



# Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

## Offshore In Principle Monitoring Plan (IPMP)

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## Table of Contents

<b>OFFSHORE IN-PRINCIPLE MONITORING PLAN</b> .....	<b>9</b>
1.1 Purpose of the Offshore In-Principle Monitoring Plan.....	9
1.2 Background.....	10
1.3 General Guiding Principles for the Proposed Monitoring.....	12
1.4 SEP and DEP Residual Impacts.....	14
1.5 In-Principle Proposals for Monitoring.....	14
<b>References</b> .....	<b>38</b>

## Table of Tables

Table 1: Key Relevant Parameters.....	11
Table 2: Proposed Scope of Work to Support Development of Detailed Plans for Cable Installation to Maximise the Chance of Burial Success for SEP and DEP.....	16
Table 3: In-Principle Monitoring Proposed – Marine Geology, Oceanography and Physical Processes.....	18
Table 1-5: In-Principle Monitoring Proposed - Benthic Ecology.....	22
Table 1-6: In-Principle Monitoring Proposed – Fish Ecology.....	25
Table 1-7: In-Principle Monitoring Proposed – Marine Mammals.....	28
Table 1-8: In-Principle Monitoring Proposed – Offshore Ornithology.....	31
Table 1-9: In-Principle Monitoring Proposed – Shipping and Navigation.....	33
Table 1-10: In-Principle Monitoring Proposed – Offshore Archaeology and Cultural Heritage.....	36



## Glossary of Acronyms

AIS	Automatic Identification System
ALARP	As Low as Reasonably Possible
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFWG	Commercial Fisheries Working Group
CRM	Collision Risk Modelling
DCO	Development Consent Order
DDV	Drop-Down Video
DEL	Dudgeon Extension Limited
DML	Deemed Marine Licence
DEP	Dudgeon Offshore Wind Farm Extension Project
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
FLCP	Fisheries Liaison and Co-existence Plan
HRA	Habitat Regulations Assessment
HVAC	High-Voltage Alternating Current
IHO	International Hydrographic Organisation
IPMP	In-Principle Monitoring Plan
km	Kilometre
LAT	Lowest Astronomical Tide
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MCA	Maritime Coastguard Agency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
NPS	National Policy Statement
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
PAM	Passive Acoustic Monitoring
PSA	Particle Size Analysis
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation

SEL	Scira Extension Limited
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SIP	Site Integrity Plan
SPA	Special Protection Area
SSS	Side-Scan Sonar
UK	United Kingdom
UXO	Unexploded Ordnance
WSI	Written Scheme of Investigation

## Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP offshore site	The Dudgeon Offshore Wind Farm Extension consisting of the DEP wind farm site, interlink cable corridors and offshore export cable corridor (up to mean high water springs).
DEP onshore site	The Dudgeon Offshore Wind Farm Extension onshore area consisting of the DEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
DEP North array area	The wind farm site area of the DEP offshore site located to the north of the existing Dudgeon Offshore Wind Farm
DEP South array area	The wind farm site area of the DEP offshore site located to the south of the existing Dudgeon Offshore Wind Farm
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Grid option	Mechanism by which SEP and DEP will connect to the existing electricity network. This may either be an integrated grid option providing transmission infrastructure which serves both of the wind farms, or a separated grid option, which allows SEP and DEP to transmit electricity entirely separately.
Horizontal directional drilling (HDD)	Trenchless technique used to install cables – in this case referring to the installation of the export cables at the landfall.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Infield cables	Cables which link the wind turbine generators to the offshore substation platform(s).
Interlink cables	Cables linking two separate project areas. This can be cables linking:  1) DEP South array area and DEP North array area

	<p>2) DEP South array area and SEP</p> <p>3) DEP North array area and SEP</p> <p>1 is relevant if DEP is constructed in isolation or first in a phased development.</p> <p>2 and 3 are relevant where both SEP and DEP are built.</p>
Interlink cable corridor	This is the area which will contain the interlink cables between offshore substation platform/s and the adjacent Offshore Temporary Works Area.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water.
Offshore cable corridors	This is the area which will contain the offshore export cables or interlink cables, including the adjacent Offshore Temporary Works Area.
Offshore export cable corridor	This is the area which will contain the offshore export cables between offshore substation platform/s and landfall, including the adjacent Offshore Temporary Works Area.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.
Offshore scoping area	An area presented at Scoping stage that encompassed all planned offshore infrastructure, including landfall options at both Weybourne and Bacton, allowing sufficient room for receptor identification and environmental surveys. This has been refined following further site selection and consultation for the PEIR and ES.
Offshore substation platform (OSP)	A fixed structure located within the wind farm site/s, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Offshore Temporary Works Area	An Offshore Temporary Works Area within the offshore Order Limits in which vessels are permitted to carry out activities during construction, operation and decommissioning encompassing a 200m buffer around the wind farm sites and a 750m buffer around the offshore cable corridors. No permanent infrastructure would be installed within the Offshore Temporary Works Area.

Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP offshore site	Sheringham Shoal Offshore Wind Farm Extension consisting of the SEP wind farm site and offshore export cable corridor (up to mean high water springs).
SEP wind farm site	The offshore area of SEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area.
Study area	Area where potential impacts from the project could occur, as defined for each individual Environmental Impact Assessment (EIA) topic.
The Applicant	Equinor New Energy Limited. As the owners of SEP and DEP, Scira Extension Limited and Dudgeon Extension Limited are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.



