundation installation. During trenching for cable installation, smothering and deposition is predicted to be up to 5cm within the Offshore Export Cable Corridor with a maximum change of up to 25cm occurring in localised hotspots. The sensitivities of identified biotopes to increased suspended sediment pressures are summarised in **Table 9-17** below.

Table 9-17 The Sensitivity of Biotopes to Increased Suspended Sediments

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Impact pressure pathway: Changes in suspended solids (water clarity)				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	Medium	High	Low	Low
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles* (*MC3211)*	High	High	Not Sensitive	High
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	High	High	Not Sensitive	Low

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	Medium	High	Low	Low
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	Medium	High	Low	Low
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	Medium	High	Low	Low
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	High	High	Not Sensitive	Low
Impact pressure pathway: Smothering and siltation rate changes (light)				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	High	High	Not Sensitive	High
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles (MC3211)*	High	High	Not Sensitive	Medium

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	Low	High	Low	Low
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	Medium	High	Low	Medium
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	Medium	High	Low	Medium
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	Medium	High	Low	Medium
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	Medium	Medium	Medium	Low
Impact pressure pathway: Smothering and siltation rate changes (heavy)				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	Low	High	Low	High

Receptor	**Tolerance**	**Recoverability**	**Sensitivity**	**Confidence assessment**
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles* (*MC3211)*	Medium	High	Low	Medium
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	Low	High	Low	Low
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	Medium	Medium	Medium	Low
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	Low	Medium	Medium	Low
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	Low	Medium	Medium	Low
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	None	Medium	Medium	Medium

169. The majority of the identified biotopes have a no-to-low sensitivity to the pressures described above. Therefore, these biotopes will not be affected by, or will recover rapidly from an increase in SSC and subsequent deposition.

170. The exception to this is the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', which has a medium sensitivity to smothering and siltation rate changes. This is due to the short length of the siphons (utilised by the characteristic piddock species to maintain contact with the surface of the seabed) being susceptible to smothering (Tillin & Hill, 2016). The piddock species *Pholas dactylus* has been found to be tolerant of deposition depths of 1-5cm (Knight, 1984).

171. As detailed in section 9.6.2.1, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' is considered to be of medium value, while the remaining biotopes are considered to be of low value.

172. This biotope was classified only in the DBS East Array Area (see **Volume 7, Figure 9-4 (application ref: 7.9.1)**).

9.6.2.2.1.2 Magnitude of Impact – DBS East or DBS West in Isolation

173. As detailed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**, regional mapping of seabed sediments indicates the Array Areas are dominated by sandy sediments and mixed sediment. The seabed sediments of the Offshore Export Cable Corridor transition from coarser mixed sediments (sandy gravel and gravelly sand) in the nearshore area, to sand-dominated sediments as the Offshore Export Cable Corridor approaches the Array Areas and Inter-Platform Cabling Corridor.

174. It is expected that the coarser sediment found along the Offshore Export Cable Corridor will settle rapidly to the seabed following disturbance, in close proximity of the disturbance event. The finer sand that comprises the majority of the Array Areas and 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.

175. During foundation installation SSCs may increase by a maximum of 2mg/l above background levels at the sea surface and 0.5mg/l near the seabed. These typically return to baseline conditions within a maximum of 5km of the area of disturbance and last no more than a few 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.

176. During seabed levelling, SSC concentrations of up to 5mg/l in the bottom layer and 0.5mg/l in the surface layer within the Offshore Export Cable Corridor. The SSCs of up to 5mg/l occur 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 predicted to persist for a period of two to four hours within the Offshore Export Cable Corridor and up to six hours within the Array Areas and Inter-Platform Cable Corridor due to lower tidal currents. The maximum predicted deposition will be <3cm spatially restricted to within the cable corridors.

177. During trenching of the Offshore Export Cable Corridor, SSCs are predicted to reach up to 1,000 – 1,500mg/l, in localised hot spots. 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. From around 60km offshore, the extent of the plume reduces from 5km from the point of disturbance to 2km within the Array Areas. Whereas, further inshore, the extent of the plume can reach 18km due to stronger tidal currents. 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.

178. Dredged material from sandwave levelling during the construction process will be disposed at a site yet to be determined at the time of writing. The volumes for disposal will be equivalent to a worst case of 33,567,300m³ for DBS East in isolation and 29,762,373m³ for DBS West in isolation. 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.

179. Overall, increases in SSC are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments, however these are likely to be widely and rapidly dispersed and within the range of natural variability within the region.

180. Given the localised and short-term increases in SSC around the point of discharge, and negligible changes in seabed level expected due to deposition, the magnitude of effect is considered to be negligible.

9.6.2.2.1.3 Magnitude of Impact – DBS East and DBS West Together

181. Dredged material from sandwave levelling during the construction process will be disposed within the Array Areas, Inter-Platform Cabling Area and Offshore Export Cable Corridor (see **Volume 8, Disposal Site Characterisation Report (application ref: 8.18)**). The volume for disposal will be equivalent to a worst case of 67,247,544m³ for DBS East and DBS West combined.

182. If both Projects are constructed together in the Concurrent Scenario, similar volumes of sediment will be disturbed over the construction phase over a shorter period of time (five years compared to seven in the Sequential Scenario). This may result in higher concentrations of suspended sediment at a single point in time during construction. However, as outlined in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** and summarised above, SSC arising from one foundation installation are unlikely to persist for a sufficiently long period of time for them to interact with subsequent operations, and therefore no cumulative effect is anticipated from multiple installations in either scenario. In the Concurrent Scenario, there is the potential for two cable lay operations to be undertaken simultaneously. However, increases in SSC will remain localised and short-term around the point of discharge, and as such the magnitude of effect is still considered to be negligible.

9.6.2.2.1.4 Significance of Effect – DBS East or DBS West in Isolation

183. As the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' was only identified within the DBS East Array Area, the significance of effect is addressed separately below for each project.

184. For DBS West in Isolation, due to the negligible magnitude and no to low sensitivity of biotopes to each impact for increased SSC, the effect is considered to be of **negligible** significance.

185. For DBS East, the worst case effect is considered for the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' which has a greater sensitivity (than other biotopes present) to increased SSC, should there be sediment deposition of >50mm (which could only occur in locations immediately adjacent to foundation installation). Therefore, the significance of effect is assessed as **minor adverse**, due to the negligible magnitude and low to medium sensitivity assessed for these biotopes.

186. No additional mitigation is proposed due to the negligible and minor adverse significance of effects assessed at DBS West and DBS East respectively. 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.

9.6.2.2.1.5 Significance of Effect – DBS East and DBS West Together

187. The same **minor adverse** significance of effect will apply for both Projects being built together, due to the high recoverability of the biotopes in the Array Areas and export cable corridors and the short-term and localised nature of sediment disturbance.

188. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is medium (as per MarESA) for the reasons set out for DBS East and DBS West in Isolation.

9.6.2.2.2 Intertidal Zone

189. A trenchless technique will be used to install cables at landfall so most potential impacts upon the shore will be avoided. However, there is potential for exit pits to be located within the intertidal zone 50m below the toe of the cliffs. The cable route between the exit pit and MLWS will be trenched. The excavated material will be disposed of directly adjacent to the location of the excavation and will comprise mostly of gravelly sandy beach sediments. As such, there is potential for temporary increases SSC to occur.

190. As the location of the exit pits will remain the same regardless of the Projects being built in isolation or concurrently, this assessment will cover both build scenarios as one.

9.6.2.2.2.1 Sensitivity of Receptor

191. As detailed in section 9.5.2, the intertidal survey conducted at the proposed landfall areas for the Projects determined that the intertidal zone was characterised by the biotope '*Barren littoral coarse sand*'.

192. The sensitivity of the biotope identified within the intertidal zone has been assessed in relation to the following MarESA pressures relevant to the construction phase increased SSC and deposition:

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

193. The pressure 'smothering and siltation rate changes (light)' has been used to assess the significance of effect as the MarESA justification for light smothering and siltation is 'up to 5cm' and in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** the worst case level sediment smothering and deposition is approximately 1-5cm in localised areas adjacent to foundation installation.

194. The sensitivity of identified biotopes to increased suspended sediment pressures are summarised in **Table 9-18** below.

Table 9-18 The Sensitivity of Barren Littoral Coarse Sand to Increased Suspended Sediments

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Impact pressure pathway: Changes in suspended solids (water clarity)				
Barren littoral coarse sand (MA5231)	High	High	Not Sensitive	Low
Impact pressure pathway: Smothering and siltation rate changes (light)				
Barren littoral coarse sand (MA5231)	High	High	Not Sensitive	High

9.6.2.2.2.2 Magnitude of Impact

195. The parameters of the exit pits are presented in **Table 9-1**. The volume of disturbed sediment across both Projects from the exit pits is 3,600m^3. If the exit pits were placed 50m from the toe of the cliff, trenching within the intertidal area would disturb 990m^3 of sediment. This may result in a maximum volume of 4,590m^3, which is extremely low when compared with estimates of sediment yield from the Holderness coast (Balson *et al*., 1998). Excavation will be undertaken at low tide, but the excavated sediment stored on the beach will become submerged at high tide, where seabed currents (predominantly wave-driven) will mobilise and redistribute it as a combination of suspended sediment and bedload.

