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Morecambe Offshore Windfarm: Generation Assets

Procedural Deadline A

Volume 8

The Applicant's Response to the Rule 9 Letter for Morecambe Offshore Windfarm Generation Assets

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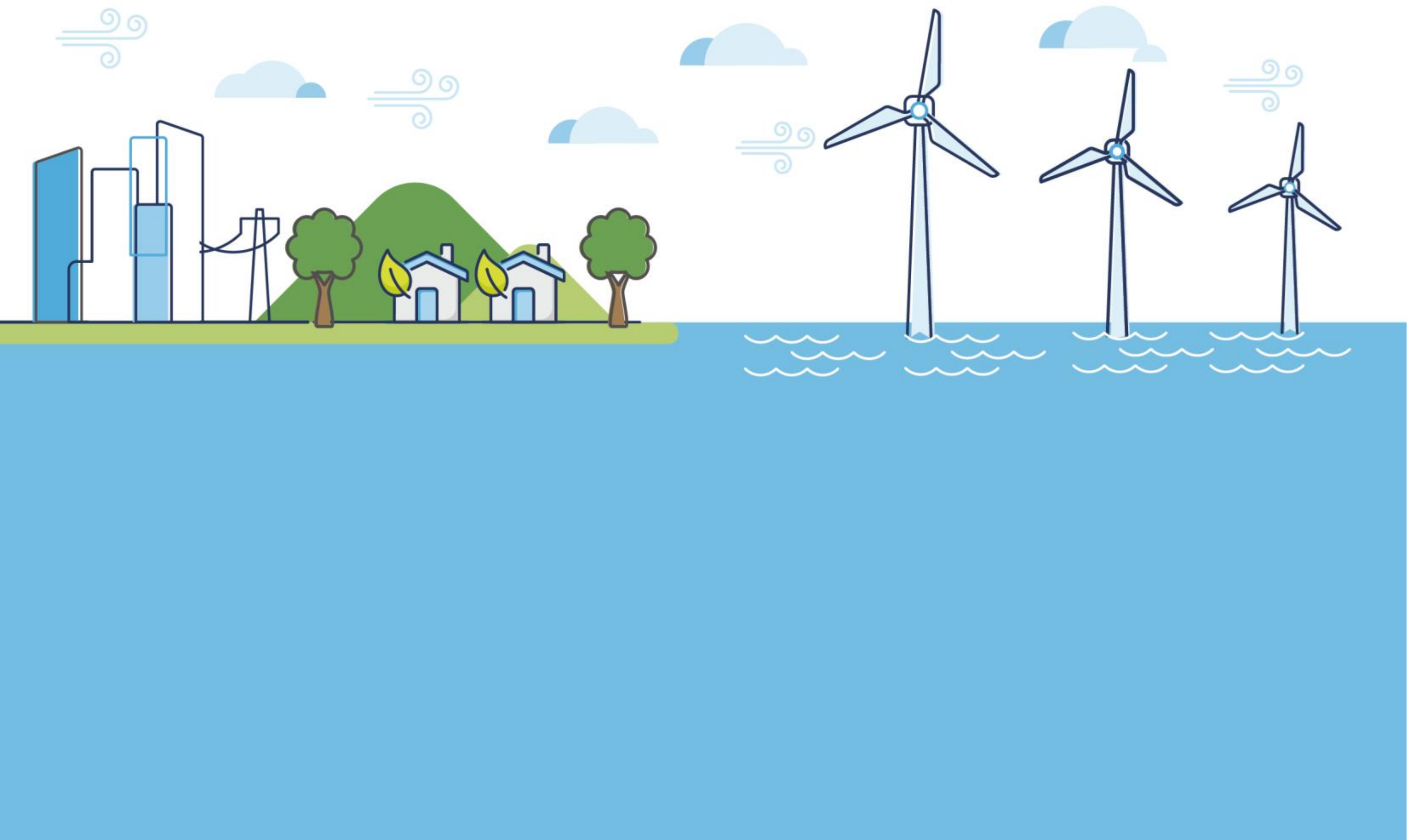

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Glossary of Acronyms

BDMPS	Biologically Defined Minimum Population Scales
CEA	Cumulative Effects Assessment
CGNS	Celtic and Greater North Seas
CIS	Celtic and Irish Sea
CRM	Collision Risk Model
DCO	Development Consent Order
DRC	Dose Response Curve
EDR	Effective Deterrence Range
EIA	Environmental Impact Assessment
EOD	Explosive Ordnance Disposal
ES	Environmental Statement
ExA	Examining Authority
FOCI	Feature of Conservation Interest
HF	High Frequency
IoM	Isle of Man
iPCoD	Interim Population Consequences of Disturbance Model
IS	Irish Sea
LCL	Lower Confidence Limit
LMB	Luftmine B
MarESA	Marine Evidence Based Sensitivity Assessment
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MU	Management Unit
MWT	Manx Wildlife Trust
NE	Natural England
NEQ	Net Explosive Quantity
NRW	Natural Resources Wales
NW	North West
OBS	Offshore Booster Station
OSP	Offshore Substation Platform
OWF	Offshore Windfarm
PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift
RR	Relevant Representation

SAC	Special Area of Conservation
sCRM	Stochastic Collision Risk Model
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
TNT	Trinitrotoluene
TTS	Temporary Threshold Shift
UCL	Upper Confidence Limit
UK	United Kingdom
UXO	Unexploded Ordnance
VHF	Very High Frequency
WTG	Wind turbine generator
ZoI	Zone of Influence

Glossary of Unit Terms

kg	Kilogram
km	Kilometre
km^2	Square kilometre
m	Metre
nm	Nautical miles

Glossary of Terminology

Applicant	Morecambe Offshore Windfarm Ltd
Biologically defined minimum population scale (BDMPS)	The estimated population size of a species within a defined biogeographic area during a biologically relevant season, as defined by Furness (2015). For many seabird species present in United Kingdom (UK) waters there are two defined biogeographic areas; UK Western waters and UK North Sea and Channel. However, some species have different defined BDMPS areas, dependent on the distribution and movements of the species population through the year. Furness (2015) defines the BDMPS for non-breeding seasons; the breeding season BDMPS is defined as the breeding population within foraging range from the project, plus non-breeders and immatures.
Cetaceans	Commonly known as whales, dolphins or porpoise.
Generation Assets (the Project)	Generation Assets associated with the Morecambe Offshore Windfarm. This is infrastructure in connection with electricity production, namely the fixed foundation wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s).
Inter-array cables	Cables which link the WTGs to each other and the OSP(s).
Necropsy	An autopsy performed on an animal.
Offshore substation platform(s) (OSP(s))	A fixed structure located within the windfarm site, containing electrical equipment to aggregate the power from the WTGs and convert it into a more suitable form for export to shore.
Permanent threshold shift (PTS)	A permanent total or partial loss of hearing sensitivity caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Platform link cable	An electrical cable which links one or more offshore substation platform.
Safety zone	An area around a structure or vessel which should be avoided, as set out in Section 95 of the Energy Act 2004 and the Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.
Stochastic Collision Risk Model (sCRM)	A programme used to assess the collision risk (estimated mortality) of seabirds to operational turbines of offshore windfarms. A sCRM is used to account for uncertainty around input variables.
Wind turbine generator (WTG)	A fixed structure located within the windfarm site that converts the kinetic energy of wind into electrical energy.
Windfarm site	The area within which the WTGs, inter-array cables, OSP(s) and platform link cables would be present.
Zone of Influence (ZoI)	The maximum anticipated spatial extent of a given potential impact.

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1 Introduction

1. This document presents a response to the further information requests and written comments on the Morecambe Offshore Windfarm Generation Assets ("the Project") Development Consent Order (DCO) Application ("the Application") raised by the Examining Authority (ExA) in a Rule 9 letter issued to Morecambe Offshore Windfarm Ltd ("the Applicant") on the 4 September 2024 (PD-006). This does not cover all information requests and written comments raised by the ExA, as some have been agreed to follow at Deadline 1 (this was outlined in The Applicant's Initial Response to the ExA's Rule 9 Letter (AS-012), issued by the Applicant to the ExA on the 17 September 2024) and confirmed by the ExA in a Rule 6 Letter (issued on the 24 September 2024).

2. This response document presents the following information:

 - **Section 2**: Sets out how the Applicant has addressed each matter raised by the ExA in the Rule 9 letter
 - **Section 3**: Sets out how the Applicant has addressed clarifications and potential errata noted by the ExA in Annex A of the Rule 9 letter
 - **Sections 4 - 6**: Provides further details in support of the Applicant's response to matters outlined in **Section 2**

2 Matters for the Applicant

3. A number of matters were raised by the ExA in relation to ecological impact assessments (including Marine Mammals and Offshore Ornithology). The Applicant has responded to each matter in **Table 2.1** below.