## OFFSHORE IN-PRINCIPLE MONITORING PLAN

### 1.1 Purpose of the Offshore In-Principle Monitoring Plan

1. This Offshore In-Principle Monitoring Plan (IPMP) has been produced in order to provide the basis for delivering the monitoring measures as required by the conditions contained within the Deemed Marine Licences (DML) for the Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP).
2. As the owners of SEP and DEP, Scira Extension Limited (SEL) and Dudgeon Extension Limited (DEL) are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.
3. The Offshore IPMP provides a key mechanism through which the relevant regulatory authorities can be assured that required offshore monitoring activities associated with the construction and operation of the offshore infrastructure for SEP and DEP will be formally controlled.
4. The Offshore IPMP provides a framework for further discussions post consent with the Marine Management Organisation (MMO), the relevant Statutory Nature Conservation Bodies (SNCB) and advisors (e.g. Maritime and Coastguard Agency (MCA) and The Wildlife Trusts (TWT) where relevant) to agree the exact detail (timings, methodologies etc.) of the monitoring that is required. Due to the long lead in time for the development of offshore wind farms it is not desirable or effective to provide final detailed method statements prior to consent being granted. However, agreeing guiding principles reinforces commitments made in the Environmental Statement (ES) and complements other requirements set out in the DMLs and will allow refinements to be made based on the best available knowledge and technology. Final detailed plans for monitoring work will be produced closer to the time that the actual work will be undertaken.
5. The relevant topics and / or receptor groups discussed in this plan are as follows:
  - Marine Geology, Oceanography and Physical Processes;
  - Marine Water and Sediment Quality;
  - Benthic Ecology;
  - Fish and Shellfish Ecology;
  - Marine Mammals;
  - Offshore Ornithology;
  - Commercial Fisheries;
  - Shipping and Navigation; and
  - Offshore Archaeology and Cultural Heritage.

## 1.1 Background

6. The Applicant is seeking a Development Consent Order (DCO) for SEP and DEP which are extensions to the existing Sheringham Shoal Offshore Wind Farm (SOW) and Dudgeon Offshore Wind Farm (DOW), located in the southern North Sea off the north Norfolk Coast.
7. The SEP wind farm site will cover an area of approximately 97.0km<sup>2</sup> and the DEP wind farm site will cover an area of approximately 114.75km<sup>2</sup>. The closest point to the coast is 15.8km from SEP and 26.5km from DEP. Depths range from 14m below Lowest Astronomical Tide (LAT) in the northwest of the SEP wind farm site to 36m in the northwest of the DEP North array area.
8. Water depths within the offshore export cable corridor range from 25-27m in the offshore part closest to SEP, shallowing to about 16m near the eastern tip of Sheringham Shoal sand bank and then decreasing progressively to 0m at the coast.
9. Once built, SEP and DEP would comprise the following offshore components:
  - The offshore wind turbines and their associated foundations;
  - Scour protection around foundations as required;
  - Offshore substation platform/s (OSP/s) supporting required electrical equipment, possibly also incorporating offshore facilities; and
  - Subsea cables comprising infield, interlink and offshore export cables and associated external cable protection as required.
10. The detailed design of SEP and DEP (e.g. numbers of wind turbines, layout configuration, foundation type and requirement for scour protection) will be determined post-consent. Therefore, the key parameters presented in **Table 1** are indicative based on current information and assumptions.
11. The earliest any offshore construction works would start is assumed to be 2027.
12. Offshore construction works would require up to two years per Project (excluding pre-construction activities such as surveys), assuming SEP and DEP were built at different times. If built at the same time, offshore construction could be completed in two years. There could be a gap of up to four years between the completion of offshore construction works on the first Project and the completion of offshore construction works on the second Project.
13. It should be noted that the construction programme is dependent on numerous factors including consent timeframes and funding mechanisms.

## 1.1.1 Key Relevant Parameters

Table 1: Key Relevant Parameters

Parameter	Details		
	SEP	DEP	Combined
Approximate offshore construction duration	2 years	2 years	2 to 4 years
Wind farm site area	97.0	114.75	211.75
Distance from wind farm site to coast (closest point) (km)	15.8	26.5	15.8
Number of wind turbines	13-23	17-30	30-53
Maximum length of export cable SEP to landfall (per cable) (km)	n/a	40	n/a
Maximum length of export cable DEP to landfall <sup>1</sup> (per cable) (km)	62	n/a	62
Maximum number of export cables and trenches	1 & 1	1 & 1	2 & 2
Maximum total length of all interlink cables (km)	66	n/a	154 <sup>2</sup>
Maximum turbine rotor diameter (m)	300	300	300
Maximum tip height above Highest Astronomical Tide (HAT) (m)	330	330	330
Minimum clearance (air gap) above HAT (m)	30	30	30
Rotor swept area (km <sup>2</sup> )	1.20-1.30	0.92-1.00	2.12-2.30
Indicative minimum and maximum separation between wind turbines (inter-row) (km)	1.05-3.3	1.05-3.3	1.05-3.3
Maximum infield cable length (not incl. interlink cables) (km)	135	90	225
Number of OSP/s	One	One	Up to two
Wind turbine foundation type options	<ul style="list-style-type: none"> <li>• Piled monopile;</li> <li>• Suction bucket monopile;</li> <li>• Piled jacket;</li> <li>• Suction bucket jacket; and</li> <li>• Gravity base structure (GBS).</li> </ul>		
OSP foundation type options	<ul style="list-style-type: none"> <li>• Piled jacket; or</li> </ul>		

<sup>1</sup> Applies either to a DEP in isolation development scenario, or for SEP and DEP with a separate OSP in the DEP North array area.

<sup>2</sup> Applies to the scenario with one OSP in the SEP wind farm site and assuming only the DEP North array area is developed – see [Chapter 4 Project Description](#) for further details.