196. As a result of the excavation process, SSCs will be elevated above prevailing conditions but are likely to remain within the range of background nearshore levels. Once mobilised, the suspended sediment will dissipate rapidly (i.e. over a period of a few hours) in the water and be transported alongshore and offshore. Complete removal of the excavated material would be expected within weeks to months of excavation, at which point prevailing conditions will resume and there will be no changes SSC. As such, the magnitude of impact is considered to be negligible.

9.6.2.2.2.3 Significance of Effect

197. With the existing biotope in the intertidal zone being not sensitive and noting the negligible magnitude of the impact, the significance of effect has been assessed as **negligible**. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is low as per Tillin & Budd (2016).

9.6.2.3 Impact 3 - Remobilisation of Contaminated Sediments

198. Sediment disturbance during construction (e.g. through drilling for foundation installation) could lead to the mobilisation of contaminants within sediments which could be harmful to the benthos.

9.6.2.3.1 Sensitivity of Receptor

199. The sensitivity of the identified biotopes within the Offshore Development Area to chemical pressures have not been assessed by MarESA. The current benchmarks for the contaminant pressures are set to the existing chemical/ pollution standard levels, that is, 'compliance with all AA EQS, conformance with PELs, EACs, ERLs' for chemical contaminants. Contaminants pressure definitions have been revised and are based on *'Exposure of marine species or habitat to one or more relevant contaminants via uncontrolled releases or incidental spills'* (Tyler-Walters *et al*, 2022) which is not relevant within this impact.

200. The majority of instances of elevated contaminants were located in the vicinity of ST164, where lead and arsenic levels were identified as being above the Canadian SQG TEL. ST164 was characterised by the biotope '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel'.

201. Overall, the evidence for species typical of this biotope indicates a tolerance of low levels of heavy metal contamination. *Mediomastus fragilis,* a key indicator species for the biotope present at ST164, is considered to be tolerant of contaminated sediments (Dean, 2008). Other species typical of the biotope, such as *Owenia fusiformis* and *Glycera. lapidum*, are noted as being tolerant of heavy metal contamination (Gibbs *et al.,* 2000; Hiscock & Bell, 2004).

202. Given the tolerance of species characteristic of the biotope to low levels of heavy metal contamination, the sensitivity has been assessed as negligible.

9.6.2.3.2 Magnitude of Impact – DBS East or DBS West In Isolation

203. As detailed in section 9.5.1.2, overall levels of contaminants were very low across the majority of the Offshore Development Area. This is likely due to the fact that sediment contaminants are typically associated with mud and silt particles, which as detailed in 9.5.1.1 have limited distribution within the Offshore Development Area. As they are associated with mud and silt particles, any contaminants will not remain in the water column for a significant length of time, and will not travel a great distance from their point of origin. Any contaminant dispersal will occur at very low levels, given the minimal contaminants identified across the Offshore Development Area, with any dispersal remaining under the significant contaminant level thresholds. Therefore, the magnitude of effect is considered to be negligible.

9.6.2.3.3 Magnitude of Impact – DBS East and DBS West Together

204. The magnitude of effect will remain the same for both Projects built together, due to the minimal findings of elevated sediments identified during the benthic survey campaign. As such, the magnitude of effect is considered to be negligible.

9.6.2.3.4 Significance of Effect – DBS East or DBS West in Isolation

205. Due to the negligible magnitude and low sensitivity to the presence of existing contamination, the overall worst case effect is considered to be of **negligible** significance from the remobilisation and redeposition of contaminated sediments. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is high due to the evidence of species characteristic of the biotope at ST164 being tolerant of contaminated sediments.

9.6.2.3.5 Significance of Effect – DBS East and DBS West Together

206. The same **negligible** significance of effect will apply for both Projects being built together. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is low for the reasons detailed in section 9.6.2.3.4.

9.6.2.4 Impact 4 - Underwater Noise and Vibration

207. Underwater noise and vibration from UXO clearance, pile driving for the installation of some foundation types, cable installation and other construction activities including seabed preparation, rock placement and vessel activity (as described in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**) have the potential to impact on benthic ecology receptors.

9.6.2.4.1 Sensitivity of Receptor

208. The sensitivity of benthic species to noise and vibration is poorly understood. The studies that have been completed have tended to focus on crustaceans. Studies have shown that some species, such as the common lobster *Homarus gammarus*, are able to detect sound by utilising their hair-fan organ to act as an underwater vibration receptor (Horridge, 1966). Lovell *et al*. (2005) showed that the common prawn *Palaemon serratus* is capable of hearing sounds within a range of 100 to 3,000Hz, and the brown shrimp *Crangon crangon*, has shown behavioural changes at frequencies around 170Hz (Heinisch & Wiese, 1987).

209. Further research into the effects of vibration on common benthic species, such as common hermit crab *Pagurus bernhardus*, found that they exhibited behaviours associated with shell rapping (when a hermit crab rapidly and repeatedly makes contact with the shell of another individual in a series of bouts (Briffa & Elwood, 2000)) as a consequence of vibrations within the sediment (Roberts *et al*., 2016). At high amplitudes, individuals lifted their shells, and some left their shell completely. Within the study, high amplitudes matched levels produced by construction works such as pile-driving, therefore further understanding of the effects of vibration is needed.

210. Dannheim *et al*. (2020) acknowledge that even though there is evidence to suggest a change in behaviour for some benthic species, the effects of noise and vibration is a priority area for future research as we do not know if changes to population structure and distribution may be affected long term.

211. The sensitivity of biotopes identified in the Offshore Development Area has been assessed in relation to the following MarESA pressure relevant to underwater noise and vibration as a result of construction activities:

- Underwater noise changes.

212. There is evidence to suggest that some benthic species perceive and react to noise as discussed above. However, the MarESA sensitivity assessment for all of the biotopes recorded in the Offshore Development Area is that noise impacts are 'Not Relevant'. 'Not Relevant' is recorded where the evidence suggests that there is no direct interaction between the pressure and biotope or characteristic species within. Therefore, the sensitivity of biotopes and species to underwater noise and vibration is considered to be negligible.

9.6.2.4.2 Magnitude of Impact – DBS East or DBS West in Isolation

213. The spatial extent of underwater noise and vibration impacts on benthic receptors is likely to be localised to areas in the immediate vicinity of monopile or jacket foundation installation. These installation activities would be intermittent. Therefore, the magnitude of effect from noise and vibration is considered to be low.

9.6.2.4.3 Magnitude of Impact – DBS East and DBS West Together

214. The magnitude of impact for both Projects together will be identical to that of the Projects in isolation, and is therefore considered to be low.

9.6.2.4.4 Significance of Effect – DBS East or DBS West in Isolation

215. Based on the worst case negligible sensitivity of biotopes and the low magnitude of impact of underwater noise on benthic ecology receptors during the construction phase, the significance of effect is assessed as **negligible**.

216. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is low, due to the lack of information available on this effect in regard to the species present within the Offshore Development Area.

9.6.2.4.5 Significance of Effect – DBS East and DBS West Together

217. As with the Projects in isolation, the significance of effect is assessed as **negligible**, and the confidence in assessment is low. No additional mitigation is proposed due to the negligible significance of effect.

9.6.3 Potential Effects During Operation

218. Impacts on the intertidal zone have been scoped out of further assessment for the operational phase of the Projects. This is because trenchless techniques will be used to install the cable, ensuring that the cable remains buried. While there exists the potential for the exit pits to be located within the intertidal zone, and therefore some cable trenching may be required in the lower intertidal zone, the cable will be buried to a sufficient depth to avoid any impacts during the operational phase. As such no impacts on the intertidal zone will occur.

219. Remobilisation of contaminated sediments has also been scoped out of assessment for the operational stage, due to the minimal presence of elevated contaminants present in the Offshore Development Area, minimal potential for disturbance events during this phase to occur resulting in re-suspension, and negligible sensitivity assessed during the construction phase.

220. In addition, as impacts from underwater noise during the operational phase of the Projects will be of a lesser magnitude than during the construction phase (due to the lack of noisy activities like pile-driving and a reduction in the intensity of vessel traffic), the significance of effect for underwater noise and vibration during the operation phase will remain negligible. Related impacts are, therefore, scoped out of the assessment.

221. Note that UXO clearance is not included for operation. Any UXO would be identified and then avoided or cleared at the pre-construction phase. Activities during operation will all be localised around existing infrastructure (foundations and cables) which will be located away from UXO or where UXO have been previously cleared during construction. There would be no need to enter areas where UXO could be present, and therefore there is no pathway for effect. If emergency UXO clearance during operation was required, an additional Marine Licence would be required and an environmental assessment completed at the time.

9.6.3.1 Impact 1 - Temporary Physical Disturbance

222. Temporary physical disturbance will occur during the operational phase of the Projects through activities such as cable repairs and reburial, turbine repairs, and potentially the deployment of jack up vessels or vessel anchors. The areas disturbed would be extremely small in comparison to those disturbed during construction.