Table 2.1 Response to the ExA's Rule 9 letter

ID	ExA comment	Applicant's Response
Offshore Ornithology		
R9-01	A full quantitative assessment of cumulative effects for ornithology following the method previously supplied by NE to the Applicant, i.e. where no quantitative data were available, using nearby windfarms with published estimates of mortality as proxies, scaled according to windfarm size and turbine specifications. We consider that this information is necessary to inform the consideration of the worst-case scenario for ornithology. The Applicant should ensure co-ordination with other Irish Sea Offshore Windfarm projects regarding the datasets. Should datasets from other projects have been derived through a different method, then these differences should be highlighted and considered (NE ref B1, B14, B16, B18-21, B24).	This information will be provided by the Applicant at Deadline 1. This approach was put forward in the Applicant's Initial Response to the Planning Inspectorate's Rule 9 Letter (AS-012), issued on the 17 September 2024 and was approved by the ExA, as per the Rule 6 letter (PD-007), issued on 23 September 2024.
R9-02	Updated assessment for lesser black backed gull at Morecambe Bay and Duddon Estuary Special Protection Area (SPA) and Ribble and Alt Estuary SPA that considers current population trajectories, noting updated figures being available for 2023 and refined apportioning of impacts (NE ref B3, B26, B27, B29).	This information will be provided by the Applicant at Deadline 1. This approach was put forward in the Applicant's Initial Response to the Planning Inspectorate's Rule 9 Letter (AS-012), issued on the 17 September 2024 and approved by the ExA, as per the Rule 6 letter (PD-007), issued on 23 September 2024.
R9-03	Updated assessment using average mortality rates recommended in the NE and Natural Resources Wales (NRW) interim advice note and as set out in Annex A of Annex B1 (NE ref B9).	This information will be provided by the Applicant at Deadline 1. This approach was put forward in the Applicant's Initial Response to the Planning Inspectorate's Rule 9 Letter (AS-012), issued on the 17 September 2024 and was approved by the ExA, as per the Rule 6 letter (PD-007), issued on 23 September 2024.
R9-04	Review and update of the months assigned to each season for gannet where necessary, noting the inconsistencies identified by NE (NE ref B10).	A review and update of the months assigned to each season for gannet has been provided in **Section 4.1**. It is noted that the updates have not affected the assessment conclusions for gannet

ID	ExA comment	Applicant's Response
		presented in Environmental Statement (ES) Chapter 12 Offshore Ornithology (APP-049).
R9-05	Check and confirmation of the total annual lower and upper confidence interval values in the Collision Risk Modelling (CRM) results table (NE ref B10).	The Applicant has reviewed the values in Table 12.46 of ES Chapter 12 Offshore Ornithology (APP-049) and confirms that they are correct. The apparent error occurs because the Stochastic Collision Risk Model (sCRM) tool calculates the monthly 95% Lower Confidence Limit (LCL) and Upper Confidence Limit (UCL) values separately to the annual values. The annual values presented in Table 12.46 (APP-049) are the outputs from the sCRM model but are not the same as if each of the monthly values had been summed (which it is assumed to be the reason that Natural England (NE) considers there to be an error). For example, for herring gull, the sum of the monthly UCL values would be 17.41, but the sCRM output for the annual UCL is 9.21, which is the value presented in the table. The Applicant provided NE on the 15 August 2024 with input and output files from the sCRM, so that these values can be checked if required.
R9-06	Provision of log files for the little gull stochastic CRM run including full inputs and outputs and details of any methodological updates (NE ref B11).	The Applicant provided NE on 15 August 2024 with all input and output files for little gull from the sCRM, so that these values can be checked, if required. As noted by NE in its relevant representations (RR) (RR-061, NE Ref. B11), the flight height data for little gull embedded in the Collision Risk Model (CRM) modelling tool appears to be erroneous and provides unexpected values when the model is run. The Applicant therefore manually inputted the 'maximum probability' values from Johnston *et al*. (2014) into the model, and the collision estimates presented are those derived using these values. The Applicant also verified these outputs using the Band CRM (2012) spreadsheet and can confirm the values were broadly similar.

ID	ExA comment	Applicant's Response
R9-07	Check and confirm the non-breeding collisions for great black-backed gull along with confirmation as to whether this changes any conclusions made (NE ref B12).	The non-breeding season mortality total in Table 12.47 of ES Chapter 12 Offshore Ornithology (APP-049) had erroneously omitted the predicted December mortality (0.65), and so the total mortality for this period should be 1.10, rather than 0.45 birds. It is noted that the total annual value presented in Table 12.47 is correct (1.75 birds). This is the value used in the assessment, and therefore this error does not affect assessment conclusions.
Marine mammals and underwater noise modelling		
R9-08	Updated presentation of the Interim Population Consequences of Disturbance Model (iPCoD) modelling results and present impact significance for all approaches used to assess disturbance impacts (NE Ref D4).	The different approaches to assessing disturbance in ES Chapter 11 Marine Mammals (APP-048) included disturbance based on known disturbance ranges for marine mammal and dose-response curve (DRC) assessments, which have been used to determine the worst-case possible disturbance effect from piling. There is currently no standard agreed method in quantifying disturbance. The worst-case or highest numbers from the different approaches have been applied to the population (Interim Population Consequences of Disturbance Model (iPCoD)) modelling which is the basis of the assessment set out in ES Chapter 11 Marine Mammals (APP-048). The iPCoD model is a good tool to assess the potential impacts of disturbance as it considers the consequences of disturbance or injury that might result from the construction or operation of OWFs. **Section 5.1** presents updated supporting text for the approach taken by the Applicant in the assessment. The Applicant also provides, for information, an extended version of Table 11.45 of ES Chapter 11 Marine Mammal (APP-048) in order to supply the requested impact significances for all approaches.
R9-09	Confirmation of the maximum piling duration based on a lower strike rate in the underwater noise assessment and an updated underwater noise taking account any change in the findings of significance (NE Ref D11).	The Applicant has considered two strike rate scenarios. The maximum strike rate scenario was used for the assessments in the RIAA (APP-027) and the ES Chapter 11 Marine Mammal (APP-048) as this resulted in the worst-case SEL_{cum} Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) impact ranges for each

ID	ExA comment	Applicant's Response
		piling event. Whilst the lower strike rate scenario lasts longer overall, more animals are impacted per pile, and therefore overall, in the higher strike rate scenario. This is due to the greater number of strikes at higher hammer energy leading to a greater SEL_{cum}. This is due to the greater number of strikes at higher hammer energy leading to a greater SEL_{cum}. This worst-case, in terms of number of animals affected, has informed the assessment. To clarify, the higher strike rate scenario, with the worst-case impact ranges that has informed the assessments in the ES (Chapter 11 Marine Mammals (APP-048)) and RIAA (APP-027), can be found in Appendix B of Appendix 11.1 Underwater Noise Assessment (APP-065). The lower strike rate found in Tables 3.2 and 3.3 of Appendix 11.1 (APP-065) does not result in worst-case numbers for SEL_{cum} impacts and has not been used for SEL_{cum} assessments in the ES (Chapter 11 Marine Mammals (APP-048)) or the RIAA (APP-027) for this reason. It is the duration of piling (in terms of number of hammer strikes), combined with the sound levels produced by each strike that drives the assessments of PTS and TTS in terms of SEL_{cum}. This is why the higher strike rate scenario affects more animals, despite completing a pile in a shorter time period. For population modelling, the duration (in hours) of a piling event is not a parameter that affects the outputs. Rather, it is the total number of piling days and the number of animals disturbed on each piling day that affects the assessment. The population modelling was conducted based on the maximum number of piling days (assuming 1 pile per day) combined with the greatest number of animals receiving disturbance/PTS from a single pile per day. In this way, the iPCoD modelling considers the greatest piling duration, in terms of days of piling, combined with the worst-case effects of each piling event.

ID	ExA comment	Applicant's Response
		The Applicant has therefore taken into consideration the worst-case piling scenario with regard to duration and strike rate in the overall assessment.
R9-10	Modelling of a nominal 750kg Unexploded Ordnance (UXO) charge weight for the assessment of underwater UXO noise impacts, unless clear evidence is available to demonstrate that a lesser charge weight represents the actual worst-case (NE Ref D12).	The Applicant notes that desk-based information on the potential Unexploded Ordnance (UXO) likely to be in the area was used to inform the charge weight modelled. A justification for the charge weight used is provided in **Section 6.1**. Regardless, the Applicant will apply for a marine licence post-consent for any required UXO clearance activities and will review the maximum UXO charge weight plus donor charge when applying for this licence. The marine licence application will take into account the latest information on potential size of UXO to be cleared (if any) once information on the composition of any confirmed UXO is available.
R9-11	Commentary on whether harbour seal populations are present at the Isle of Man (NE ref D2, D13).	The Applicant provided information regarding the harbour seal population in ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066), stating that harbour seal visits to the Isle of Man (IoM) are rare. Small numbers haul out along the coast, however this is not considered to be a resident population. Email communication from the Manx Wildlife Trust (MWT) (16 August 2023) highlighted that knowledge on harbour seal on the IoM is limited in comparison to what is known about grey seal. None of the recent surveys (MWT, 2018; 2021) conducted by the MWT included harbour seals during the annual surveys, likely because the few that are present are considered transients. As a result, their numbers are unknown. The Applicant has reviewed other DCO applications in the wider area. These have also stated that harbour seals at the IoM have an unknown population count.
R9-12	Provision of an assessment for grey seal against the North West Marine Unit (NW MU) grey seal population alone as a reference population (NE ref D2, D15).	The Applicant has used a conservative approach to the assessment. The Applicant provided an overview of the reference population in ETG 5 meeting (11th October 2023), where the Isle of Man population was presented to be part of the wider reference

ID	ExA comment	Applicant's Response
		population. In ETG 6 meeting (31st January 2024), the Applicant presented the combined grey seal reference population to include the Isle of Man and the North West (NW) England Management Unit (MU). No questions or objections arose from this ETG. Based on satellite tracking maps (Carter *et al.* 2020; 2022), connectivity with grey seals from the Isle of Man and the NW MU was observed. The annual Special Committee on Seals (SCOS) reports have not included the Isle of Man population in the total population for the Britain & Ireland or apportioned the Isle of Man counts to any of the relevant MUs. Consequently, for all the assessments in the ES, the two reference populations were added to form the 'combined population' (1,593 grey seal), which has been considered to be a more conservative approach to assessments also provided against the 'wider reference population' (13,283 grey seal), which included all other MUs. A discussion was held on this point to justify this position with NE on the 12 September 2024. The Applicant does not consider further information is required.
R9-13	A review and update of collision risk rate calculations where relevant (NE Ref D26).	In response to NE's RR (NE Ref. D26), the data used to calculate the collision risk rate has been updated in **Section 5.2**. Discrepancies identified in Table 11.55 of ES Chapter 11 Marine Mammals (APP-048) were due to issues in the pivot table of the original datasheet. These discrepancies have not affected the collision risk rate, and therefore, the assessment outcomes as set out in ES Chapter 11 Marine Mammals (APP-048) remain unchanged. The risk rate was estimated by dividing the sum of the number of deaths due to physical trauma of unknown cause plus the deaths due to physical trauma from vessels with the number of necropsied animals with known causes of death.