Parameter	Details		
	SEP	DEP	Combined
	<ul style="list-style-type: none"> <li>Suction bucket jacket.</li> </ul>		
Number of piles per foundation for wind turbines	Monopile = 1 Piled jacket = 4		
Maximum number of piles for wind turbines	Monopiles = 23 Piled jacket = 92	Monopiles = 30 Piled jacket = 120	Monopiles = 53 Piled jacket = 212
Maximum number of piles for OSPs	2 x 4 leg-jacket = 8 pin piles	2 x 4 leg-jacket = 8 pin piles	4 x 4 leg-jacket = 16 pin piles
Hammer energies (kilojoules) (kJ)	Maximum hammer energy for monopiles: <ul style="list-style-type: none"> <li>Up to 5,000kJ for 15 MW wind turbines</li> <li>Up to 5,500kJ for 18+MW wind turbines</li> </ul> Maximum hammer energy for pin-piles: up to 3,000kJ		
Maximum pile diameter (m)	<ul style="list-style-type: none"> <li>3.5-4m for piled jackets</li> <li>13-16m for monopiles</li> </ul>		

## 1.2 General Guiding Principles for the Proposed Monitoring

14. Throughout the ES and supporting documentation the Applicant has taken steps to avoid or reduce significant impacts either through the iterative process of project design ('embedded mitigation' e.g. the location of project boundaries) or by 'additional' mitigation measures which will be applied during the construction, operation and maintenance or decommissioning phases of SEP and DEP.
15. The Applicant notes the following Natural England comment provided at Section 42 consultation:
 

*Natural England has concerns that SEP and DEP may be operational at different times which would have an effect on post-construction monitoring i.e. when would post-construction monitoring begin? Does the post-construction monitoring start when the last project becomes operational, or the first one? What if there are long periods of time (i.e. years) between this?*
16. Firstly, it is noted that the Applicant is seeking to coordinate the development of SEP and DEP as far as possible. The preferred option is a development scenario with an integrated transmission system, providing transmission infrastructure which serves both of the wind farms, where both Projects are built concurrently and therefore under this scenario post construction monitoring would be coordinated to begin in an appropriate manner once both Projects had completed construction.
17. However, it is recognised that due to the various development scenarios (see **Section 4.1.1 of Chapter 4 Project Description** (document reference 6.1.4) and the **Scenarios Statement** (document reference 9.28), there could be a gap of up to four years between the completion of offshore construction works of each Project. As such careful consideration will need to be given to pre and post-construction monitoring timescales.
18. A key consideration is the potential for the effects from construction activities at SEP and DEP to interact since this could potentially influence monitoring results.



19. Since the development scenario and construction programme will not be determined until post-consent, the Applicant considers that details of the monitoring programme should be agreed through the development of topic specific monitoring plans that will be produced prior to the start of construction, as conditioned in the DMLs. This will enable those plans to take account of the nature of the impact in question and the monitoring that is proposed in relation to it. Notwithstanding this, where relevant, consideration has been given in the in-principle monitoring proposals included below as to whether the timing of construction activities between Projects is likely to be a relevant concern.
20. The guiding principles for monitoring and which apply in general to the in-principle monitoring outlined in this document are as follows:
- All consent conditions, which would include those for monitoring, should be “necessary, relevant to planning, relevant to the permitted development, enforceable, precise and reasonable in all other respects” as set out in Paragraph 4.1.7 of the National Policy Statement (NPS) EN-1 and Paragraph 206 of the National Planning Policy Framework and referred to as the ‘six tests’ (Department for Communities and Local Government, 2012).
  - In line with good practice, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified (Cefas, 2012; Glasson *et al.* 2011; OSPAR 2008). As such, monitoring proposals should have an identified end date and confirmed outputs, which provide statistically robust data sets, as applicable to the hypothesis being tested.
  - Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to SEP and DEP and can be realistically filled, as well as those species or features considered to be the most sensitive to SEP and DEP impacts including those of conservation, ecological and/or economic importance.
  - Proposals for monitoring should be based, where relevant, on the best practice and outcomes of the latest review of environmental data associated with post-consent monitoring of licence conditions of offshore wind farms (MMO, 2014).
  - The scope and design of all monitoring work should be finalised and agreed following review of the results of any preceding survey and / or monitoring work (i.e. an adaptive approach), including those surveys conducted in support of the EIA. This includes the potential for survey requirements to be adapted based on the results of the monitoring outlined in this document. Where it has been agreed that there are no significant impacts, monitoring need not be conditioned through the DMLs.
  - The Applicant is supportive of appropriate strategic monitoring studies. Where the Applicant is made aware of new strategic monitoring studies and they are aligned with the Applicant’s business goals, they will discuss with the relevant authorities if they are appropriate to discharging specific SEP and DEP DML conditions.

### 1.3 SEP and DEP Residual Impacts

21. The EIA predicts the residual impact to receptors taking into account:
  - Linkages using the source > pathway > receptor model;
  - Embedded / Additional Mitigation;
  - Sensitivity to the effect;
  - Magnitude of the effect; and
  - Ecological / economic importance / value.
22. The significance of the residual impact should not in its own right necessarily lead to the requirement for monitoring. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to SEP and DEP and can be realistically filled.
23. For each receptor the residual impacts and major areas of uncertainty as predicted within the SEP and DEP ES, **Stage 1 Cromer Shoal Chalk Beds (CSCB) Marine Conservation Zone (MCZ) Assessment** (document reference 5.6) and **Report to Inform Appropriate Assessment (RIAA)** (document reference 5.4) are detailed. Monitoring has been deemed necessary and required as part of the DML where moderate or major adverse impacts are predicted in the assessment or where uncertainty remains at an industry-wide level.

### 1.4 In-Principle Proposals for Monitoring

24. The following sections set out the in-principle proposals for monitoring in relation to each of the topics and / or receptor groups covered in the ES.
25. While accepting that this Offshore IPMP represents the best approach to monitoring available at the time of writing, it is recognised that the outcomes of the survey work discussed could influence future monitoring requirements, methodologies, focus and effort for SEP and DEP, as knowledge and understanding develops. For example, where appropriate, and in consultation with the MMO and its advisors, these scopes may be refined to consider other relevant studies carried out by the existing Sheringham Shoal Offshore Wind Farm Project (SOW) and Dudgeon Offshore Wind Farm Project (DOW) or other neighbouring projects in the region. This is a key principle for an adaptive approach to monitoring and will be the subject of ongoing consultation between the Applicant, the MMO and its advisors, as discussed under guiding principles (see **Section 1.2**).
26. This document has been submitted with the DCO application and will be used as a basis for further discussions post consent.