9.6.3.1.1 Sensitivity of Receptor

223. The sensitivity of the biotopes identified in the Offshore Development Area have been assessed in relation to MarESA pressures relevant to construction phase temporary physical disturbance, set out in **Table 9-15**.

224. Whilst there is potential for recurring disturbance during maintenance, these impacts would be at discrete locations and times, and it is highly unlikely that the same stretch of cable or turbine would repeatedly fail. Therefore, recurring disturbance in the same location is considered highly unlikely. The worst-case would be temporary disturbance to the biotope *'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay'* found in DBS East, which as detailed previously is highly sensitive to penetration or disturbance of the substratum subsurface.

9.6.3.1.2 Magnitude of Impact – DBS East or DBS West in Isolation

225. The impacts from planned maintenance and changes in physical disturbance would be temporary, localised and small scale. Overall, there would be less impact than during construction.

226. The area of disturbance will be even smaller than that already detailed in section 9.6.2.1.1above. An indiscernible, temporary change, over a small area of the receptors is anticipated. Therefore the magnitude of this effect is considered to be negligible.

9.6.3.1.3 Magnitude of Impact – DBS East and DBS West Together

227. While the area of disturbance will be larger with both Projects together as opposed to the Projects in isolation, the area of disturbance will still be very small in the context of the extent of the biotopes present across the Dogger Bank and wider North Sea. Therefore, the magnitude of this effect is considered to be negligible.

9.6.3.1.4 Significance of Effect – DBS East or DBS West in Isolation

228. Based on the worst case high sensitivity of biotopes and the negligible magnitude of temporary physical disturbance during the operation phase, the effect is assessed as **minor adverse** for the Offshore Development Area. This has been concluded on the basis that each disturbance activity would occur relatively infrequently, would be localised and temporary and that benthic ecology receptors would recover rapidly.

229. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is medium based on a balance of confidence provided by MarESA.

9.6.3.1.5 Significance of Effect – DBS East and DBS West Together

230. The same **minor adverse** significance as detailed for the Projects built in isolation remains applicable for both Projects built together, given the infrequent disturbance activities and localised and temporary nature of any impacts. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment remains medium.

9.6.3.2 Impact 2 – Increased Suspended Sediment Concentrations (Including Sediment Deposition and Smothering)

231. As with the impact of increases in SSC during construction, impacts may occur as a result of O&M of infrastructure in the Array Areas, Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor (including landfall). Activities such as seabed disturbances from jack-up vessels and cable maintenance 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 to during construction.

9.6.3.2.1.1 Sensitivity of Receptor

232. The sensitivity of the biotopes identified in the Offshore Development Area have been assessed in relation to MarESA pressures relevant to construction phase increased suspended sediment , set out in **Table 9-17**

233. Whilst there is potential for recurring increases in SCC during maintenance, these impacts would be at discrete locations and times, and it is highly unlikely that the same stretch of cable or turbine would repeatedly fail. Therefore, a recurring impact in the same location is considered highly unlikely. The worst-case of increased SSC would be disturbance to the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', which as detailed previously has medium sensitivity to smothering and siltation rate changes.

9.6.3.2.1.2 Magnitude of Impact – DBS East or DBS West in Isolation

234. The impacts from planned maintenance and changes to SSC would be temporary, localised and small scale, and overall there would be less impact than during construction.

235. The volume of sediment and subsequent area of deposition will be even smaller than that already detailed in section 9.6.2.2.1 above. An indiscernible, temporary change, over a small area of the receptors is anticipated. Therefore, the magnitude of this effect is considered to be negligible.

9.6.3.2.1.3 Magnitude of Impact – DBS East and DBS West Together

236. While the volume of sediment and subsequent area of deposition will be larger with both Projects together as opposed to the Projects in isolation, the area of disturbance will still be very small in the context of the extent of the biotopes present across the Dogger Bank and wider North Sea. The magnitude of this effect is considered to be negligible.

9.6.3.2.1.4 Significance of Effect – DBS East or DBS West in Isolation

237. Based on the worst case medium sensitivity of biotopes and the negligible magnitude of increased SSC during the operation phase, the effect is assessed as **minor adverse** for the Offshore Development Area. This conclusion has been reached on the basis that each disturbance event would occur relatively infrequently, would be localised and temporary and because benthic ecology receptors would recover rapidly.

9.6.3.2.1.5 Significance of Effect – DBS East and DBS West Together

238. The same **minor adverse** significance as detailed for the Projects built in isolation remains applicable for both Projects built together, given the infrequent disturbance activities and localised and temporary nature of any impacts.

9.6.3.3 Impact 5 - Permanent Habitat Loss

239. Permanent habitat loss will occur as a result of the presence of Projects' foundations, scour and scour protection, and external cable protection installed on the seabed, leading to change from a sedimentary habitat to one characterised by hard substrate. It is assessed here as habitat loss and a potential adverse effect (due to the potential shift in the baseline condition).

240. For the Array Areas, the Dogger Bank SAC boundary is used here as a discrete geographic unit to provide context for this assessment. The assessment of permanent habitat loss in relation to the Conservation Objectives of the SAC is presented in **Volume 6, Report to Inform Appropriate Assessment (RIAA)** **(application ref: 6.1)**.

9.6.3.3.1 Sensitivity of Receptor

241. The sensitivity of biotopes identified in the Array Areas have been assessed in relation to the following MarESA pressure relevant to habitat loss:

- Physical change to another seabed type.

242. Installed infrastructure / protection will be colonised by some species of the existing epibenthic community (such as more mobile species, hydroids and bryozoans). The new hard substrate will differ in character from the existing substrate of predominantly sand and muddy sand with varying proportions of gravel / shell fragments Hence, the replacement of natural surfaces with artificial hard substratum may lead to changes in the biotope through changes in species composition, richness and diversity.

243. The sensitivity of the identified biotopes to habitat loss is summarised in **Table 9-19**.

Table 9-19 The Sensitivity of Biotopes to Physical Change to Another Seabed Type

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Impact Pressure Pathway: Physical Change to Another Seabed Type				
Faunal communities of full salinity Atlantic infralittoral sand (MB523) *Proxy used - Infralittoral mobile clean sand with sparse fauna (MC5231)*	None	Very Low	High	High
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	None	Very Low	High	High
Faunal communities of Atlantic circalittoral coarse sediment (MC321) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles (MC3211)*	None	Very Low	High	High

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Faunal communities of Atlantic circalittoral mixed sediment (MC421) *Proxy used - Mysella bidentata and Thyasira* spp. *in circalittoral muddy mixed sediment (MC4213)*	None	Very Low	High	High
Faunal communities of Atlantic circalittoral sand (MC521) and offshore circalittoral sand (MD521) *Proxy used - Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand (MC5211)*	None	Very Low	High	High
Faunal communities of Atlantic circalittoral mud (MC621) *Proxy used - Seapens and burrowing megafauna in circalittoral fine mud (MC6126)*	None	Very Low	High	High

244. As shown in **Table 9-19**, the sensitivity of all benthic ecology biotopes identified within the Array Areas, Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor to habitat loss is high.

9.6.3.3.2 Magnitude of Impact – DBS East or DBS West in Isolation

245. The estimated area of worst case habitat loss within the DBS East and DBS West Array Areas is 0.88km² and 0.92km² respectively, representing 0.25% and 0.26% of each Array Area and combined only 0.02% of the area of the Dogger Bank (using the Dogger Bank SAC area of 12,331km² as a reference). The estimated loss of habitat within the entire Offshore Export Cable Corridor is 1.2km² and 1km² for DBS East and DBS West respectively, representing 0.32% of the Offshore Export Cable Corridor in both cases.

246. Although the effect is long term, with the lifespan of the Projects estimated to be 30 years per project, as shown above this represents a very small portion of the Dogger Bank and wider North Sea where these biotopes are commonly encountered, with the exception of 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay'. Therefore, loss of habitat is considered to be of negligible magnitude in relation to the site and the wider region.

9.6.3.3.3 Magnitude of Impact – DBS East and DBS West Together

247. The estimated area of worst case habitat loss within both DBS East and DBS West together is 2.05km², representing 0.2% of the combined total Array Areas and Inter-Platform Cabling Corridor for the Projects and 0.02% of the overall area of the Dogger Bank (using the Dogger Bank SAC area of 12,331km² as a reference). The estimated loss of habitat within the Offshore Export Cable Corridor is 1.90km² for both DBS East and DBS West combined, representing 0.30% of the Offshore Export Cable Corridor. The estimated loss of habitat within the Dogger Bank area (using the Dogger Bank SAC area of 12,331km² as a reference) due to the Offshore Export Cable Corridor is 0.005%.

248. As with the Projects in isolation, although the effect is long term it is over a negligible percentage of the comparable biotopes within the Dogger Bank and wider North Sea. Therefore, the impact of loss of habitat is considered to be of negligible magnitude in relation to the site and the wider region.

9.6.3.3.4 Significance of Effect – DBS East or DBS West in Isolation

249. While the biotopes identified within the Array Areas, Inter-Platform Cabling Corridor, and Offshore Export Cable Corridor are considered sensitive to the MarESA pressure 'physical change to another seabed type', given the negligible magnitude of the impact of habitat loss, the significance of effect is assessed as **minor adverse**.