ID	ExA comment	Applicant's Response
R9-14	Presentation of impact significance for each approach used to determine the marine mammal disturbance range, using the combination of sensitivity and magnitude (percentage of reference population within the disturbance range) and present the cumulative impact significance for cetaceans using the worst-case numbers disturbed i.e. not only the iPCoD modelling results (NE Ref D28).	The different approaches to assessing disturbance in ES Chapter 11 Marine Mammals (APP-048) included disturbance based on known disturbance ranges for marine mammal and DRC assessments, which have been used to determine the worst-case possible disturbance effect from piling. There is currently no standard agreed method in quantifying disturbance. The worst-case or highest numbers from the different approaches have been applied to the population iPCoD modelling which is the basis of the assessment set out in ES Chapter 11 Marine Mammals (APP-048). The iPCoD model is a good tool to assess the potential impacts of disturbance as it considers the consequences of disturbance or injury that might result from the construction or operation of OWFs. **Section 5.1** presents updated supporting text for the approach taken by the Applicant in the assessment. The Applicant provides, for information, an extended version of Table 11.108 in Section 11.7.3.2 of ES Chapter 11 Marine Mammals (APP-048) in order to provide the requested impact significances for all approaches.
R9-15	Clarification of the values in the median impacted as percentage of unimpacted column in Table 11.39. These do not currently correspond to the difference between the un-impacted population mean and the impacted population mean. The difference between the two means in each table that presents iPCoD modelling results, including in the cumulative effects assessment should be presented or the difference between these figures explained. Information should be provided to support the value considered to be most appropriate (NE Ref D32).	The iPCoD modelling results presented in ES Chapter 11 Marine Mammals (APP-048) and the RIAA (APP-027) considered the median of the ratio of impacted:unimpacted population sizes for the relevant marine mammal populations as the key metric to determine effect significance using the iPCoD method. This is due to the fact that the median of the ratio of impacted:unimpacted population sizes is considered more robust to the effects of extreme outliers than the mean value, particularly with lower sample sizes. In addition, this metric is considered least sensitive to mis-specification of demographic parameters, therefore enabling more robust assessment of offshore renewable effects (Jital *et al*., 2017; Sinclair *et al*., 2019). This rationale, developed by the authors of the iPCoD code, has resulted in this metric being used and accepted for other recent offshore wind farm (OWF) Environmental Impact

ID	ExA comment	Applicant's Response
		Assessments (EIA) as the primary metric for assessing significance using iPCoD. In line with other recent OWF projects, mean values have also been presented for population sizes as these match with the graphical outputs produced by the iPCoD code. Further metrics, explanation and clarification is provided in **Section 5.3**.
Benthic Ecology, Physical Processes and Marine Sediment and Water Quality		
R9-16	Confirmation of the worst-case assessment for benthic ecology, physical processes, marine sediment and water quality impacts due to UXO (NE Ref E11, F9).	A clarification of the worst-case assessment for benthic ecology, physical processes, marine sediment and water quality impacts due to UXO is provided in **Section 6.2**.

3 Clarifications

4. Clarifications and potential errata were noted by the ExA in Annex A of the Rule 9 letter (PD-006). These are detailed and addressed in **Table 3.1** and presented in The Applicant's Errata Sheet (Document Reference 8.4), where appropriate. The Errata Sheet is being maintained across the DCO Application and submitted alongside this document at Procedural Deadline A.

Table 3.1 The Applicant's response to the ExA's Annex A clarifications

ID	Exam Library Reference	Document	Comments	Applicant's Response
R9-17	(APP-042) and (APP-044)	ES Chapter 5, para 5.94 and ES Chapter 7, Table 7.1	ES para 5.94 refers to 10% sand wave clearance but Chapter 7, Table 7.1 confirms that there are no sand waves within the site. Clarify whether the term sand wave clearance is used in the generic sense of clearance of seabed sand features.	The Applicant can confirm that the term sand wave clearance has been used in the generic sense of clearance of seabed sand features. While geophysical surveys to date do not indicate a high prevalence of sand waves, this allows for the eventuality that sand waves are detected in pre-construction surveys and the generic clearance of seabed sand features.
R9-18	(APP-042) (APP-044), (APP-045) and (APP-046)	ES Chapter 5, para 5.148 ES Chapter 7 Table 7.2, ES Chapter 8, Table 8.2 and ES Chapter 9, Table 9.2, p29	Table 9.2 references a 25m wide cable installation corridor. Other chapters, for example ES Chapter 5 (para 5.148), ES Chapter 7 (Table 7.2, p43) and ES Chapter 8 (Table 8.2), refer to 10m wide clearance widths. It is unclear whether installation corridor and clearance widths are intended to be synonymous but if so, clarify which width is correct and ensure that any dependent assessments are updated where relevant.	As noted above, the term sand wave clearance is used in the generic sense of clearance of seabed sand features. This maximum width would be 10m wide. As detailed in Table 5.18 of ES Chapter 5 Project Description (APP-042), the maximum width of disturbance (including spoil pushed aside by trenching, and pre-lay activities such as jack up set down and boulder clearance) for inter-array and platform link cables is 25m. The 25m width is assessed as the maximum width of disturbance of the seabed in ES Chapter 9 Benthic Ecology (APP-046), whilst the maximum 10m width of disturbance for sand wave clearance is used to calculate the volume of sediment arisings from sand wave/seabed sand feature clearance, as

ID	Exam Library Reference	Document	Comments	Applicant's Response
				assessed in ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044) and ES Chapter 8 Marine Sediment and Water Quality (APP-045). The 10m width for sand wave/seabed sand feature clearance is included within the wider 25m disturbance width (which encompasses additional construction activities such as boulder clearance and jack-up set down) and is assessed within ES Chapter 9 Benthic Ecology (APP-046) as habitat disturbance for benthic features.
R9-19	(APP-047)	ES Chapter 10, Table 10.8	Errata in Table 10.8 low criteria, confirm whether text should read temporary* 'change'.	The Applicant confirms that in Table 10.8, within the low criteria row, text should read 'temporary* change'. This is also noted in the Applicant's Errata Sheet (Document Reference 8.4), which is being submitted alongside this document at Procedural Deadline A.
R9-20	(APP-047)	ES Chapter 10, para 10.73	Para 10.73 states 'for fish and shellfish' but Table 10.13 only shows spawning/ nursery ground information for fish. Is this correct?	The Coull *et al*., (1998) and Ellis *et al*., (2012) references do consider the extent of spawning and nursery grounds of *Nephrops norvegicus*, so in this sense, the references considered in Table 10.13 do have some consideration of shellfish, however the Nephrops grounds mapped in these references do not overlap with the windfarm site and are therefore not presented.

ID	Exam Library Reference	Document	Comments	Applicant's Response
				This means that despite consideration of spawning and nursery grounds of both the fish and shellfish species included in Coull *et al*., (1998) and Ellis *et al*., (2012), only fish species are presented in Table 10.13 as no spawning or nursery grounds for shellfish overlap with the windfarm site.
R9-21	(APP-066)	Appendix 11.2 Figures 6.1 and 6.2	Figures have a grey line that relates to certain population extents but the relevant population is not explained in the key.	The grey lines in Figure 6.1 and 6.2 of Appendix 11.2 Marine Mammal Information and Survey Data (APP-066) represent the 12nm waters around England, Wales and the IoM. These figures have been updated to include this information in the key and are included within Appendix 11.2 Marine Mammal Information and Survey Data_Rev 02 which is being submitted alongside this document at Procedural Deadline A (see 1.3 Guide to the Application_Rev 03).

** Temporary time scale indicated where appropriate for each impact relevant to each receptor*

4 Update to the Offshore Ornithology Assessment

4.1 Response to ID R9-04 (NE Ref. B10)

5. This section provides an update to the assessment of effects on gannet presented in ES Chapter 12 Offshore Ornithology (APP-049), which has been undertaken at the request of the ExA (ID R9-04), who requested a '*review and update of the months assigned to each season for gannet where necessary, noting the inconsistencies identified by NE (NE Ref B10)*'.