#### 1.4.1 Engineering Related Monitoring

27. In addition to the environmental survey and monitoring required as conditions of the DMLs within the DCO, additional studies will be undertaken for engineering purposes. Some of these will overlap with the conditioned monitoring and wherever possible the Applicant will look to combine surveys for monitoring purposes with those already being carried out for engineering purposes. These are:
  - Geophysical;
  - Geotechnical;



- Unexploded Ordnance (UXO) survey;
  - Remotely Operated Vehicle (ROV) survey; and
  - Cable burial survey.
28. Other relevant Plans required under the DML with commitments to monitoring (linked to those listed above) are:
- A cable specification and installation monitoring plan (CSIMP) in accordance with the **Outline CSCB MCZ CSIMP** (document reference 9.7)
  - A scour protection and cable protection plan (monitoring of scour and protection measures);
  - A cable specification and installation and monitoring plan (cable burial monitoring); and
  - An offshore operations and maintenance plan (OOMP) in accordance with the **Outline OOMP** (document reference 9.9).

## 1.4.2 Marine Geology, Oceanography and Physical Processes

### 1.4.2.1 Conclusions of the Environmental Statement

29. No residual impacts greater than negligible were predicted within the ES. The Applicant would wish to survey areas using appropriate geophysical surveys including high resolution bathymetric, multibeam echosounder (MBES) and side-scan sonar (SSS) surveys of the area(s) within the Order limits for engineering purposes. This information would also help inform the interpretation of the benthic monitoring results (see **Section 1.4.4**).

### 1.4.2.2 In-Principle Monitoring

30. **Table 3** provides information on the monitoring requirements for marine, geology, oceanography and physical processes. The proposed monitoring will be discussed and agreed with Natural England and the MMO.
31. Regarding the timing of construction activities depending on the build out scenario for SEP and DEP, this is not considered to be a relevant concern since the only monitoring activities for which there is potential for interaction would be in relation to sand wave levelling within the export cable corridor however since there are no sand waves within the shared portion of the export cable corridor for SEP and DEP (see **Figure 4.9** of **Chapter 4 Project Description** (document reference 6.1.4)) there is no potential for interaction.

32. Regarding monitoring within the CSCB MCZ, **Table 2** (taken from the **Outline CSCB MCZ CSIMP** (document reference 9.7)) outlines a scope of work that the Applicant will carry out in the development of the detailed plans for installation and burial of cables in the MCZ. This forms a comprehensive evidence base providing confidence that execution of the installation and burial strategy will meet the relevant burial requirements. In the case of SEP and DEP this uniquely benefits from the experience that the Applicant has in undertaking the SOW and DOW export cable installation campaigns, providing direct evidence that lessons learnt have been accounted for and that, in the case of DOW, similar design approaches, installation methods and tools have been used to achieve successful outcomes. Details of these lessons learnt are provided in **Section 1.6.3.1** of the **Outline CSCB MCZ CSIMP**.
33. It is proposed that as the tasks outlined in **Table 2** are progressed, the specific details and requirements for monitoring are discussed and agreed with Natural England and the MMO, once the detailed design, installation techniques and programme for SEP and DEP are confirmed. Consideration will be given to how monitoring within the MCZ can build on that undertaken for SOW and DOW rather than repeating what was undertaken for those projects. This approach would also apply to any related benthic ecology monitoring.

*Table 2: Proposed Scope of Work to Support Development of Detailed Plans for Cable Installation to Maximise the Chance of Burial Success for SEP and DEP*

Task	Details
Lessons learnt from the SOW export cable installation	Identify key areas of success and under-performance, primary causes of any under-performance. Recommendations to maximise chance of success for SEP and DEP.  See <b>Section 1.6.3.1</b> of the <b>Outline CSCB MCZ CSIMP</b> (document reference 9.7).
Lessons learnt from the DOW export cable installation	
Learning from other projects	As above.
Pre-construction survey campaign	Detailed geophysical and geotechnical surveys to: <ul style="list-style-type: none"> <li>Establish sub-sea bed (0-2m) soil conditions;</li> <li>Identify sea bed anomalies, debris, magnetic targets (UXO), fishing gear, out of service cables etc.; and</li> <li>Confirm sea bed mobility.</li> </ul> Geotechnical survey brought forward to 2021 to inform consents process.
CBRA ( <b>Appendix 2</b> of the <b>Outline CSCB MCZ CSIMP</b> (document reference 9.7))	Defining burial depths – update as required pre-construction to take account of latest information.
Cable Burial Study (CBS)	Likelihood of burial success based on geophysical, geotechnical and environmental information. Suitability of trenching tools. Informed by ICBS.
Burial tool capability study	Assess burial tools used on SOW and DOW and their performance and limitations. Included in CBRA and summarised in the ICBS and updated where necessary pre-construction to take account of latest tools available on the market.
Development of flowchart to map out the decision-making process for any unexpected events e.g. bad weather	To assist in dealing with unexpected events without compromising the success of the cable burial process.



Task	Details
Establish metocean design basis along the export cable corridor	To feed into the decision making process for unexpected events and the detailed design plan.
Prepare for potential cable repair	Contingency plan in the event of cable fault or damage during installation to minimise any further sea bed disturbance.
Contractor selection	Select experienced contractor with well proven vessel and burial tools.
Make use of Fisheries Liaison Officer (FLO) onboard cable installation vessel/s	To reduce the risk of fishing activities affecting the performance of the cable installation and burial works.