250. No additional mitigation is proposed due to the minor significance of effect, but further refinement to the Projects Design Envelope during detailed design may further reduce footprints. The confidence in this assessment is high, in line with MarESA.

9.6.3.3.5 Significance of Effect – DBS East and DBS West Together

251. The significance of effect for both Projects together in regard to permanent habitat loss remains **minor adverse**, with confidence in the assessment being high. No additional mitigation is proposed due to the minor significance of effect.

9.6.3.4 Impact 6 - Interactions of EMF (Including Potential Cumulative EMF Effects)

252. 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.

253. 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 7.85μT directly next to the cable (0m) to 1.47μT at 4m distance (Normandeau *et al.*, 2011). Localised heating of sea water may occur, but this is limited to distances of tens of centimetres, and is likely to be of small magnitude. Therefore no impact is predicted from heating effects (Boehlert & Gill, 2010; Moray Offshore Windfarm Ltd, 2018).

254. 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 extent of EMF effects. 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 & Desender, 2020).

255. Jakubowska *et al* (2019) studied the effect of EMF on the behaviour and bioenergetics of the polychaete, *Hediste diversicolor*. No avoidance or attraction behaviour to EMF was shown, but burrowing activity was enhanced in EMF treatment, indicating a potential stimulating effect on bioturbation potential.

256. Information on the effects of EMF on fish and shellfish species is presented within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**.

9.6.3.4.1 Sensitivity of Receptor

257. The sensitivities of biotopes identified in the Offshore Export Cable Corridor and the Array Areas have been assessed in relation to the MarESA pressure relevant to the impact of EMF:

- Electromagnetic changes.

258. There is a lack of evidence as to the impacts of EMF on benthic species. There is a need for further research so understanding can be complete for how EMF impacts the behavioural, physiological and biological aspects of the benthos.

259. The biotopes identified over the entire Offshore Development Area have a MarESA sensitivity of 'Not Relevant' in relation to the impact of EMF. 'Not Relevant' is recorded where the evidence suggests that there is no direct interaction between the pressure and biotope or characteristic species within. Therefore, the sensitivity of biotopes and species to EMF is considered to be negligible.

9.6.3.4.2 Magnitude of impact – DBS East or DBS West in Isolation

260. The presence of increased EMF will last over the entirety of the operational phase for either Project in isolation. However, indiscernible alterations to baseline EMF levels are predicted. This is due to the cables being planned to be buried in the seabed (where conditions allow) to a depth of up to 1 or 1.5m depending on the cabling area. Love *et al*. (2017) found that EMF levels for submarine power cables declined to background levels about one metre from the cable. Therefore, the magnitude of the impact of EMF is considered to be negligible.

9.6.3.4.3 Magnitude of Impact – DBS East and DBS West Together

261. The presence of increased EMF will last over the entirety of the operational phase of the Projects. However, indiscernible alterations to baseline EMF levels are predicted given attenuation of effects due to cable burial. Therefore, the magnitude of the interactions of EMF is considered to be negligible.

9.6.3.4.4 *Significance of Effect – DBS East or DBS West in Isolation*

262. Due to the negligible sensitivity of biotopes present in the offshore cable corridor and interconnector cable, and the negligible magnitude of effect, the overall significance of effect from interactions of EMF is **negligible**.

263. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is low, due to the lack of information available on the effects of EMF upon the species present within the Offshore Development Area.

9.6.3.4.5 *Significance of Effect – DBS East and DBS West Together*

264. As for the Projects in isolation, due to the negligible sensitivity of biotopes present in the offshore cable corridor, and the negligible magnitude of effect, the overall significance of effect from interactions of EMF is **negligible**, with the confidence in assessment being low. No additional mitigation is proposed due to the negligible significance of effect.

9.6.3.5 Impact 7 - Colonisation of Introduced Substrate, Including Invasive / Non-native Species

265. Artificial hard substrates introduced via infrastructure such as foundations, scour and cable protection could act as potential 'stepping stones' or vectors for INNS.

266. 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.

267. The construction of offshore wind farms in the southern North Sea introduces a new habitat of artificial hard substratum into a region which is mostly charactered by sandy sediment. This may enhance biodiversity of the region creating a 'reef effect', but in turn facilitates the establishment and dispersal of species previously not present in the southern North Sea, strengthening of stronghold of INNS and furthering their spread (Kerckhof *et al*., 2011).

268. The primary pathway for the potential introduction of INNS is from the use of vessels and infrastructure that has originated from an ecologically different location than the southern North Sea. Though the initial introduction of INNS will most likely be in the construction phase, it has been assessed in the operational phase as all the hard substrates would be installed and establishment of INNS could take place. Therefore, the significance of effect would be greater in this phase.

269. It should be noted that in line with the embedded mitigation measures outlined in section 9.3.3, the risk of spreading INNS during the operation phase will be reduced by employing a range of industry standard biosecurity measures. As such, the risk of introduction of INNS from operational activities for the Projects is limited, with any potential spread of INNS arising from existing species within the Dogger Bank and wider North Sea, such as those found in the site-specific surveys for the Projects (see section 9.5.4).

270. Due to a natural lack of hard substrate in the southern North Sea, many species found in such habitats do not naturally occur across the study area (Cameron & Askew, 2011). However, increasing numbers of wreck, oil and gas rigs, and now offshore wind turbines, may make it possible for more species to successfully colonise and establish communities in sheltered areas.

9.6.3.5.1 Sensitivity of Receptor

271. The sensitivity of biotopes identified in the Offshore Export Cable Corridor and the Array Areas have been assessed in relation to the MarESA pressure:

- Introduction or spread of invasive non-indigenous species.

272. The sensitivity of identified biotopes to increased suspended sediment pressures are summarised in **Table 9-20** below.

Table 9-20 Sensitivity of Biotopes to Introduction or Spread of Invasive Non-Indigenous Species

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Impact pressure pathway: Introduction or Spread of Invasive Non-Indigenous Species				
Nephtys cirrosa and *Bathyporeia* spp. in Atlantic infralittoral sand (MB523)	High	High	Not Sensitive	High
Circalittoral coarse sediment (MC3) *Proxy used - Pomatoceros triqueter with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles (MC3211)*	High	High	Not Sensitive	High

Receptor	Tolerance	Recoverability	Sensitivity	Confidence assessment
Branchiostoma lanceolatum in Atlantic circalittoral coarse sand with shell gravel (MC3215)	High	High	Not Sensitive	High
Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212)	None	Very Low	High	High
Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212)	None	Very Low	High	High
Abra alba and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)	None	Very Low	High	High
Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay (MC1251)	High	High	Not Sensitive	High

273. Of the identified biotopes, four are considered not sensitive to the introduction of INNS, primarily due to the mobile nature of the sediments upon which the biotopes are based preventing INNS from establishing themselves.

274. The three remaining biotopes are considered to be highly sensitive to INNS, in particular 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 & Budd, 2023).

275. It should be noted that there is no existing evidence for the spread of these species being facilitated by offshore wind developments, with *D. vexillum*, for example, typically being spread via shipping and aquaculture activities (Marine Scotland, 2021).

9.6.3.5.2 Magnitude of Impact – DBS East or DBS West in Isolation

276. The risk of spreading INNS will be reduced by employing biosecurity measures in accordance with the embedded mitigation detailed in **Table 9-3**. As such, the magnitude of impact is negligible.

9.6.3.5.3 Magnitude of Impact – DBS East and DBS West Together

277. As the same embedded mitigation will be followed for the construction of both Projects together, the magnitude of impact is still considered to be negligible.

9.6.3.5.4 Significance of Effect – DBS East or DBS West in Isolation

278. As the sensitivity of present biotopes across the Offshore Development Area is high and the magnitude of impact is negligible, the overall significance of effect from the colonisation and introduction of INNS is **minor adverse**. No additional mitigation is proposed due to the minor adverse significance of effect. The confidence in this assessment is high.

9.6.3.5.5 Significance of Effect – DBS East and DBS West Together

279. As with the Projects in isolation, the overall significance of effect from the colonisation and introduction of INNS is **minor adverse**, and the confidence in this assessment is high. No additional mitigation is proposed due to the minor adverse significance of effect.

9.6.4 Potential Effects During Decommissioning

280. 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, 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.

281. The scope of the decommissioning works would most likely involve removal of the accessible installed components. This is outlined in **Volume 7, Chapter 5 Project Description (application ref: 7.5)** 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.

282. 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 physical disturbance;
- Temporary increase of SSC (including sediment deposition and smothering);
- Remobilisation of contaminated sediments; and
- Underwater noise and vibration.

283. The footprint of permanent habitat loss (due to infrastructure left *in situ*) would be less than the totals estimated in section 9.6.3.3, as turbines and some of the foundations would be removed. The same is true for any habitat change from colonisation of foundations and cable protection.

284. The magnitude of decommissioning effects will be comparable to or less than the construction phase. Accordingly, given that impacts 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.

9.7 Potential Monitoring Requirements

285. Offshore monitoring requirements are described in the **In-Principle Monitoring Plan (IPMP) (application ref: 8.23)** submitted alongside the DCO application and further developed and agreed with stakeholders prior to construction based on the IPMP and taking account of the final detailed design of the Projects.