6. Ref. B10 of NE's RRs to the Applicant, stated:

'*There is some inconsistency in the months assigned to each season for gannet. Where a month overlaps with both a migration season and the breeding season, Natural England advise that it should be considered as the breeding season. The Applicant has shaded the seasons correctly in Table 12.16, but comparison of the seasonal mean peak abundances in Table 12.21 with the array +2km buffer abundances in Table 5.76 in the Technical Report show an inconsistency, as the mean peak abundances reported are higher than any abundance values detected in the relevant months for those seasons.*

Assigning abundances to the correct NE advised seasons would mean that no gannets were detected in the wind farm array + 2km buffer in the Spring migration period of Dec-Feb, and far fewer gannets were detected in the Autumn migration period of Oct-Nov.

We note that the correct NE- advised months have been used for assigning collision impacts to seasons.'

4.1.1 Approach

7. The Applicant has reviewed the gannet mean peak seasonal values used for the displacement assessment in line with NE's advice, using the following periods:

- Breeding season – March to September
- Autumn migration period – October to November
- Spring migration period – December to February

8. The updated seasonal totals, based on abundance estimates presented in Table 5.76 of Appendix 12.1 (Offshore Ornithology Technical Report (APP-070)) have been inputted to revised displacement matrices, using the same approach as presented in ES Chapter 12 Offshore Ornithology (APP-049) and accompanying Offshore Ornithology Technical Report (APP-070). These have

been presented for both mean and lower and upper 95% confidence limits (LCL and UCL). The displacement matrices present displacement rates between 10% and 100%, and mortality rates of displaced birds of between 1% and 100%, in accordance with Statutory Nature Conservation Bodies (SNCB) guidance. A range of rates between 60% and 80% displacement and 1% mortality have been highlighted to represent the most likely displacement levels and mortality scenarios.

9. In its RR, NE also advised that it recommended updated mean mortality rates should be used to estimate changes in background mortality. The updated rate advised by NE was therefore used to estimate changes in background mortality, based on the relevant regional population for each season.

10. In accordance with NE comments, the correct seasonal values were used in ES Chapter 12 Offshore Ornithology (APP-049) to estimate gannet collision mortality. However, as gannet are considered vulnerable to both displacement and collision effects, an updated estimate of the combined displacement and collision mortality has also been presented. Therefore, both collision and the summed collision and displacement have been included in this update note, to account for both the updated displacement and background mortality values advised by NE.

4.1.2 Results

4.1.2.1 Update to gannet operation and maintenance phase displacement and barrier effects assessment

11. The seasonal mean peak estimates for the spring and autumn periods were updated to reflect NE's advice, as shown in **Table 4.1**. Breeding season estimates were unchanged from those presented in ES Chapter 12 Offshore Ornithology (APP-049); this is because the estimates are based on peak counts, and although a longer breeding period has been considered, the peak counts during that period are the same. The background mortality rate was also updated to reflect the change to average annual mortality of 0.1866 (see **Table 4.2**), following the advice given by NE (NE Ref. B9).

12. **Table 4.3** to **Table 4.6** present the updated displacement matrices for the autumn and spring migration periods, and the associated percentage change to background mortality matrices, replacing Table 3.42 to Table 3.45 in Appendix 12.1 Offshore Ornithology Technical Report (APP-070). As above, there is no change to the predicted breeding season mortality, but any change in the assessment arising from change in background mortality has been presented in **Paragraph 19**. **Table 4.7** presents the updated displacement matrices for year-round effects, replacing Table 12.26 in ES Chapter 12 Offshore Ornithology (APP-049).

Table 4.1 Changes in seasonal mean peaks used for the gannet displacement assessment

Species / season	ES calculated mean peak (Chapter 12 Offshore Ornithology (APP-049))	Updated mean peak
Gannet – autumn migration period	124 (September to November)	**14 (October to November)**
Gannet – spring migration period	8 (December to March)	**0 (December to February)**

Table 4.2 Changes in gannet mortality rate as recommended by NE

Species	ES average mortality rate (Chapter 12 Offshore Ornithology (APP-049))	Updated NE advised mortality rate
Gannet	0.188	**0.1866**

Autumn migration period

13. The estimated number of gannets subject to operational disturbance/ displacement during the autumn migration period season is 14 individuals, reduced from 124 in the ES (Paragraph 12.192 in Chapter 12 Offshore Ornithology (APP-049)). Based on displacement rates of 60-80% and a precautionary mortality rate of 1%, the number of individuals which could potentially suffer mortality due to displacement has now been estimated as zero individuals (see **grey** highlighted cells in **Table 4.3**), **reduced** from one bird in the EIA (Paragraph 12.192 in ES Chapter 12 Offshore Ornithology (APP-049)).

14. The Biologically Defined Minimum Population Scales (BDMPS) for gannet in autumn is 545,954 (Furness, 2015). Using the updated average baseline mortality rate for gannet of 0.1866, the number of individuals subject to mortality in the autumn migration period would be 101,875 (545,954 x 0.1866), this is slightly reduced from the value used in the EIA (102,639; Para 12.193 in ES Chapter 12 Offshore Ornithology (APP-049)). Since zero individuals are predicted to suffer from displacement/disturbance related mortality, the assessment conclusion is now **no impact**. This is **reduced** from minor adverse in the EIA (Paragraph 12.193 in ES Chapter 12 Offshore Ornithology (APP-049)).

15. The change in background mortality across the confidence interval (LCL-UCL) is **unchanged** from the EIA within the highlighted cells (see highlighted cells in **Table 4.4**; and in Table 3.43 in ES Appendix 12.1 Offshore Ornithology Technical Report (APP-070) for comparison).

Spring migration period

16. The estimated number of gannets subject to operational disturbance/ displacement during the spring migration period is now zero individuals, this is reduced from eight in the EIA (Paragraph 12.194 in ES Chapter 12 Offshore Ornithology (APP-049)). Based on displacement rates of 60-80% and a precautionary mortality rate of 1%, the number of individuals which could potentially suffer mortality due to displacement has been estimated as zero individuals (see highlighted cells in **Table 4.5**), this is **unchanged** from the EIA (Paragraph 12.194 in ES Chapter 12 Offshore Ornithology (APP-049)).

17. The BDMPS for gannet in spring is 661,888 (Furness, 2015). Using the updated average baseline mortality rate for gannet of 0.1866, the number of individuals subject to mortality in the spring migration period would be 123,508 (661,888 x 0.1866), this is slightly reduced from the value used in the EIA (124,435; Paragraph 12.195 in ES Chapter 12 Offshore Ornithology (APP-049)). Since zero individuals are predicted to suffer from displacement/ disturbance related mortality, the assessment conclusion is **no change** in EIA terms, and is **unchanged** from the EIA (Paragraph 12.195 in ES Chapter 12 Offshore Ornithology (APP-049)).

18. The change in background mortality at the LCL/UCL is **unchanged** from the EIA within the highlighted cells (see highlighted cells in **Table 4.6**; and Table 3.45 in ES Appendix 12.1 Offshore Ornithology Technical Report (APP-070) for comparison).

Breeding season

19. As set out above, there would be no change to the mean peak population used for the breeding season assessment (541 individuals), and therefore the predicted mortality during the breeding season would be unchanged from that presented in Paragraphs 12.188-12.191 of ES Chapter 12 Offshore Ornithology (APP-049); i.e. 3-4 individuals. Applying the updated background mortality rate (0.1866) to the relevant regional BDMPS (522,888) would result in a background mortality of 97,571 individuals. A maximum increase in mortality of four individuals would increase background mortality by <0.01%; this is **unchanged** from the EIA (Paragraph 12.191 in ES Chapter 12 Offshore Ornithology (APP-049))

Year-round

20. The estimated number of gannets subject to operational disturbance/ displacement year-round would be 555 individuals – summing the breeding season (541; as presented in ES Chapter 12 Offshore Ornithology (APP-049)) and the above seasons – this is reduced from 673 in the EIA (Paragraph 12.196 in ES Chapter 12 Offshore Ornithology (APP-049)). Of these, based on displacement rates of 60-80% and a precautionary mortality rate of 1%, the

mean number of individuals which could potentially suffer mortality due to displacement has been estimated as three to four individuals (**Table 4.7**). This is **reduced** from four to five in the EIA (Paragraph 12.196 in ES Chapter 12 Offshore Ornithology (APP-049)).

21. Using the updated average baseline mortality rate for gannet of 0.1866, the number of individuals subject to mortality from the largest BDMPS population (Furness, 2015) throughout the year (spring migration) would be 123,508 (661,888 x 0.1866) which is slightly reduced from that presented in the EIA (124,435; Paragraph 12.197 in ES Chapter 12 Offshore Ornithology (APP-049)). The addition of a maximum of four individuals would increase mean mortality by <0.01%. This is **unchanged** from the EIA (Paragraph 12.197 in ES Chapter 12 Offshore Ornithology (APP-049)). This leaves the conclusion of the assessment of displacement on gannets as **unchanged** from the EIA, which is **minor adverse** significance (Paragraph 12.197 in ES Chapter 12 Offshore Ornithology (APP-049)).