**Table 3: In-Principle Monitoring Proposed – Marine Geology, Oceanography and Physical Processes**

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Changes in sea bed level and the sediment transport regime, including scour processes	Physical environment and linked receptor groups e.g. marine ecology	Pre-construction	<ul style="list-style-type: none"> <li>• Engineering and design purposes</li> <li>• Input to benthic and other related ecological surveys and monitoring requirements as agreed with the MMO.</li> </ul>	A single survey within the agreed SEP and DEP wind farm site and offshore cable corridor survey areas using full sea bed coverage swath-bathymetric, MBES and SSS surveys (to meet the requirements of Marine Guidance Note (MGN) 654 and its Annexes) of the area(s) within the Order Limits in which it is proposed to carry out construction works, including a 500m buffer area around the site of each works. (The “site of each works” being the area within the order limits which is actually taken forwards to construction noting that it is possible that certain areas within the order limits may not be developed.).	Scope of surveys and programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works. Surveys carried out for up to 3 years post-construction, which could be non-consecutive years, with provision of the agreed reports in the agreed format in accordance with the agreed timetable, unless otherwise agreed in writing with the MMO in consultation with the relevant SNCBs
		Post-construction	<ul style="list-style-type: none"> <li>• Structural integrity / engineering (scour)</li> <li>• Sand wave recovery / sand wave migration</li> <li>• Sediment mounds in shallow areas</li> </ul>	Surveys within the agreed SEP and DEP wind farm site and offshore cable corridor survey areas using full sea bed coverage swath-bathymetric surveys undertaken to meet the requirements of MGN 654 and its Annexes. For this purpose the undertaker will, prior to the first such survey, submit a desk based assessment (based on detailed pre-construction survey data and which takes account of all factors which influence scour) to identify the sample of adjacent wind turbines with greatest potential for scour. The survey will be used to validate the desk based assessment: further surveys may be required if there are significant differences between the modelled scour and recorded scour.	



Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
				<p>The quantity of turbines subject to monitoring will be confirmed following the completion of detailed design studies and in consultation with the MMO. This will also include consideration of secondary scour i.e. scour around the perimeter of installed scour protection.</p> <p>Monitoring will also include consideration of the recovery of any dredged or partially dredged sand waves using methods outlined in Larsen et al. (2009) (if required and with full recovery expected) and any movement of sand waves since the pre-construction phase.</p> <p>Geophysical monitoring of any sediment mounds created during sea bed preparation for GBS foundations will also be undertaken where the mounds are in waters less than 15m deep.</p>	



### 1.4.3 Marine Water and Sediment Quality

#### 1.4.3.1 Conclusions of the Environmental Statement

34. No residual impacts greater than **minor adverse** were predicted within the ES.

#### 1.4.3.2 In-Principle Monitoring

35. As stated in **Section 1.2**, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to SEP and DEP and can be realistically filled, as well as those species or features considered to be the most sensitive to the potential impacts including those of conservation, ecological and / or economic importance.

36. In this instance no monitoring or independent surveys are required.

### 1.4.4 Benthic Ecology

#### 1.4.4.1 Conclusions of the Environmental Statement

37. No impact was greater than **minor adverse** for the project alone or cumulatively. However, the SEP and DEP offshore export cable corridor transits through the CSCB MCZ.

#### 1.4.4.2 In-Principle Monitoring

38. The following table provides information on the monitoring requirements for benthic ecology. Where it is possible, synergies with monitoring commitments made in **Section 1.4.2** would be explored in interpreting geophysical data.

39. Consideration has been given to habitats / species of principal importance. As noted in **Chapter 8 Benthic Ecology** (document reference 6.1.8), pre-construction surveys will be undertaken to determine if potential Annex I / UK BAP Priority Habitat *S. spinulosa* reef<sup>3</sup> and UK BAP priority habitat 'peat and clay exposures with piddocks' are present within the proposed wind turbine locations or offshore cable routes.

40. 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.

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<sup>3</sup> Note any Annex I *S. spinulosa* reef identified would not be associated with an SAC for which *S. spinulosa* reef is a qualifying feature since the SEP and DEP offshore sites do not overlap with any SACs.



41. 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. 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.



Table 1-4: In-Principle Monitoring Proposed - Benthic Ecology

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Effects on <i>Sabellaria</i> reef and piddocks	<i>Sabellaria</i> reef and piddocks	Pre-construction	Determine the location and extent of any <i>Sabellaria</i> reef and piddocks within areas of the Order Limits in which it is proposed to carry out construction works to inform the appropriate mitigation if found	<ul style="list-style-type: none"> <li>Undertake geophysical survey to inform engineering design options and analyse results for potential <i>Sabellaria</i> reefs and sediments where piddocks may be present (and other potential constraints such as archaeology).</li> <li>Undertake ground-truthing of potential <i>Sabellaria</i> reefs and piddocks through drop-down video (or grab sample where visibility prevents confirmation through video) against the methodology to be agreed with the MMO.</li> </ul>	<ul style="list-style-type: none"> <li>Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of the first survey.</li> <li>Surveys must be undertaken no longer than 12-18 months prior commencement of construction.</li> <li>Unless commencement of construction occurs within 18 months of the survey being undertaken, a second survey and report will be required prior to construction commencing.</li> </ul>
		Post-construction	The requirement for post-construction monitoring will be dependent on the findings of the pre-construction surveys.	<ul style="list-style-type: none"> <li>Where no <i>Sabellaria</i> reef or piddocks is identified by the pre-construction survey of the proposed works area or where reef or piddocks has been identified but is avoided (including associated buffers to be agreed post-consent), no post-construction surveys will be undertaken;</li> <li>Where <i>Sabellaria</i> reef or piddocks is identified during the baseline survey and has not been able to be avoided (avoidance defined 50m for construction activities), post-construction surveys, the number of which are to be agreed with the MMO</li> </ul>	<ul style="list-style-type: none"> <li>If required, survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to completion of construction / commissioning.</li> <li>If significant impacts are observed, the potential requirement for further surveys will be agreed with the MMO following review of the post-construction survey.</li> </ul>



Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
				<p>post consent, specifically targeting those reefs and piddocks identified in the baseline survey which were affected by the works will be undertaken to check their condition and monitor their recovery using the same methodology set out for pre-construction monitoring.</p>	



## 1.4.5 Fish Ecology

### 1.4.5.1 Conclusions of the Environmental Statement

42. No impact was greater than **minor adverse** for the project alone or cumulatively for SEP and DEP.

### 1.4.5.2 In-Principle Monitoring

43. **Table 1-5** provides information on the monitoring requirements for fish ecology. Where it is possible, synergies (e.g. collection of any required grab samples) with monitoring commitments made in **Section 1.4.4** would be explored.