Offshore monitoring requirements will be agreed as part of the benthic implementation and monitoring plan produced as part of strategic compensation for the Dogger Bank SAC (see **Appendix 3 Project Level Dogger Bank Compensation Plan (application ref: 6.2.3**). Dependent upon the type and location of the compensation measure, these requirements may enhance or compliment the measures proposed the **In-Principle Monitoring Plan (IPMP) (application ref: 8.23)**.

286. Due to the use of the Dogger Bank by multiple industries, such as offshore wind, oil and gas extraction and commercial fishing, there exists a large amount of existing data on the habitat and species composition of the Dogger Bank, and by association, the Offshore Development Area.

287. Any monitoring requirements are intended to be focused on any habitats / species where there exists substantial uncertainty regarding their presence and / or the predicted effects on them.

9.8 Cumulative Effects Assessment

288. As detailed in section 9.4.4 this section presents an assessment of cumulative effects in relation to benthic and intertidal ecology.

9.8.1 Screening for Cumulative Effects

289. 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.

290. The overarching method followed in identifying and assessing potential cumulative effects is set out in **Volume 7, Chapter 6 EIA Methodology (application ref: 7.6)** and **Volume 7, Appendix 6-2 Offshore Cumulative Assessment (application ref: 7.6.6.2)**. The overall approach is based upon the Planning Inspectorate Advice Note Seventeen: Cumulative Effects Assessment (PINS, 2017) and Phase III Best Practice by Natural England and DEFRA (Parker *et al*., 2022). The approach to the CEA is intended to be specific to the Projects and takes account of the available knowledge or the environment and other activities around the Offshore Development Area.

291. The CEA has followed a four-stage approach developed from the Planning Inspectorate Advice Note Seventeen. These stages are set out in Table 1-1 of **Volume 7, Appendix 6-2 Offshore Cumulative Assessment Methodology (application ref: 7.6.6.2)**. Stage four of this process, the CEA assessment is undertaken in two phases. The first step in the CEA is the identification of which residual impacts assessed for the Projects on their own have the potential for a cumulative impact with other plans, projects and activities. This information is set out in **Table 9-21** which details the potential impacts assessed in this chapter and identifies the potential for cumulative effects to arise, providing a rationale for such determinations. Only potential impacts assessed in section 9.6 where the potential for cumulative effects has been identified (minor, moderate or major), have been taken forward to the final CEA (i.e. those assessed as 'negligible' or 'no change' are not taken forward, as there is no potential for them to contribute to a cumulative effect). Each project has been considered on a case by case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial / temporal scales involved.

Table 9-21 Potential Cumulative Effects

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Construction (and decommissioning)			
Impact 1: Temporary physical disturbance	Yes	High	Temporary physical disturbance from construction activities for projects with overlapping ZOIs could result in a cumulative effect on benthic receptors.
Impact 2: Increased suspended sediment concentrations (including sediment deposition and smothering)	Yes	High	Increased suspended sediment concentrations from projects with overlapping ZOIs could result in a cumulative effect on benthic receptors.

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Impact 3: Remobilisation of contaminated sediments	No	High	Due to the very low levels of contaminants identified during surveys for the Projects, and a negligible significance of effect for the Projects, no cumulative effects are predicted for the remobilisation of contaminated sediments.
Impact 4: Underwater noise and vibration	No	High	Underwater noise generated by construction activities for the Projects has been assessed as negligible. Impacts upon benthic receptors are likely to be localised to areas in the immediate vicinity of the activity and intermittent, therefore no cumulative effects are predicted.
Operation & Maintenance			
Impact 1: Temporary physical disturbance	Yes	High	Temporary physical disturbance from construction activities for projects with overlapping ZOIs could result in a cumulative effect on benthic receptors.
Impact 2: Increased suspended sediment concentrations (including sediment deposition and smothering)	Yes	High	Increased suspended sediment concentrations from projects with overlapping ZOIs could result in a cumulative effect on benthic receptors.

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Impact 5: Permanent habitat loss	Yes	High	Habitat loss in the Dogger Bank SAC and wider area from nearby schemes may result in a cumulative effect on benthic receptors
Impact 6: Interactions of EMF (including potential cumulative EMF effects)	No	High	As the impact from EMF is negligible for the Projects, there will be no cumulative effect.
Impact 7: Colonisation of introduced substrate, including non-native species	Yes	High	Presence of hard substrate from nearby projects could provide a surface for INNS to colonise, resulting in a cumulative effect on benthic receptors.

292. The second phase of the CEA is a project specific assessment of the potential for any significant cumulative effects to arise due to the construction and / or O&M of the Projects. To do this, a short-list of schemes based on the search distance of 14km (i.e. maximum tidal excursion ellipse), for the CEA has been produced relevant to benthic and intertidal ecology (**Table 9-22**) following the approach outlined in **Volume 7, Appendix 6-2 Offshore Cumulative Assessment Methodology (application ref: 7.6.6.2)**. The second phase of this assessment is only undertaken if the first phase identifies that cumulative effects are possible.

293. The CEA has been based on information available on each relevant scheme as of January 2024. It is noted that the further information regarding the identified schemes may become available in the period up to construction, or may not be available in detail at all prior to construction. The assessment presented here is therefore considered to be conservative, with the level of impacts expected to be reduced compared to those presented here.

294. Schemes have been assigned a tier, based on information used within the CEA. A seven tier system, based on the guidance issued by Natural England and Defra (Parker *et al*., 2022), has been employed as presented below:

295. This approach has been agreed via EIA Scoping and consultation with technical working groups and follows advice from Natural England. Further information on the methodology can be found in **Volume 7, Chapter 6 EIA Methodology (application ref: 7.6**).

296. Types of schemes that could potentially be considered for the cumulative assessment of benthic and intertidal ecology include:

- Other offshore wind farms;
- Carbon Capture Storage (CCS);
- Marine aggregate extraction;
- Oil and gas exploration and extraction;
- Sub-sea cables and pipelines; and
- Commercial shipping.

297. With respect to these types of schemes, for those that are fully operational (i.e. Tier 1 schemes) at the time of this assessment, the cumulative assessment methodology considers them to be part of the baseline conditions for the surrounding area (and assumes that any residual effect has been captured within the baseline). As such, it is not expected that the Projects would contribute to cumulative effects with these existing activities and, therefore, these have not been the subject of further assessment.

298. For projects that are not currently fully operational, i.e. those in planning / pre-construction stages, or even where construction may have commenced but not yet be complete, these are screened in for further assessment in the final cumulative assessment.

299. Schemes included in the CEA, and their distance to the Array Areas and Offshore Export Cable Corridor for the Projects are provided below in **Table 9-22**.

Table 9-22 List of Plans / Projects Screened for Further Assessment in the CEA

Tier	**Scheme**	**Closest Distance to (km):**	
		Export Cable Corridor	**Array Areas**
Offshore Wind Farms and associated export cables			
2	Sofia[1]	n/a	35 (included for operational Impact 2: Permanent habitat loss only)
2	Dogger Bank A	20	8

Tier	Scheme	Closest Distance to (km):	
		Export Cable Corridor	Array Areas
2	Dogger Bank A export cable	0.25 (export cable corridor overlap the Projects 1km Construction Buffer Zone	4
2	Dogger Bank B	n/a	17 (included for operational Impact 2: Permanent habitat loss only)
2	Dogger Bank B export cable	0.25 (Export Cable Corridor overlaps the Projects 1km Construction Buffer Zone)	8
3	Dogger Bank C[1]	n/a	56 (included for operational Impact 2: Permanent habitat loss only)
1	Hornsea Project Four export cable[1]	0 (export cable corridor crosses the Projects)	n/a
6	Dogger Bank D	11	68 (estimated) (included for operational Impact 2: Permanent habitat loss only)
6	Dogger Bank D export cable	11	0 (export cable corridor runs adjacent to DBS East Array Area
Carbon Capture and Storage			
4	Northern Endurance	12	n/a
4	Northern Endurance Pipeline	0 (pipeline crosses the Projects' Offshore Export Cable Corridor)	n/a

Tier	Scheme	Closest Distance to (km):	
		Export Cable Corridor	Array Areas
7	CCS North Sea Leasing Round SNS Area 1 Licences CS020 & CS025	0 (overlaps the Projects' Offshore Export Cable Corridor and Array Areas)	
7	CCS North Sea Leasing Round SNS Area 3 Licence CS028	0 (overlaps the Projects' Offshore Export Cable Corridor)	n/a
7	CCS North Sea Leasing Round SNS Area 7	n/a	8
Subsea Cables			
3	Eastern Green Link 2 (EGL2)	2	n/a
6	Eastern Green Link 3 (EGL3)*	0 (potentially crosses the Projects' Offshore Export Cable Corridor)	n/a
6	Eastern Green Link 4 (EGL4)*	0 (potentially crosses the Projects' Offshore Export Cable Corridor)	n/a
7	Aminth Energy Interconnector*	Not available	
7	Continental Link*	Not available	
7	National Grid HND Bootstrap*	Not available	Potentially within the Array Areas

n/a – scheme is out with the ZOI for the Projects' Array Areas or Offshore Export Cable Corridor.