*Table 4.3 Mean, LCL and UCL displacement matrices for **gannet** from Morecambe OWF (operation and maintenance phase) in the **autumn migration period** season. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	0	0	0	1	1	1
	20%	0	0	0	0	0	0	1	1	1	2	3
	30%	0	0	0	0	0	0	1	1	2	3	4
	40%	0	0	0	0	0	1	1	2	3	4	6
	50%	0	0	0	0	0	1	1	2	4	6	7
	60%	0	0	0	0	0	1	2	3	4	7	8
	70%	0	0	0	0	0	1	2	3	5	8	10
	80%	0	0	0	0	1	1	2	3	6	9	11
	90%	0	0	0	1	1	1	3	4	6	10	13
	100%	0	0	0	1	1	1	3	4	7	11	14

LCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0

UCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	0	1	1	2	3	4
	20%	0	0	0	0	0	1	2	2	4	6	8
	30%	0	0	0	0	1	1	2	4	6	10	12
	40%	0	0	0	1	1	2	3	5	8	13	16
	50%	0	0	1	1	1	2	4	6	10	16	20
	60%	0	0	1	1	1	2	5	7	12	19	24
	70%	0	1	1	1	1	3	6	8	14	22	28
	80%	0	1	1	1	2	3	6	10	16	26	32
	90%	0	1	1	1	2	4	7	11	18	29	36
	100%	2	4	6	8	9	19	38	57	94	151	189

*Table 4.4 Mean, LCL and UCL displacement matrices showing change in mortality rate for **gannet** due to displacement from Morecambe OWF (operation and maintenance phase) in the **autumn migration period** season. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

LCL		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

UCL		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%

*Table 4.5 Mean, LCL and UCL displacement matrices for **gannet** from Morecambe OWF (operation and maintenance phase) in the **spring migration period** season. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0

LCL	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0	0	0	0	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0	0	0	0	0
100%	0	0	0	0	0	0	0	0	0	0	0

UCL	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0	0	0	0	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0	0	0	0	0
100%	0	0	0	0	0	0	0	0	0	0	0

*Table 4.6 Mean, LCL and UCL displacement matrices showing change in mortality rate for **gannet** due to displacement from Morecambe OWF (operation and maintenance phase) in the **spring migration period** season. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

LCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

UCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

*Table 4.7 Mean, LCL and UCL displacement matrices for **gannet** from Morecambe OWF (operation and maintenance phase) **year-round**. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	1	1	2	2	3	6	11	17	28	44	56
	20%	1	2	3	4	6	11	22	33	56	89	111
	30%	2	3	5	7	8	17	33	50	83	133	167
	40%	2	4	7	9	11	22	44	67	111	178	222
	50%	3	6	8	11	14	28	56	83	139	222	278
	60%	3	7	10	13	17	33	67	100	167	266	333
	70%	4	8	12	16	19	39	78	117	194	311	389
	80%	4	9	13	18	22	44	89	133	222	355	444
	90%	5	10	15	20	25	50	100	150	250	400	500
	100%	6	11	17	22	28	56	111	167	278	444	555

LCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	1	1	2	3	5	8	13	16
	20%	0	1	1	1	2	3	6	10	16	26	32
	30%	0	1	1	2	2	5	10	14	24	38	48
	40%	1	1	2	3	3	6	13	19	32	51	64
	50%	1	2	2	3	4	8	16	24	40	64	80
	60%	1	2	3	4	5	10	19	29	48	77	96
	70%	1	2	3	4	6	11	22	34	56	90	112
	80%	1	3	4	5	6	13	26	38	64	102	128
	90%	1	3	4	6	7	14	29	43	72	115	144
	100%	2	3	5	6	8	16	32	48	80	128	160
UCL	Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	1	2	3	3	4	8	17	25	42	68	85
	20%	2	3	5	7	8	17	34	51	85	136	170
	30%	3	5	8	10	13	25	51	76	127	204	255
	40%	3	7	10	14	17	34	68	102	170	272	340
	50%	4	8	13	17	21	42	85	127	212	340	425
	60%	5	10	15	20	25	51	102	153	255	408	510
	70%	6	12	18	24	30	59	119	178	297	476	595
	80%	7	14	20	27	34	68	136	204	340	544	679
	90%	8	15	23	31	38	76	153	229	382	612	764
	100%	8	17	25	34	42	85	170	255	425	679	849

*Table 4.8 Mean, LCL and UCL displacement matrices showing change in mortality rate for **gannet** due to displacement from Morecambe OWF (operation and maintenance phase) **year-round**. Estimated population based on windfarm site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in **grey** cells.*

Mean		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	30%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.13%
	40%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.14%	0.18%
	50%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.22%
	60%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.22%	0.27%
	70%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.16%	0.25%	0.31%
	80%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.29%	0.36%
	90%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.32%	0.40%
	100%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.09%	0.13%	0.22%	0.36%	0.45%

LCL	Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.07%	0.09%
	80%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	90%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.12%
	100%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.06%	0.10%	0.13%

UCL	Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.07%
	20%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
	30%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.17%	0.21%
	40%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.08%	0.14%	0.22%	0.28%
	50%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.07%	0.10%	0.17%	0.28%	0.34%
	60%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.21%	0.33%	0.41%
	70%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.10%	0.14%	0.24%	0.39%	0.48%
	80%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.11%	0.17%	0.28%	0.44%	0.55%
	90%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.19%	0.31%	0.50%	0.62%
	100%	0.01%	0.01%	0.02%	0.03%	0.03%	0.07%	0.14%	0.21%	0.34%	0.55%	0.69%

4.1.2.2 Update to gannet collision risk assessment

22. The updated estimates for change in background mortality rate for gannet (**Table 4.2**) are presented in **Table 4.9**. In accordance with the approach in ES Chapter 12 Offshore Ornithology (APP-049), results have been presented both with and without an assumed 70% macro-avoidance by this species. These values update those for gannet presented in Table 12.48 in ES Chapter 12 Offshore Ornithology (APP-049).

Table 4.9 Update of precautionary estimates of percentage increases in the background mortality rate of seasonal and annual populations of gannet due to predicted collisions. Figures ***bold*** *show a change from Table 12.48 in ES Chapter 12 Offshore Ornithology (APP-049)*

Species		Gannet	Gannet (70% macro-avoidance)
Baseline average mortality rate		**0.1866**	**0.1866**
Breeding Season	Reference population	522,888	522,888
	Baseline seasonal mortality	**97,571**	**97,571**
	Mean seasonal mortality from collision	4.14	1.24
	Increase in background mortality (%)	<0.01%	<0.01%
Autumn migration	Reference population	545,954	545,954
	Baseline seasonal mortality	**101,875**	**101,875**
	Mean seasonal mortality from collision	0.07	0.02
	Increase in background mortality (%)	<0.01%	<0.01%
Spring migration	Reference population	661,888	661,888
	Baseline seasonal mortality	**123,508**	**123,508**
	Mean seasonal mortality from collision	0.00	0.00
	Increase in background mortality (%)	0.00%	0.00%
Annual (largest BDMPS)	Reference population	661,888	661,888
	Baseline annual mortality	**123,508**	**123,508**
	Mean annual mortality from collision	4.20	1.26
	Increase in background mortality (%)	<0.01%	<0.01%

23. When compared to the values presented in ES Chapter 12 Offshore Ornithology (APP-049), there would be no measurable change in background mortality. The value for total annual mortality (<0.01%) would be unchanged. The assessment conclusion for gannet would therefore be unchanged (Paragraph 12.294 of ES Chapter 12 Offshore Ornithology (APP-049)); i.e. a **minor adverse** effect.

4.1.2.3 Update to combined gannet collision risk and displacement effects assessment

24. As noted in **Section 4.1.2.2**, there has been no change to the number of additional mortalities from collision risk (1.26 with 70% macro-avoidance applied) from the EIA (Paragraph 12.315 in ES Chapter 12 Offshore Ornithology (APP-049)). **Section 4.1.2.1** details changes to the assessment of displacement related effects on gannets. The estimated mean annual mortality for gannet displacement is three to four individuals at displacement rates of 60-80% and mortality of 1%, which is reduced from four to five in the EIA (Paragraph 12.315 in ES Chapter 12 Offshore Ornithology (APP-049)).

25. Based on the largest annual BDMPS for the United Kingdom (UK) Western Waters of 661,888 (Furness, 2015) and the revised baseline mortality rate 0.1866 (**Table 4.2**), 123,508 individual gannets would be subject to mortality each year. This is slightly reduced from 124,435 individuals in the EIA, based on the previous baseline mortality rate of 0.188 (Paragraph 12.316 in ES Chapter 12 Offshore Ornithology (APP-049)).

26. The combined addition of a maximum of six individuals (i.e. 1.26 from collision and four from displacement, rounded up to the next whole number; reduced from seven in the EIA) would represent an increase in annual mortality of <0.01%, which is **unchanged** from the EIA (Paragraph 12.316 in ES Chapter 12 Offshore Ornithology (APP-049)). This magnitude of increase would not materially alter background mortality of the population and would be undetectable.

27. Therefore, the combined effect of displacement and collision risk on gannet is **unchanged** from the EIA and remains of **negligible** magnitude, with the effect significance for a receptor of **medium** sensitivity remaining as **minor adverse** and not significant in EIA terms (Paragraph 12.317 in ES Chapter 12 Offshore Ornithology (APP-049)).