*Table 1-5: In-Principle Monitoring Proposed – Fish Ecology*

Potential Effect	Receptors	Phase	Headline reasons for monitoring	Monitoring Proposal	Details
Habitat loss	Sandeel	Pre- and post-construction	<ul style="list-style-type: none"> <li>Determine the suitability of the wind farm site as sandeel habitat.</li> </ul>	Grab samples (number to be agreed with the MMO post-consent) to be taken at locations to be agreed with the MMO post-consent. Subsequent PSA of the samples to determine a likely preference or avoidance of the area by sandeels.	<ul style="list-style-type: none"> <li>Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works.</li> <li>It is anticipated that post-construction surveys would be undertaken 1 to 2 years following completion of construction of the Project</li> </ul>



## 1.4.6 Marine Mammals

### 1.4.6.1 Conclusions of the Environmental Statement

44. At a project alone level, the residual impacts from SEP and DEP are assessed as **minor adverse** at worst during construction for grey and harbour seal and harbour porpoise from the following activities:
- Piling (physical and auditory injury and disturbance impacts);
  - Other construction activities (physical and auditory injury);
  - Underwater noise and disturbance from construction vessels (physical and auditory injury);
  - Barrier effects from underwater noise;
  - Increased risk of collision with vessels;
  - Disturbance at seal haul-out sites;
  - Changes to prey availability; and
  - Changes to water quality.
45. During operation, **minor adverse** impacts at worst are assessed for grey and harbour seal and harbour porpoise from the following activities:
- Underwater noise from operational turbines (physical and auditory injury);
  - Underwater noise from operation and maintenance activities (disturbance);
  - Underwater noise from operation and maintenance vessel disturbance;
  - Displacement of harbour porpoise due to changes in prey resource during operation and maintenance is also assessed to be **minor adverse**;
  - Disturbance at seal haul-out sites;
  - Changes to prey availability; and
  - Changes to water quality.
46. The conclusions of the assessment are based on varying levels of confidence in the data used in the assessment. However, the conclusions of the assessment are of a precautionary nature where there is high uncertainty or low confidence in the data.
47. All potential cumulative residual impacts were determined to be **minor adverse** (not significant). Project-specific Site Integrity Plans (SIPs) for the Southern North Sea Special Area of Conservation (SAC) are proposed which will give due consideration to mitigation and monitoring, if deemed required.
48. It should also be noted that the contribution of SEP and DEP to the cumulative harbour porpoise assessment is very small with a worst-case of up to 0.51% of the reference population (North Sea Management Unit) assessed as being potentially at risk of TTS from cumulative exposure from piling operations.



### 1.4.6.2 In-Principle Monitoring

49. It is recognised that monitoring is an important element in the management and verification of the actual SEP and DEP impacts. The **Draft MMMP** (document reference 9.4) and **In Principle Site Integrity Plan (SIP) for the Southern North Sea (SNS) SAC** (document reference 9.6) contain key principles that provide the framework for any mitigation that could be required. If piled foundations are used in the final project design, underwater noise monitoring of the first four piles of each piled foundation type will be undertaken with the methods agreed with the MMO and relevant SNCBs in the pre-construction period.
50. **Table 1-6** includes provision for potential compliance monitoring as is secured through the **Draft MMMP** and the **In Principle SIP for the SNS SAC**. Details of this potential monitoring will be dependent upon the requirements of the final approved plan and protocol.
51. The Applicant is also supportive, in principle, of joint industry projects or alternative site based monitoring of existing marine mammal activity inside the area(s) within the Order Limits in which it is proposed to carry out construction works and would welcome collaboration opportunities from SNCBs, Non-Government Organisations (NGOs) or other developers in strategic monitoring programmes. This would likely be managed outwith the IPMP e.g. Equinor is an active member in the Offshore Wind Strategic Monitoring Research Forum, looking to address wider knowledge gaps and industry priorities.

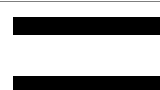


Table 1-6: In-Principle Monitoring Proposed – Marine Mammals

Potential Effect	Receptors	Phase	Headline reasons for monitoring	Monitoring Proposal	Details
Potential disturbance resulting from underwater noise	Harbour porpoise, grey seal, harbour seal	Construction	Determine that the maximum piling energies assessed within the ES are not being breached.	Noise measurements taken from the first four piled foundations of each piled foundation type will be undertaken to validate the assessments within the ES and <b>RIAA</b> (document reference 5.4). One of the first four piles will be at a location anticipated to generate the greatest underwater noise emissions.	The final design and scope of monitoring will be agreed with the relevant stakeholders and included within the final Monitoring Plan submitted for approval. In the event that the monitoring shows noise levels which are significantly different to those assessed in the ES, all piling activity must cease until an update to the marine mammal mitigation protocol and further monitoring requirements have been agreed.
Potential disturbance resulting from underwater noise	Harbour porpoise	All phases	To ensure measures and controls managed through the SIP are monitored for effectiveness	The form of monitoring will be dependent on project design, construction method and the mitigation measures required	The final design and scope of monitoring will be agreed with the relevant stakeholders and included within the final Monitoring Plan submitted for approval.
Potential injury resulting from underwater noise	Marine mammals	Construction	Reporting of MMMP measures	The form of monitoring will be dependent on project design, construction method and the mitigation measures required	The final design and scope of any monitoring will be agreed with the relevant stakeholders and included within the final MMMP submitted for approval.