** Cable route not yet finalised.*

[1] Sofia and Dogger Bank C's export cable, and Hornsea Project Fours array area are out with the ZOI and therefore not screened into this CEA.

300. The CEA for benthic and intertidal ecology has not identified any schemes where significant cumulative effects could arise.

9.8.2 Potential Cumulative Effects During Construction (and Decommissioning)

301. The CEA assumes the worst case scenario for benthic and intertidal ecology (**Table 9-1)**. Therefore, the construction, operation and decommissioning of DBS East and DBS West concurrently, and / or in isolation, is assessed within the CEA.

9.8.2.1 Impact 1 -Temporary physical disturbance

302. There is the potential for cumulative temporary physical disturbance as a result of construction and decommissioning activities associated with the Projects and other developments. For the purposes of this assessment, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 14km around the Offshore Development Area, and represents the furthest distance sediments can travel.

303. As discussed in section 9.6.2.1.1.1 above the sensitivity of prevalent biotopes within the Offshore Development Area to temporary physical disturbance is considered to be low due to their high recoverability. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', present at several stations within the Offshore Development Area has a higher sensitivity (medium) to temporary physical disturbance than others present and thus may be impacted by cumulative construction activities. However as noted in section 9.5.1.3.7 this biotope was not recorded within surveys for the Hornsea Four or Dogger Bank A and B offshore windfarms. Given that the areas of overlap of other developments screened into the CEA do not overlap with the stations where this biotope was recorded, it is unlikely that a cumulative effect could occur.

304. Dogger Bank A and B arrays are located 8km and 17km north from the Offshore Development Area. Offshore construction of Dogger Bank A began in 2022 with first power generated in October 2023. First power of Dogger Bank B is expected in summer 2024. Therefore, there is no potential for construction overlap with the Projects and no pathway for cumulative temporary physical disturbance impacts.

305. Hornsea Project Four export cables are proposed to cross the DBS Offshore Export Cable Corridor in the nearshore area, approximately 13km from landfall. Offshore construction of Hornsea Project Four is expected to commence in 2027 at the earliest and offshore export cable installation activities will take place between 2027 and 2029 (Ørsted, 2022). The worst case construction timescale if DBS East and DBS West are built sequentially will see offshore export cable installation between 2028 and 2031. The construction of Hornsea Project Four export cables will result in a maximum design scenario temporary habitat disturbance of 36.05km^2 (Ørsted, 2022). However, only 46% of the Hornsea Project Four export cable corridor falls within the Projects' ZOI. It can therefore be assumed that worse case 16.6km^2 temporary habitat disturbance from Hornsea Project Four export cables fall within the Projects ZOI. Even with the spatial overlap, it is unlikely that a temporal overlap in export cable construction activities would occur in the same location at the same time, there are not predicted to be any significant cumulative effects from the construction of Hornsea Four export cables.

306. The export cable corridor of Dogger Bank D overlaps the Projects ZOI with the closest distance being 11km to the Projects Offshore Export Cable Corridor and being adjacent to DBS East Array Area. Construction is expected to begin no earlier than 2027 (SSE Renewables & Equinor, 2023). However, there is no spatial overlap of the cable corridors or Projects Array Areas, and therefore no pathway for cumulative temporary disturbance effects.

307. The Northern Endurance Carbon Capture and Storage (CCS) scheme's Teeside corridor is proposed to cross the Projects' Offshore Export Cable Corridor approximately 64km from landfall. The storage area is located approximately 12km from the Offshore Development Area. Installation of the pipelines and seabed infrastructure for the project is scheduled to commence in 2024, with the first CO_2 injection anticipated to take place in 2026 (Xodus, 2021). Therefore, there is no potential for construction overlap between the Projects and no pathway for cumulative temporary disturbance effects.

308. There are two CCS North Sea Leasing Round schemes – Area 7 which is 8km from the Offshore Development Area and Areas 1 & 3 which slightly overlap the Projects' Array Areas and Offshore Export Cable Corridor. Licences for these were awarded in 2023. Neptune Energy and BP were each awarded a licence within the Southern North Sea (SNS) Area 1, with Shell awarded a licence within SNS Area 3, and Neptune Energy also being awarded a licence for the SNS Area 7 (NSTA, 2023). These schemes have not yet scoped, there is no indication of infrastructure timelines and therefore it is not possible to undertake detailed assessment. These schemes will need to assess impacts as part of their CEA for consenting purposes.

309. Due to the distance from the Projects' Offshore Development Area there is no spatial overlap and therefore no pathway for cumulative temporary physical disturbance impacts with EGL 2.

310. The design parameters and construction timelines are unknown for the remaining schemes listed in **Table 9-22**, and therefore it is not possible to undertake a detailed assessment. However, like with other export cable crossings, the impacts are predicted to be minimal, temporary and localised to the site. Therefore, it is anticipated that any effects, once quantified, would result in no significant effect.

311. Although the cumulative area of temporary physical disturbance is larger than for the Projects in isolation, given the small scale and temporary nature of disturbance in the context of the extent of impacted habitats within the Dogger Bank and wider North Sea area, the magnitude of cumulative effect is low. Therefore, the impact of cumulative temporary disturbance during construction is assessed as of **minor adverse** significance.

9.8.2.2 Impact 2 – Increased suspended sediment concentrations (including sediment deposition and smothering)

312. There is the potential for cumulative increases is SSC and associated deposition as a result of construction activities associated with the Projects and other developments. Where sediment plumes interact, there is likely to be a corresponding increase in SSC at that location over and above what would be expected should the developments be undertaken in isolation. For the purposes of this assessment, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 14km around the Offshore Development Area, and represents the furthest distance sediments can travel.

313. As discussed in section 9.6.2.2.1.1, the sensitivity of prevalent benthic habitats and biotopes to increased SSC is considered to be low due to their high recoverability. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', present at several stations within the Offshore Development Area having a higher sensitivity (medium) to increased SSC than others present and thus may be impacted by cumulative construction activities.

314. As with impact 1 (section 9.8.2.1), there is no potential for temporal construction overlaps between the Projects and Dogger Bank A and B or the Northern Endurance project.

315. Hornsea Project Four export cables are proposed to cross the Projects' Offshore Export Cable Corridor in the nearshore area. Construction of Hornsea Project Four is expected to commence in 2027, whereas the Projects could start in 2026. Therefore, there is potential of the construction stages to overlap. Cable trenching and sandwave clearance within the Hornsea Project Four export cable corridor will result the cumulative suspension of up to 10,181,000m^3 of sediment (Ørsted, 2022). However, only 46% of the Hornsea Project Four export cable corridor falls within the Projects ZOI, therefore the maximum amount of sediment released cumulatively will be considerably less. It can be assumed that worse case 4,683,260m^3 of sediment will be suspended from Hornsea Project Four export cables within the Projects ZOI. Based on the marine physical processes modelling (see **Volume 7, Chapter 8 (application ref: 7.8)**), the sediment plume from in the nearshore part of the cable corridor is much more limited in extent and restricted to within 2km of the cable corridor. The small potential overlap of sediment plumes and it being highly unlikely cable installation activities would occur at the same location at the same time there are not predicted to be any significant cumulative impacts by increased SSCs from the construction of Hornsea Project Four export cables.

316. There is, however, potential for cumulative changes in deposition of SSCs due to cable installation where the two export cable corridors overlap. The maximum predicted deposition at the cable crossing location is up to 3cm due to cable installation activities for the DBS Projects alone, with changes of a similar order of magnitude expected for the Hornsea Project Four, although not reported in the Hornsea Project Four ES. This could result in a cumulative change of <10cm (see **Volume 7, Chapter 8 (application ref: 7.8)**). The habitats within this area have a low to medium sensitivity to smothering and siltation rate changes (heavy) (see **Table 9-17** and **Volume 7, Figure 9.4** and **Figure 9.5 (application ref:7.9.1)**), but it is likely any sediment deposited during cable installation will be transported as bedload and incorporated into the baseline sediment transport regime. Therefore, no significant cumulative impacts by increased SSCs (including deposition) from the construction of Hornsea Project Four export cables are predicted.

317. As discussed in impact 1, the export cable corridor of Dogger Bank D overlaps the Projects ZOI with the closest distance being 11km to the Projects Offshore Export Cable Corridor and being adjacent to DBS East Array Area. From around 60km offshore, the extent of the sediment plume due to the Projects cable installation reduces from 5km to around 2km within the Array Areas. As such there is unlikely to be a spatial overlap of both projects' sediment plumes and therefore no pathway for cumulative impact.

318. EGL 2 export cable installation could have the potential to create a cumulative increase in SSCs with the Projects. Construction of the cable is planned to commence in 2025, with the aim of being operational by 2030 and therefore the construction periods could overlap. There is currently limited detail on the EGL 2 scheme and therefore it is not possible to undertake a detailed assessment. However, the impacts associated with EGL 2 are assumed to be similar to those of the Projects' Offshore Export Cable therefore effects are predicted to be minimal, temporary and localised to the site. Therefore, it is anticipated that any effects, once quantified would result in no significant cumulative effects if construction periods overlap.