5 Update to the Marine Mammals and Underwater Noise Assessment

5.1 Response to ID R9-08 and ID R9-14 (NE Ref. D4 and D28)

28. This section provides information in response to the ExA (ID R9-08 and R9-14; see **Table 3.1**), regarding the assessment of underwater noise on marine mammals as presented in ES Chapter 11 Marine Mammals (APP-048), which has been undertaken at the request of the ExA (ID R9-08 and R9-14) who requested *'Updated presentation of the Interim Population Consequences of Disturbance Model (iPCoD) modelling results and present impact significance for all approaches used to assess disturbance impacts (NE Ref D4)'* and *'Presentation of impact significance for each approach used to determine the marine mammal disturbance range, using the combination of sensitivity and magnitude (percentage of reference population within the disturbance range) and present the cumulative impact significance for cetaceans using the worst-case numbers disturbed i.e. not only the iPCoD modelling results (NE Ref D28).'*

29. Ref. D4 of NE's RR to the Applicant stated:

"*Natural England does not agree with the project-alone assessment of disturbance impacts from piling. We have concerns with how the results of the iPCoD modelling are presented. We also require that the impact significance should be presented based on each approach taken to assessing disturbance, not just based on the iPCoD modelling. We cannot agree with the assessment conclusions of the project-alone disturbance effects at this stage. (See Natural England Refs 19 and 23)*

Update how the iPCoD modelling results are presented in line with comments. Present impact significance for all approaches used to assess disturbance impact.

Commit to further mitigation of project-alone impacts, should they be significant."

30. Ref. D28 of NE's RR to the Applicant stated:

"*The significance of the disturbance impact must be presented for each of the approaches used to determine disturbance distance. Each approach and subsequent assessment of impact significance provides necessary information for Natural England to inform its advice. For example, the magnitude of impact to harbour porpoise using the EDR approach is Medium, which when combined with a Medium sensitivity, leads to a Moderate impact significance which is Significant in EIA terms. Information such as this is* *currently missing. It is not appropriate to only present the significance of the disturbance impact after population modelling has been undertaken. This also applies to the CEA.*

We advise that an assessment of cumulative impacts to cetacean species is presented using the approach that generates the worst-case numbers disturbed. The Applicant should not only present the iPCoD modelling results. Present the impact significance for each approach used to determine the disturbance range, using the combination of sensitivity and magnitude (percentage of reference population within the disturbance range). Present the cumulative impact significant for each species using the worst-case numbers disturbed i.e. not only the iPCoD modelling results."

31. It is also noted that NE requested in comment NE Ref. D21 of their RR that sensitivity of a number of species (bottlenose dolphin, common dolphin, Risso's dolphin and grey and harbour seal) should be updated. A full response to these comments will be provided at Deadline 1. However, the updated sensitivities have been incorporated in the updated significance assessments below to provide a comprehensive response to the Rule 9 request in line with other related NE comments in their RR.

5.1.1 Clarifications to the Project-alone assessment

32. This section provides information in response to NE's comment (NE Ref. D4).

5.1.1.1 Harbour porpoise

33. **Table 5.1** presents the magnitude and significance of effect for all assessment methods used in ES Chapter 11 Marine Mammals (APP-048) to assess for potential disturbance to harbour porpoise from piling (including the Effective Deterrence Range (EDR) approach, the DRC approach, and the population modelling (iPCoD) approach).

34. For the EDR approach, the significance of effect is moderate adverse (significant in EIA terms). Whereas the other two methods, the DRC and the iPCoD population modelling show that there is a minor adverse effect respectively (not significant in EIA terms) for the potential of disturbance to harbour porpoise.

35. Brown *et al*. (2023) highlights that the approach used to produce the current 26km EDR likely overestimates the response because it does not account for underlying seasonal variation during baseline and piling periods. In addition, findings in the latest PrePared report looking at harbour porpoise response to piling at Ocean Winds Moray West OWF found evidence of an EDR of 10km, providing a strong case for reducing the current 26km EDR for unabated impact piling of monopiles (Benhemma-Le Gall *et al*., 2024).

36. As stated by NE within their Phase III Best Practice guide[1] "*a dose-response curve is recommended to assess behavioural responses as a matter of best practice, where possible and relevant. This is the most recent approach, is a more realistic representation of animal response, and is based on empirical at-sea monitoring data*".

37. Therefore, the resultant significance level using the DRC approach is considered the most realistic assessment for harbour porpoise and based on the latest research and knowledge, while the EDR approach, as outline above, can be considered to be over-precautionary. Regardless, the resultant iPCoD modelling used the results from the EDR approach to investigate the validity of the indicated significant effect on the harbour porpoise population, with no population level effect expected, even with the over-precautionary use of the EDR approach.

38. Taking into account all considerations as outlined above, it has been concluded that the potential for disturbance from the Project for harbour porpoise would be **minor adverse, therefore not significant in EIA terms,** and in line with the assessment set out in ES Chapter 11 Marine Mammals (APP-048).

[1] 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).

Table 5.1 Assessment of potential disturbance of harbour porpoise (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect (changes compared to ES highlighted in red)
26km EDR for monopiles (2,124km^2)	3,443 (5.5% of Celtic and Irish Sea (CIS) Management Unit (MU))	Medium	Medium	Not provided	Significant (Moderate adverse) *Significance is further investigated through iPCoD modelling*
DRC	1,857.9 (2.97% of the CIS MU)	Medium	Low	Not provided	Not Significant (Minor adverse)
iPCoD modelling	<1% of the CIS MU	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

5.1.1.2 Bottlenose dolphin

39. **Table 5.2** presents the results from all methods used to assess for potential disturbance from underwater noise due to piling to bottlenose dolphin. Results from the DRC (with the harbour porpoise DRC used as a proxy) show that there could be a major adverse effect (significant in EIA terms), however, taking into account the difference in hearing sensitivity between harbour porpoise (Very-High Frequency (VHF) cetaceans) and bottlenose dolphin (High-Frequency (HF) cetaceans (see Table 11.20 in ES Chapter 11 Marine Mammals (APP-048); Southall *et al.,* 2019), this would be over-precautionary. DRC should be used where the species and sound type combination is available, which is lacking for all dolphin species (Sinclair et al., 2023). In addition, the resultant iPCoD modelling used the results from the DRC approach to investigate the validity of the indicated significant effect on the bottlenose dolphin population, with no population level effect expected, even with the over-precautionary use of the harbour porpoise DRC.

40. Using TTS as a proxy for disturbance or results from the iPCoD population assessment generate an effect of minor adverse (not significant in EIA terms). It is also important to note that bottlenose dolphin have a predominantly coastal distribution (see ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066)). They are primarily an inshore species, with most sightings within 10km of land. The Project windfarm site would be located approximately 30km from the nearest point on the coast; therefore, bottlenose dolphin are unlikely to be significantly disturbed.

41. It is therefore concluded that the significance of effect for bottlenose dolphin from potential disturbance from underwater noise from piling would be **minor adverse (not significant in EIA terms)** whereas it was assessed as negligible adverse in ES Chapter 11 Marine Mammals (APP-048). Increasing the sensitivity (in line with NE Ref. D21) would result in an increase in the significance of effect, but it would remain as not significant in EIA terms.

Table 5.2 Assessment of potential disturbance of bottlenose dolphin (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low*)	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
TTS 0.1km^2	0.001 (0.0004% of Irish Sea (IS) MU)	Medium	Negligible	Not provided	Not Significant (Minor adverse)
DRC	56.3 bottlenose dolphin (19.2% of the IS MU)	Medium	High	Not provided	Significant (Major adverse) *Significance is further investigated through iPCoD modelling*
iPCoD modelling	<2% of the IS MU	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.1.3 Common dolphin

42. **Table 5.3** presents the results from all methods used to assess potential disturbance to common dolphin from underwater noise due to piling. Using TTS as a proxy for disturbance or results from the DRC assessment (using the harbour porpoise DRC as a proxy) results in an effect of minor adverse (not significant in EIA terms).

43. Amending the sensitivity of disturbance from underwater noise for common dolphin from low to medium (in line with NE Ref. D21) changes the significance of effect from negligible adverse (not significant in EIA terms) to **minor adverse, not significant in EIA terms** (**Table 5.3**), and therefore the overall conclusions are in line with the ES (Chapter 11 Marine Mammals (APP-048)).

Table 5.3 Assessment of potential disturbance of common dolphin (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
TTS 0.1km^2	0.003 (0.000003% of Celtic and Greater North Seas (CGNS) MU)	Medium	Negligible	Not provided	Not Significant (Minor adverse)
DRC	127.6 (0.12% of the CGNS MU)	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.1.4 Risso's dolphin

44. **Table 5.4** presents the results from all methods used to assess for potential disturbance to Risso's dolphin from underwater noise due to piling. Using TTS as a proxy for disturbance or results from the DRC assessment (using the harbour porpoise DRC as a proxy) results in an effect of minor adverse (not significant in EIA terms).

45. Amending the sensitivity of disturbance from underwater noise for Risso's dolphin from low to medium changes the significance of effect from negligible adverse (not significant in EIA terms) to **minor adverse,** which is **not significant in EIA terms** (**Table 5.4**) and therefore the overall conclusions are in line with the ES (Chapter 11 Marine Mammals (APP-048)).

Table 5.4 Assessment of potential disturbance of Risso's dolphin (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
TTS 0.1km^2	0.0006 (0.0000005% of CGNS MU)	Medium	Negligible	Not provided	Not Significant (Minor adverse)
DRC	2.4 (0.02% of the CGNS MU)	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.1.5 White-beaked dolphin

46. **Table 5.5** presents the results from all methods used to assess for potential disturbance to white-beaked dolphin from underwater noise due to piling. Using TTS as a proxy for disturbance or results from the DRC assessment (using the harbour porpoise DRC as a proxy) results in a significance effect of minor adverse (not significant in EIA terms).