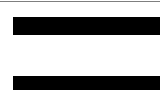
## 1.4.7 Offshore Ornithology

### 1.4.7.1 Conclusions of the Environmental Statement

52. The impacts that could potentially arise during the construction, operation and decommissioning of SEP and DEP have been discussed with Natural England, Royal Society for the Protection of Birds (RSPB) and the MMO as part of the Evidence Plan Process (EPP) (see **Chapter 11 Offshore Ornithology** of the ES) (document reference 6.1.11).
53. At the SEP and DEP project-alone level, during the construction phase and operation and maintenance phases no impacts have been assessed to be greater than **minor adverse** for any bird species.
54. During construction and operation phases, disturbance, displacement and barrier effects on Sandwich tern (operation only), red-throated diver (including within the offshore export cable corridor), gannet (operation only), razorbill and guillemot is assessed as **minor adverse** significance.
55. Collision risk with wind turbines from SEP and DEP is assessed as **minor adverse** significance for Black-headed gull, common tern, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, little gull, Sandwich tern, common gull and non-breeding waterbirds when considered for all biological seasons against the most appropriate population scale.
56. Potential plans and projects have been considered for how they might act cumulatively with SEP and DEP and a screening process carried out. The cumulative assessment identified that most impacts would be temporary, small scale and localised. Given the distances to other activities in the region (e.g. other offshore wind farms) and the highly localised nature of the impacts the assessment concluded that there is no pathway for interaction between most impacts cumulatively.
57. The risk to birds from cumulative collisions with wind turbines across all wind farms considered is assessed as no greater than **minor adverse** significance for all species except Sandwich tern and great black-backed gull which are assessed as **moderate adverse**. Therefore, it is proposed that any required monitoring should focus on the operational period when there is a pathway to the risk (collision with turbines) and, where possible, on Sandwich tern and great black-backed gull.

### 1.4.7.2 In-Principle Monitoring

58. It is the position of the Applicant that any ornithological monitoring proposal should be targeted to address impacts, evidence gaps or uncertainty of most relevance to SEP and DEP and the specific species. **Table 1-7** outlines the proposed in-principle monitoring.
59. Therefore, the Applicant considers that offshore ornithology monitoring for the SEP and DEP project should focus on the potential collision risk with respect to Sandwich tern.
60. It is also noted that the Applicant has submitted derogation proposals for kittiwake and Sandwich tern (see the **HRA Derogation: Provision of Evidence** (document reference 5.5) and will therefore implement compensatory measures of which monitoring will be a necessary part of the proposals.



61. The Applicant is supportive, in principle, of joint industry projects or alternative site based monitoring of existing seabird activity inside the area(s) within the Order Limits and would welcome collaboration opportunities from SNCBs, NGOs or other developers in strategic monitoring programmes. This would likely be managed outwith the IPMP.



*Table 1-7: In-Principle Monitoring Proposed – Offshore Ornithology*

Potential Effect	Receptors	Phase	Headline reasons for monitoring	Monitoring Proposal	Details
Collision risk	Offshore ornithology	Post-construction	<ul style="list-style-type: none"> <li>Increase certainty of collision risk modelling (CRM) parameters</li> </ul>	Review of existing monitoring at other offshore wind farm projects and development of appropriate additional survey / monitoring.	To be confirmed

## 1.4.8 Commercial Fisheries

### 1.4.8.1 Conclusions of the Environmental Statement

62. The impacts on commercial fisheries during the construction, operation and decommissioning phases of SEP and DEP found that there will be impacts of **negligible** to **minor adverse** significance on commercial fishing fleet receptors, and moderate adverse impacts (in the absence of further mitigation) on the UK potting fleet during construction, operation and decommissioning phases of SEP and DEP. However, the moderate adverse impacts on the UK potting fleet will be mitigated through justifiable disturbance payments to reduce the significance of residual impacts to **minor adverse**.

1.4.8.2 Cumulative impacts were assessed to be **minor adverse** to all mobile fleets and **moderate adverse** to UK potters driven by the inclusion of potential management measures within MPAs that could lead to restrictions to the UK potting fleet. The cumulative effect of the MPAs is unmitigable by the Applicant. Even if the cumulative contribution from SEP and DEP to this impact is *de minimis* the assessment of significance would remain the same as a result of the inclusion of the MPAs.

#### 1.1.1.1 In-Principle Monitoring

63. No monitoring in relation to commercial fisheries is considered necessary, other than the standard arrangements for fisheries liaison, which will be agreed in the Fisheries Liaison and Co-existence Plan (FLCP) prior to the start of construction. The FLCP will be produced in accordance with the **Outline FLCP** (document reference 9.8) submitted with the DCO application.

## 1.4.9 Shipping and Navigation

### 1.4.9.1 Conclusions of the Environmental Statement

64. The effects of SEP and DEP have been assessed in **Chapter 13 Shipping and Navigation** of the ES (document reference 6.1.13) with impacts ranging from broadly acceptable to tolerable. All impacts are assessed to be as low as reasonably possible (ALARP).

#### 1.4.9.2 In-Principle Monitoring

65. **Table 1-8** provides information on the vessel traffic monitoring requirements for shipping and navigation.