319. As with impact 1, there are a number of schemes listed in **Table 9-22** which cross the Projects' Offshore Development Area. The construction timelines are unknown for these projects and therefore it is not possible to undertake a detailed assessment. However, the potential exists for some of the respective plumes to interact if construction stages overlap. The cumulative impacts associated with increased SSC from the construction of cables / pipelines are predicted to be temporary and localised (i.e. of small spatial extent) within the site. Therefore, it is anticipated that any effects, once qualified, would result in no significant effect.

320. The cumulative impacts of increased SSC (and deposition), as the Projects assessment (section 9.6.2.2) 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.

321. Based on a medium sensitivity and low magnitude of impact, cumulatively increased SSCs and subsequent deposition during construction would have a **minor adverse** effect on the biotopes and habitats that are present within the ZOI of the Projects, which is not significant in EIA terms.

9.8.3 Potential Cumulative Effects During Operation

9.8.3.1 Impact 1 -Temporary physical disturbance

322. There is potential for cumulative direct disturbance to the seabed from jack-up vessels and cable maintenance activities associated with the Projects and other developments. For the purposes of this assessment and to ensure a precautionary approach, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 14km around the Offshore Development Area, and represents the furthest distance sediments can travel.

323. The operational phase of Dogger Bank A and B will overlap with the Projects' operation. The Dogger Bank A and B ES does not detail predicted direct disturbance from maintenance activities within export cable, although industry often assume that approximately 10% of the cable will require remedial work over the project lifetime. A proportion of these maintenance activities will fall in the percentage project overlap with the Projects ZOI. However, the impacts associated with maintenance are known to be temporary in duration, spatially localised, and likely not to overlap temporally. Therefore, any cumulative impacts are therefore expected to be minimal.

324. The operational phase of Hornsea Four will overlap with the Projects' operation. As previously discussed, only 46% of the total Hornsea Project Four export cables cross within the Projects benthic ZOI. The direct disturbance from cable maintenance activities within the entire export cable corridor is predicted to be 1.75km^2 (Ørsted, 2022). Given the small extent of and limited potential for temporal overlap, any cumulative impacts are expected to be minimal.

The CCS projects, pipelines, platforms and wells operational phases will overlap the Projects' operation. The worst case habitat disturbance from maintenance activities of the pipeline is not known but it is expected to be similar or less to those of an export cable. 0.7% of Northern Endurance pipeline crosses the DBS export cable, given that impacts associated with maintenance are expected to be low, over a smaller area and less intense than construction, they will be for an increased duration. However, it can be assumed that any cumulative impacts from these projects will be minimal and will be controlled through individual projects' Offshore Operations and Maintenance Plans.

325. Although the cumulative area of temporary physical disturbance during O&M is larger than for the Projects in isolation, given the small scale and temporary nature of disturbance in the context of the extent of impacted habitats within the Dogger Bank and wider North Sea area, the magnitude of cumulative effect is low. Therefore, the impact of cumulative temporary disturbance during operation is assessed as being of **minor adverse** significance.

9.8.3.2 Impact 2 - Increased suspended sediment concentrations (including sediment deposition and smothering)

326. There is potential for cumulative increases in SSC from jack-up vessels and cable maintenance activities associated with the Projects and other developments. For the purposes of this assessment and to ensure a precautionary approach, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 14km around the Offshore Development Area, and represents the furthest distance sediments can travel.

327. As discussed in section 9.6.2.2.1.1, the sensitivity of prevalent benthic habitats and biotopes to increased SSC is considered to be low due to their high recoverability. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', present at several stations within the Offshore Development Area having a higher sensitivity (medium) to increased SSC than others present and thus may be impacted by cumulative construction activities. As discussed in section 9.8.2.1 the biotope was not recorded within surveys for the Hornsea Project Four or Dogger Bank A and B offshore windfarms. Given that the areas of overlap of other developments screened into the CEA do not overlap with the stations where this biotope was recorded, it is unlikely that a cumulative effect could occur.

328. As discussed in section 9.8.3.1, it is unlikely that maintenance activities would overlap spatially and temporally. However, the impacts associated with maintenance are known to be temporary in duration and spatially localised, therefore any cumulative impacts are therefore expected to be minimal.

329. As with the cumulative impact of increased SSC during construction (section 9.8.2.2) and the Projects assessment (section 9.6.3.2) 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.

330. Based on a medium sensitivity and low magnitude of impact, increased SSC and subsequent deposition during operations would have a **minor adverse** effect on the biotopes and habitats that are present within the ZOI of the Projects, which is not significant in EIA terms.

9.8.3.3 Impact 5 – Permanent habitat loss

331. Cumulative permanent habitat loss is predicted to occur as a result of the DBS infrastructure and other projects within the Dogger Bank (using the Dogger Bank SAC boundary as a reference). Permanent habitat loss may result from the physical presence of foundations, scour protection and cable / pipeline protection, which are assumed to be in place for the lifetime of the relevant projects and potentially beyond. Note that the Dogger Bank SAC is used here simply as a discrete geographic unit for this assessment. The assessment of permanent habitat loss in relation to the Conservation Objectives of the SAC is presented in **Volume 6, Report to Inform Appropriate Assessment (RIAA**) **(application ref: 6.1)**.

332. The CEA is based on information available within ESs where available, it must be noted that project parameters quoted in ESs are often refined during the determination period of the application or post consent during detailed design. Therefore, the assessment presented is considered to be precautionary, with the magnitude of impact on benthic ecology expected to be less than that presented here once projects are actually constructed.

As presented in **Table 9-23**, the predicted cumulative permanent habitat loss from all schemes is estimated to be 0.114% of the Dogger Bank or 14.01km^2 (using the Dogger Bank SAC boundary as a reference) . While the cumulative impact from permanent habitat loss will be locally significant and comprise a long-term or permanent change in seabed habitat within the footprint of the structures, the footprint of the area affected is highly localised. The total predicted habitat calculations for these schemes are based on worst case consented parameters or those presented in the schemes' ES. The likely build scenario is expected to result in a much smaller area of habitat loss.

333. In addition, BEIS (2019) estimated that other infrastructure (cables, and oil and gas infrastructure) accounted for approximately 1.7km^2 of habitat loss within the Dogger Bank SAC. In total, the habitat loss based on the BEIS estimates and the Applicants own calculations (**Table 9-23**), equates to 0.13% of the area.

Table 9-23 Predicted permanent habitat loss for screened in operational schemes within the Dogger Bank (using the Dogger Bank SAC area of 12,331km² as a reference)

Scheme	Total predicted habitat loss (km^2)	Percentage of habitat loss (km^2)	Cumulative percentage of habitat loss
DBS East	1.02*	0.008	0.111% (or 13.69km^2)
DBS West	0.97*	0.008	
Dogger Bank A	3.36	0.027	
Dogger Bank B	3.16	0.026	
Dogger Bank C	2.77	0.022	
Dogger Bank D	Not available	Not available	
Sofia	2.41	0.020	

** Total predicated habitat loss includes that predicted for the Array Areas and Inter-Platform Cable Corridor, and 29.3% of the Offshore Export Cable Corridor which falls within the boundary of the Dogger Bank SAC used as reference*

334. Given that the habitats and characterising biotopes observed within the Offshore Development Area are common and widespread throughout the Dogger Bank, and that the percentage area of the Dogger Bank SAC affected by habitat loss is small, the magnitude of impact is assessed as negligible.

335. As the maximum sensitivity of biotopes in the Offshore Development Area was assessed as high (section 9.6.3.3.1), the same can be assumed for other biotopes within the Dogger Bank, and the magnitude of impact is negligible. It is therefore concluded that the significance of effect from cumulative permanent habitat loss with the Dogger Bank is **minor adverse**.

9.8.3.4 Impact 7 - Colonisation of introduced substrate, including non-native species

336. Colonisation of introduced hard substrates in the form of foundations and scour/ cable protection by marine flora and fauna will occur on all projects within the Dogger Bank and wider area. This is of particular note in sedimentary environments like Dogger Bank where availability of suitable substrates for colonisation are very limited.

337. Noting the presence of epifaunal species and colonising fauna found within the Offshore Development Area during the site-specific surveys (**Volume 7, Appendix 9-2 (application ref: 7.9.9.3)**), it is likely that these fairly common species will also colonise any introduced substrate. However, it is difficult to determine if such a change represents a beneficial or adverse impact. The introduced substrate has the potential to create a 'reef effect', which may be beneficial to certain fish and shellfish species but also may provide potential corridors for the spread of invasive species.

338. The amount of hard substrate introduced to the wider region via these developments will be broadly similar to the permanent habitat loss areas calculated in **Table 9-23**. Due to this very small area, it is unlikely that a 'reef effect' will occur in the Dogger Bank SAC due to introduced substrate, and therefore the magnitude of impact is negligible.

339. As the sensitivity of the biotopes present within the Offshore Development Area is high but the magnitude of impact is negligible, the overall significance of cumulative effect from the colonisation of introduced substrate, including non-native species is **minor adverse**.