47. Amending the sensitivity of disturbance from underwater noise for white-beaked dolphin from low to medium (in line with NE Ref. D21) changes the significance of effect from negligible adverse (not significant in EIA terms) to **minor adverse, which is not significant in EIA terms** (**Table 5.5**), and therefore the overall conclusions are in line with the ES Chapter 11 Marine Mammals (APP-048).

Table 5.5 Assessment of potential disturbance of white-beaked dolphin (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
TTS 0.1km^2	0.001 (0.000002% of CGNS MU)	Medium	Negligible	Not provided	Not Significant (Minor adverse)
DRC	17.9 (0.04% of the CGNS MU)	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium*

5.1.1.6 Minke whale

48. **Table 5.6** presents the results of assessing any potential disturbance to minke whale from underwater noise due to piling, including using the 30km disturbance range approach from Richardson *et al*., 1999; based on the literature review in Section 6.1.3 in Appendix 11.2 Marine Mammal Information and Survey Data (APP-066) and iPCoD modelling. Both methods result in a significance of effect of **minor adverse (not significant in EIA terms**), and

therefore the overall conclusions are in line with the ES (Chapter 11 Marine Mammals (APP-048)).

Table 5.6 Assessment of potential disturbance of minke whale (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity	Magnitude (temporary effect)	Significance of effect (as presented ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
30km disturbance range (2827.43km^2)	24.9 (0.12% of CGNS MU)	Medium	Negligible	Not provided	Not Significant (Minor adverse)
iPCoD modelling	<1% of the IS MU	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

5.1.1.7 Grey seal

49. **Table 5.7** presents all methods used to assess for potential disturbance to grey seal. Using the 25km disturbance range (Russel *et al*., 2016) the effect is major adverse (which is significant in EIA terms). The 25km disturbance range is the only accepted EDR for assessing disturbance to seals from piling. However, it is unknown how appropriate the 25km disturbance range is as the study was conducted on harbour seal only.

50. The 25km disturbance range for grey seal could be considered over precautionary because it stems from a single study on harbour seal response to OWFs. This study did not account for variations in piling characteristics or the effects of bathymetry on sound propagation. Consequently, the displacement distance of grey seal could vary significantly across sites (Madsen *et al.,* 2006, Russel *et al*., 2016).

51. The results from the iPCoD modelling used the results from the 25km disturbance range approach to investigate the validity of the indicated significant effect on the grey seal population, with no population level effect expected.

52. The DRC assessment and the iPCoD modelling result in a minor adverse significance of effect (not significant in EIA terms).

53. Therefore, taking all three assessments into account, it is concluded that the potential for disturbance to grey seal from underwater noise due to piling

would be **minor adverse (not significant in EIA terms**), in line with the conclusions of ES Chapter 11 Marine Mammals (APP-048).

54. In ES Chapter 11 Marine Mammals (APP-048), the significance of effect was assessed as negligible adverse (not significant in EIA terms), therefore increasing the sensitivity (NE Ref. D21) has increased the significance of effect but it remains not significant in EIA terms.

Table 5.7 Assessment of potential disturbance of grey seal (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low)**	Magnitude (temporary effect)*	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect*
25km disturbance range (1,963.5 km^2)	196.4 (12.3% of the combined MU; or 1.5% of the wider ref population)	Medium	High (low)	Not provided	Significant (Major adverse) *Significance is further investigated through iPCoD modelling*
DRC	0.151 (0.009% of the combined MU; 0.00001% of the wider reference population)	Medium	Negligible (negligible)	Not provided	Not Significant (Minor adverse)
iPCoD modelling	<1% of the CIS MU	Medium	Negligible (negligible)	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**Magnitudes in brackets are for the wider reference population*

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium*

5.1.1.8 Harbour seal

55. **Table 5.8** presents all methods used to assess potential disturbance to harbour seal. Using the 25km disturbance range (Russel *et al*., 2016) which is the only accepted disturbance range for seals, could be again considered as over precautionary as it is a result from one study. Disturbance ranges can vary amongst different projects, due to pile designs, bathymetry on sound propagation. Using the 25km disturbance range, the effect would be minor adverse, and under the DRC and iPCoD modelling approach, the assessments are also minor adverse (both not significant in EIA terms). In ES Chapter 11 Marine Mammals (APP-048), the effect was assessed as negligible adverse (not significant in EIA terms), but due to increasing the sensitivity from low to medium to disturbance (NE Ref. D21), the significance of effect would be minor adverse (not significant in EIA terms).

56. Therefore, taking all three assessments into account, it is concluded that the potential for disturbance to harbour seal from underwater noise due to piling would be **minor adverse (not significant in EIA terms**), in line with the overall conclusions of ES Chapter 11 Marine Mammals (APP-048). Again, the iPCoD modelling is the most appropriate tool to assess the potential impacts of disturbance to consider the longer term population consequences of harbour seal.

Table 5.8 Assessment of potential disturbance of harbour seal (updates to ES are shown in red)

Assessment Method	Maximum number of individuals (% of reference population)	Sensitivity (updated from low)*	Magnitude (temporary effect)*	Significance of effect (as presented in the ES Chapter 11 Marine Mammals (APP-048))	Significance of effect*
25km disturbance range (1,963.5 km^2)	0.22 (3.1% of the North West (NW) MU; or 0.015% of wider ref population)	Medium	Low (negligible)	Not provided	Not Significant (Minor adverse)
DRC	0.001 (0.0084% of the NW MU; or <0.00001% of the wider reference population)	Medium	Negligible (negligible)	Not provided	Not Significant (Minor adverse)
iPCoD modelling	<1% of the CIS MU	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**Magnitudes in brackets are for the wider MU*

****In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.2 Clarifications to cumulative effects from underwater noise due to piling

57. This section provides information in response to NE's comment (Ref. D28).

58. The following section applies to harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal, where a quantitative assessment (beyond population modelling) has not been presented previously in the ES. Within the ES, following the initial screening of UK and European OWFs, further screening was undertaken to identify those OWF projects that have the potential for overlapping construction phases with the Project. This screening considered known piling activities and/or construction timings, in order to determine a more realistic, but still worst-case, list of UK and European OWF projects that may have the potential for overlapping piling activities with the Project (see Appendix 11.4 Marine Mammal CEA Project Screening (APP-068) for further details).

59. The potential disturbance from underwater noise during piling activities has been assessed based on the worst-case numbers of animals disturbed taken from assessments either using disturbance ranges or EDR's or the dose-response curves (Project-alone). The worst-case numbers of animals disturbed used for the cumulative assessment is presented in Table 7.6 in Appendix 11.2 Marine Mammal Information and Survey Data (APP-066) from other OWF projects' ESs and Preliminary Environmental Information Report (PEIR)s. These numbers were only presented in the iPCoD modelling, however to address NE comment (NE Ref. D28), these numbers are presented **Table 5.9**; **Table 5.11**; **Table 5.13**; **Table 5.15**; and **Table 5.17** and quantitatively assessed by adding the numbers of potentially disturbed animals together to get the total estimated number, estimated effect on the population. The total estimates of the number of animals that could be potentially disturbed from underwater noise from other piling projects is presented with and without the Project, with the significance of effect.

60. There were six OWFs screened in as having a construction period that could potentially overlap with the construction of the Project, that could be undertaking piling activities at the same time as the Project (Table 11.84, in the ES Chapter 11 Marine Mammals (APP-048)). These other projects were included in individual marine mammal assessments if the projects were within the marine mammals MU. The numbers of animals potentially disturbed were added together to get an overall estimated impact on the population.

61. For common dolphin and Risso's dolphin, the quantified assessments using disturbance ranges or DRC have already been provided within Table 11.85 of ES Chapter 11 Marine Mammals (APP-048) (note that white-beaked dolphin are not included in this cumulative assessment (for disturbance from piling) as

no other projects screened in for assessment included this species as a receptor).

5.1.2.1 Harbour porpoise

62. **Table 5.9** provides a quantified assessment of magnitude of cumulative disturbance due to piling overlap with other OWF, utilising project-specific data from published PEIRs and ESs for other OWFs as outlined in Table 7.6 Appendix 11.2 Marine Mammal Information and Survey Data (APP-066).