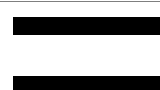




Table 1-8: In-Principle Monitoring Proposed – Shipping and Navigation

Potential Effect	Receptors	Phase	Headline reasons for monitoring	Monitoring Proposal	Details
Effects on the levels of marine traffic across the offshore development area	Marine traffic	Construction	Validate the predictions made in the Environmental Statement and Navigational Risk Assessment with respect to potential effects on the levels of shipping traffic.	Construction monitoring shall include vessel traffic monitoring by Automatic Identification System (AIS), including the provision of reports on the results of that monitoring periodically as requested by the Maritime Coastguard Agency (MCA).	During construction, vessel traffic monitoring using AIS will be conducted, with the detailed requirements for this being agreed with the MMO and MCA six months before commencement of construction.
		Post-construction		Vessel traffic monitoring in line with the Marine Traffic Monitoring Strategy by AIS, totalling a maximum of 28 days taking account of seasonal variations in traffic patterns over one year, following the commencement of commercial operation. A report will be submitted to the MMO and the MCA following the end of the monitoring and periodically, if required, as requested by the MCA.	Post-construction vessel traffic monitoring would be in line with the Marine Traffic Monitoring Strategy and would consist of AIS monitoring for a maximum of 28 days (but not consecutively) and will take account of seasonal variation of traffic patterns over a year. This will be done at a suitable time as agreed with the MMO and MCA following the commencement of commercial operation.
Effect on marine traffic routing and safety.	Marine Traffic	Construction	Ensure temporary aids to navigation are functional and fit for purpose	Aids to Navigation Management plan that remains functional throughout the lifetime of the Project with reporting to Trinity House.	Aids to Navigation and Aids to Navigation Management Plan to be agreed with Trinity House prior to commencement of construction.

Potential Effect	Receptors	Phase	Headline reasons for monitoring	Monitoring Proposal	Details
		Post - construction	Ensure aids to navigation are functional and fit for purpose		Aids to Navigation Management Plan for the life of the project to be agreed with Trinity House prior to commencement of construction.
Effect on marine traffic routing and safety.	Marine Traffic	Post - construction	To ensure charted depth remains in line with that agreed in consultation with the MCA and nautical charts remain up to date.	A swath bathymetric survey to IHO Order 1a of the installed cable corridor (post construction and decommissioning).	A swath bathymetric survey to IHO Order 1a of the installed cable corridor (post construction and decommissioning). Data is to be supplied to the MCA, UKHO and survey report to the MMO.
Effect on marine traffic routing and safety.	Marine Traffic	Post-Construction	To ensure charted depth remains in line with that agreed in consultation with the MCA and nautical charts remain up to date. To ensure that cables do not become exposed and present a snagging risk to fishing or anchoring vessels.	Periodic monitoring of cable burial / protection.	Periodic monitoring of cable burial / protection with a risk-based approach to the management (this work will be undertaken for engineering and asset integrity purposes, with the frequency determined by need).

## 1.4.10 Offshore Archaeology and Cultural Heritage

### 1.4.10.1 Conclusions of the Environmental Statement

66. The construction, operation and decommissioning phases of SEP and DEP will result in a range of potential effects upon the marine archaeological and cultural heritage environment. At the SEP and DEP project alone level, the effects that have been assessed are anticipated to be reduced to a **minor adverse** residual significance or are considered to be negligible on the basis of embedded mitigation and best practice, including further interpretation / assessment of geophysical and geotechnical data post consent. Furthermore, known archaeological receptors are not considered to be subject to significant cumulative impacts on the basis that they should be avoided due to appropriate mitigation.

### 1.4.10.2 In-Principle Monitoring

67. **Table 1-9** provides information on the monitoring requirements for offshore archaeology and cultural heritage. The principle mechanism for delivery of monitoring for offshore archaeology and cultural heritage is through agreement on the Written Scheme of Investigation (WSI) (Offshore) (in accordance with the **Outline WSI (Offshore)** (document reference 9.11)) and / or further activity specific method statements to be agreed with the MMO in consultation with Historic England.



**Table 1-9: In-Principle Monitoring Proposed – Offshore Archaeology and Cultural Heritage**

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
All direct and indirect effects on the archaeological resource	All Archaeology receptors	Pre-construction	Validate the predictions made where reasonable in the ES with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation.	<ul style="list-style-type: none"> <li>An <b>Outline WSI (offshore)</b> (document reference 9.11) has been compiled which makes provision for all archaeological mitigation that might be required in the light of pre-construction investigations, including field investigation, post-fieldwork activities, archiving and dissemination of results. The WSI includes provision to update the document as the project design is refined and as the results of further archaeological assessment become available. With the final agreed WSI acting as a ‘point-in-time’ document and submitted to the MMO four months in advance of the licensed activities.</li> <li>Full sea floor coverage swath-bathymetric surveys undertaken to International Hydrographic Organisation (IHO) Order 1A standard, geotechnical, magnetometer, geophysical and SSS of the area(s) within the Order limits in which it is proposed to carry out construction works, including a 500m buffer area around the site of each works. This should include the identification of sites of historic or archaeological interest (around the whole feature for A1 receptors and 100m around centre point for A3 receptors) and any unidentified anomalies to agreed dimensional criteria (A2 receptors), which may require the refinement, removal or introduction of archaeological exclusion zones and to confirm project specific micro-siting requirements (for A2 receptors).</li> </ul>	The Applicant has submitted an <b>Outline WSI (Offshore)</b> (document reference 9.11) with the DCO application. A WSI will be in place prior to licensed activities.
All direct and indirect effects on the archaeological resource					



Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
All direct and indirect effects on the archaeological resource	All Archaeology receptors	Construction	Validate the predictions made in the ES, where reasonable, with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation (Historic England requirement)	<ul style="list-style-type: none"> <li>Specific requirements relating to monitoring during post-construction (including a conservation programme for finds) as detailed in the WSI. Notably the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) shall be followed during all intrusive works.</li> </ul>	The WSI produced pre-construction will be a 'point-in-time' document, with the specific methodology for each subsequent package of archaeological works (i.e. construction or operation) to be taken forward through archaeological method statements produced under the umbrella of the WSI and agreed with the archaeological curator. Survey and work package specific archaeological objectives will be established on a case-by-case basis

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