9.9 Transboundary Effects

340. There are no transboundary effects with regard to benthic and intertidal ecology as the Offshore Development Area is located 40km from the UK's exclusive economic zone boundary, which is greater than the 14 km ZOI of the Projects. Transboundary effects are therefore scoped out of this assessment and not considered further as agreed with the Planning Inspectorate (see **Volume 7, Appendix 9-1 (application ref: 7.9.9.1)**).

9.10 Interactions

341. The effects identified and assessed in this chapter have the potential to interact with each other. The areas of potential interaction between effects are presented in **Table 9-24**. This provides a screening tool for which effects have the potential to interact. **Table 9-25** provides an assessment for each receptor (or receptor group) as related to these impacts.

342. Within **Table 9-25** the effects are assessed relative to each development phase to see if multiple effects could increase the significance of the effect upon a receptor. Following this, a lifetime assessment is undertaken which considers the potential for an effect on receptors across all development phases.

Table 9-24 Interactions Between Impacts – Screening

Potential Interactions between Impacts				
Construction (and decommissioning)				
	Impact 1: Temporary physical disturbance	Impact 2: Increased suspended sediment concentrations (including sediment deposition and smothering)	Impact 3: Remobilisation of contaminated sediments	Impact 4: Underwater noise and vibration
Impact 1: Temporary physical disturbance (including sediment deposition and smothering)		Yes	Yes	Yes
Impact 2: Increased suspended sediment concentrations	Yes		Yes	No
Impact 3: Remobilisation of contaminated sediments	Yes	Yes		No
Impact 4: Underwater noise and vibration	Yes	No	No	

Potential Interactions between Impacts				
Operation				
	Impact 1: Temporary physical disturbance	Impact 2: Permanent habitat loss	Impact 3: Interactions of EMF (including potential cumulative EMF effects)	Impact 4: Colonisation of introduced substrate, including non-native species
Impact 1: Temporary physical disturbance (including sediment deposition and smothering)		No	No	No
Impact 2: Permanent habitat loss	No		No	Yes
Impact 3: Interactions of EMF (including potential cumulative EMF effects)	No	No		No
Impact 4: Colonisation of introduced substrate, including non-native species	No	Yes	No	

Table 9-25 Interaction Between Impacts – Phase and Lifetime Assessment

Receptor	Highest Significance Level				
	Construction	**Operation**	**Decommissioning**	**Phase Assessment**	**Lifetime Assessment**
Benthic habitats and biotopes	Minor adverse	Minor adverse	Minor adverse	No greater than individually assessed impacts: • Long term habitat loss during operation increases the potential for interactions with other impacts assessed for that phase. • However, all potential effects are non-significant (minor adverse or less) and localised in nature, being restricted to the Projects' ZOI. The majority of effects are also temporary in nature. Together, these factors limit the potential for different impacts to interact within each phase. • As a result, none of the potential interactions identified with respect to benthic ecology are expected to result in a synergistic or greater significance of effect than those already assessed	No greater than individually assessed impacts: • As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. • Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases

9.11 Inter-relationships

343. For benthic and intertidal ecology, potential inter-relationships between other topics assessed within the ES include **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** and **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**. A summary of the potential inter-relationships between benthic and intertidal ecology and these topics is provided in **Table 9-26**.

Table 9-26 Benthic and Intertidal Ecology Inter-Relationships

Topic and Description	Related Chapter	Where Addressed in this Chapter	Rationale
Construction			
Fish and Shellfish – edible crabs, prey resources, nursery and spawning ground	**Volume 7, Chapter 10 Fish and Shellfish Ecology**	This chapter informs Chapter 10.	The benthic environment represents a habitat for many fish and shellfish species. Additionally, a number of benthic species are prey for fish and shellfish. Therefore, impacts on benthic ecology can lead to indirect impacts on fish and shellfish.
Suspended sediments and deposition	**Volume 7, Chapter 8 Marine Physical Environment**	Impacts as a result of suspended sediment and deposition are assessed in section 9.6.2.2.	Changes in suspended sediment concentrations are assessed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**. Changes in suspended sediment concentrations and associated sediment deposition could have potential impacts on benthic habitats and species.

Topic and Description	Related Chapter	Where Addressed in this Chapter	Rationale
Re-mobilisation of contaminated sediments	**Volume 7, Chapter 8 Marine Physical Environment**	Re-mobilisation of contaminated sediments during construction is assessed in section 9.6.2.2.2.	**Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** provides an assessment of the potential for contaminants to be present in the study area. Re-mobilisation of contaminated sediments and associated deposition could have potential impacts on benthic habitats and species.
Operation			
Fish and Shellfish – edible crabs, prey resources, nursery and spawning ground	**Volume 7, Chapter 10 Fish and Shellfish Ecology**	This chapter informs Chapter 10.	The benthic environment represents a habitat for many fish and shellfish species. Additionally, a number of benthic species are prey for fish and shellfish. Therefore, impacts on benthic ecology can lead to indirect impacts on fish and shellfish.
Suspended sediments and deposition	**Volume 7, Chapter 8 Marine Physical Environment**	Impacts as a result of suspended sediment and deposition are assessed in section 9.6.2.2.	Changes in suspended sediment concentrations are assessed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**. Changes in suspended sediment concentrations and associated sediment deposition could have potential impacts on benthic habitats and species.
Decommissioning			
Inter-relationships for impacts during the decommissioning phase will be the same as those outlined above for the construction phase.			

9.12 Summary

344. This ES chapter has provided a characterisation of the existing environment for benthic and intertidal ecology based on both existing and site-specific survey data.

345. It has also investigated the potential effects on intertidal and subtidal benthic ecology receptors arising from the Projects. The range of potential impacts and associated effects has been informed by consultation responses from stakeholders, alongside reference to existing legislation and guidance.

346. Seabed composition across the survey area was predominantly characterised by sand, with gravel comprising the highest proportion of sediment up to 24km from the proposed landfall location. Some evidence of elevated contaminants were detected, but this was primarily focussed at one sample station (ST164), approximately 24km offshore.

347. Of non-native species, 15 individuals of *Goniadella gracilis* were recorded across seven sample stations, with the cryptogenic species *Polydora cornuta* (polychaete) and ascidians of the genus *Molgula* spp. (potentially including *Molgula manhattensis*) being recorded across three sample stations. The INNS recorded are not included in the invasive species England Biodiversity Indicator for 2021.

348. Six biotopes and one habitat were identified across the survey area, with the biotope *Nephtys cirrosa and Bathyporeia spp. in Atlantic infralittoral sand* (MB5233) typifying the majority of the survey area. Some of the habitats and biotopes recorded are, or are representative of, UK BAP priority habitats and include '*Subtidal sands and gravel*' and '*Piddocks with Sparse Associated Fauna in Sublittoral Very Soft Chalk or Clay*'. Aggregations of cobbles at 16 stations were evaluated for the potential of Annex I habitat 'Reef' (geogenic). The overall assessment for the aggregations of cobbles was of 'no resemblance' or 'low resemblance' to a stony reef and as such, unlikely to represent Annex I habitat under the current marine nature conservation legislation.

349. The entirety of the intertidal zone for each potential landfall has been classified as the biotope '*Barren littoral coarse sand*' (MA5231).

350. The assessment has established that there will be some minor adverse residual effects during the construction, operation and decommissioning phases of DBS East and DBS West, both in isolation and together. Effects are generally localised in nature, being restricted to the project boundaries and immediate surrounding area.

351. Cumulative impacts 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 activities in the study area. The cumulative assessment established that there will be some minor adverse residual effects during the construction and operation of DBS East and DBS West with other activities in the area.

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

353. A summary of the significance of effect assessment for benthic and intertidal ecology is provided in **Table 9-27** below.

Table 9-27 Summary of Potential Likely Significant Effects on Benthic and Intertidal Ecology

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect	Residual Cumulative Effect
Construction (and decommissioning)							
Impact 1: Temporary physical disturbance	Benthic habitats and species within the Offshore Development Area.	Low-High (Array Areas, Inter-Platform Cabling Corridor and Export Cable Corridor) Medium (intertidal)	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse
Impact 2: Increased suspended sediment concentrations (including sediment deposition and smothering)		Not Sensitive – Medium (Array Areas, Inter-Platform Cabling Corridor and Export Cable Corridor) Not Sensitive (intertidal)	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse
Impact 3: Remobilisation of contaminated sediments		Low	Negligible	Negligible	N/A	Negligible	N/A
Impact 4: Underwater noise and vibration		Negligible	Negligible	Negligible	N/A	Negligible	Negligible
Operation							
Impact 1: Temporary physical disturbance	Benthic habitats and species within the Offshore Development Area.	Low – High	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse
Impact 2: Increased suspended sediment concentrations (including sediment deposition and smothering)		Not Sensitive – Medium	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse
Impact 5: Permanent habitat loss		High	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect	Residual Cumulative Effect
Impact 6: Interactions of EMF (including potential cumulative EMF effects)		Negligible	Negligible	Negligible	N/A	Negligible	N/A
Impact 7: Colonisation of introduced substrate, including invasive / non-native species		High	Negligible	Minor Adverse	N/A	Minor Adverse	Minor Adverse

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