Table 5.9 Quantified Cumulative Effect Assessment (CEA) for the potential disturbance for harbour porpoise during single piling at the OWF projects which could be piling at the same time as the Project

Harbour porpoise			
Project	**Harbour porpoise density (/km^{2})**	**Impact area (km^{2})**	**Maximum number of individuals potentially disturbed during single piling**
The Project	1.621	2123.7	3,442.5
Awel y Mor OWF	1.00	DRC	2,112
Mona Offshore Wind Project	0.097	DRC	429.0
Morgan Offshore Wind Project Generation Assets	0.274	DRC	979.0
Morgan and Morecambe Offshore Wind Farms: Transmission Assets[2]	0.560	DRC	1,793.0
Erebus Offshore Wind Project	0.400	DRC	1,967.0
White Cross OWF	0.92	2123.7	1,949.6
Total number of harbour porpoise (*without the Project*)			**12,672.1** ***9,229.6***
Percentage of CIS MU (*without the Project*)			**20.3%** ***14.8%***
Magnitude of cumulative effect (*without the Project*)			**High** ***High***

63. **Table 5.10** presents the assessment of significance of effect for harbour porpoise due to cumulative effects from piling and using data such as EDRs and DRC assessments from other projects. With or without the Project, the significance of effect for harbour porpoise is major adverse (**Table 5.10**). This is considered very precautionary as it does not take into account any mitigation measures, and it is unlikely that all projects would pile on the same day, for various reasons such as project timings, technical and mechanical issues, port calls, and varying weather restraints affecting vessels and

[2] At the time of writing the ES, a decision had been taken that the offshore substation platforms (OSPs) would not be included within the DCO Application for the Transmission Assets. This decision post-dated the Transmission Asset PEIR (within which the OSPs are also assessed). The final ES for the Transmission Assets will therefore not include the OSPs or associated interconnector cables. Additionally, a decision had been taken since the PEIR that the Morgan Offshore Booster Station (OBS) would no longer be required. Whilst the OSPs, OBS and interconnector cables will not form part of the DCO Application for the Transmission Assets, they are included here as they were contained within the Transmission Asset PEIR which has been used to inform the ES.

equipment. In addition, the potential for a significant effect was further investigated through iPCoD modelling, to determine the validity of the indicated significant effect on the harbour porpoise population. The results of the population modelling, using the same data as shown in **Table 5.9**, found that there is no population level effect expected as presented in Section 11.7.3.2. in the ES Chapter 11 Marine Mammals (APP-048).

64. In ES Chapter 11 Marine Mammals (APP-048), impact significance results were presented as minor adverse due to the results from the population modelling. The Applicant still considers iPCoD to be the best approach. The model requires detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproduction rates (Sinclair *et al*., 2023) by taking the worst-case numbers of disturbance, models a thousand scenarios, and looks at population effects on an annual and longer term basis. Therefore, it is considered to be the most appropriate tool to assess cumulative disturbance. For harbour porpoise the effect of cumulative disturbance from piling has been assessed as **minor adverse (not significant in EIA terms)**, in line with ES (Chapter 11 Marine Mammals (APP-048)).

Table 5.10 Assessment of significance of effect for disturbance of harbour porpoise from cumulative effects from underwater noise (updates to ES are shown in red)

Assessment Method	Sensitivity	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
EDR and/or DRC	Medium	High	Not provided	Significant (Major adverse) *Significance is further investigated through iPCoD modelling*
iPCoD modelling	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

5.1.2.2 Bottlenose dolphin

65. **Table 5.11** provides a quantified assessment of disturbance to bottlenose dolphin due to piling overlap with other OWF, utilising project-specific data from PEIRs and ESs for other OWFs as outlined in Table 7. 6 in ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066). **Table 5.11** shows that a high percentage of bottlenose dolphins would be at risk of potential disturbance. However, this assessment does not consider the

distance to the piling activity nor the unlikelihood of all activities taking place on the same day. This is due to factors such as project timings, technical and mechanical issues, port calls, and varying weather constraints affecting vessels and equipment. Therefore, population modelling was used by the Applicant which takes into account the detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair *et al*., 2023). This method is, therefore, regarded as the most appropriate for evaluating potential cumulative disturbances and the population consequences for bottlenose dolphin from the IS MU.

Table 5.11 Quantified CEA for the potential disturbance for, bottlenose dolphin during single piling at the OWF projects which could be piling at the same time as the Project

Bottlenose dolphin			
Project	**Bottlenose Dolphin density (/km^2)**	**Impact area (km^2)**	**Maximum number of individuals potentially disturbed during single piling**
The Project	0.0104	DRC	56.3
Awel y Mor OWF	0.0350	DRC	23
Mona Offshore Wind Project	0.0350	DRC	13
Morgan Offshore Wind Project Generation Assets	0.0350	DRC	11
Morgan and Morecambe Offshore Wind Farms: Transmission Assets[2]	0.0010	DRC	4
Total number of bottlenose dolphin			**107.3**
(without the Project)			***51.0***
Percentage of IS MU			**36.6%**
(without the Project)			**17.4%**
Magnitude of cumulative effect			**High**
(without the Project)			***High***

66. **Table 5.12** presents the significance of effect from cumulative disturbance due to piling for bottlenose dolphin. Again, as described in **Section 2**, it is considered using the DRC assessments from other projects is over precautionary, as these assessments are not specifically designed for dolphin species. Furthermore, the population modelling incorporated the worst-case numbers of disturbance and auditory injury and provided data on how that could impact the IS bottlenose dolphin population.

67. Therefore, for bottlenose dolphin the effect of cumulative disturbance from piling has been assessed as **minor adverse (not significant in EIA terms)** which is no change to the significance of effect presented in ES Chapter 11 Marine Mammals (APP-048) as the Applicant still considers population modelling to be the best approach.

Table 5.12 Assessment of significance of effect for disturbance of bottlenose from cumulative effects from underwater noise (updates to ES are shown in red)

Assessment Method	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
DRC	Medium	High	Not provided	Significant (Major adverse) *Significance is further investigated through iPCoD modelling*
iPCoD modelling	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium*

5.1.2.3 Minke whale

68. **Table 5.13** provides a quantified assessment of disturbance to minke whale due to piling overlap with other OWF, utilising project-specific data from PEIRs and ESs for other OWFs as outlined in Table 7.6 in ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066), and results in a **minor adverse effect (not significant in EIA terms).**

Table 5.13 Quantified CEA for the potential disturbance of minke whale during single piling event at the OWF projects which could be piling at the same time as the Project

Minke whale			
Project	**Minke whale density (/km^2)**	**Impact area (km^2)**	**Maximum number of individuals potentially disturbed during single piling event**
The Project	0.0088	2827.43	24.9
Awel y Mor OWF	0.0170	DRC	36
Mona Offshore Wind Project	0.0173	DRC	77
Morgan Offshore Wind Project Generation Assets	0.0173	DRC	69
Morgan and Morecambe Offshore Wind Farms: Transmission Assets[2]	0.0050	DRC	17
Erebus OWF	0.0112	DRC	53
White Cross OWF	0.0112	TTS 100m	0.0004
Total number of minke whale			**276.9**
(*without the Project*)			***252.0***
Percentage of CGNS MU			**1.38%**
(*without the Project*)			***1.25%***
Magnitude of cumulative effect			**Low**
(*without the Project*)			***Low***

69. **Table 5.14** presents the significance of effect for minke whale from cumulative disturbance due to underwater noise from piling, and the significance of effect is **minor adverse,** therefore, **not significant in EIA terms**; this is in line with the conclusions of the assessment provided in ES Chapter 11 Marine Mammals (APP-048). A number of minke whale would be at risk of potential disturbance, yet this assessment does not account or the distance to the piling activity or the unlikelihood of all activities occurring simultaneously. Factors such as project schedules, technical and mechanical issues, port calls, and varying weather conditions affecting vessels and equipment contribute to this. Consequently, the Applicant used population modelling, which incorporates detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair et al., 2023). This method is considered the most appropriate for

assessing potential cumulative disturbance and its population consequences for minke whale from the CGNS MU.

Table 5.14 Assessment of significance of effect for disturbance of minke whale from cumulative effects from underwater noise (updates to ES are shown in red)

Assessment Method	Sensitivity	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
Known Disturbance range / DRC/TTS	Medium	Low	Not provided	Not Significant (Minor adverse)
iPCoD modelling	Medium	Negligible	Not Significant (Minor adverse)	Not Significant (Minor adverse)

5.1.2.4 Grey seal

70. **Table 5.15** provides a quantified assessment of cumulative disturbance to grey seal due to piling overlap with other OWFs, utilising project-specific data from PEIRs and ESs for other OWFs as outlined in ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066) and results in a **minor adverse effect (not significant in EIA terms)**. A large number of grey seal could be at risk of potential disturbance, although the assessment does not consider the unlikelihood of all activities occurring simultaneously, nor the distances to the piling activities. Factors such as project schedules, technical and mechanical issues, port calls, and varying weather conditions affecting vessels and equipment contribute to this. Consequently, the Applicant used population modelling, which incorporates detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair et al., 2023). This method is considered the most appropriate for assessing potential cumulative disturbance and its population consequences for grey seal.

Table 5.15 Quantified CEA for the potential disturbance for grey seal during single piling event at the OWF projects which could be piling at the same time as the Project

Grey seal			
Project	**Grey seal density (/km^2)**	**Impact area (km^2)**	**Maximum number of individuals potentially disturbed during single piling event**
The Project	0.1	1963.5	196.4
Awel y Mor	0.070	DRC	81
Mona Offshore Wind Project	0.196	DRC	45
Morgan Offshore Wind Project Generation Assets	0.041	DRC	45
Morgan and Morecambe Offshore Wind Farms: Transmission Assets[2]	0.106	DRC	28
Erebus OWF	0.070	DRC	18
White Cross OWF	0.005	1963.5	9.5
Total number of grey seal ***(without the Project)***			**422.9** / ***226.5***
Percentage of wider reference pop ***(without the Project)***			**3.18%** / ***1.70%***
Magnitude of cumulative effect ***(without the Project)***			**Low** / ***Low***

71. **Table 5.16** presents the significance of effect for grey seal from cumulative disturbance due to underwater noise from piling, and the significance of effect is **minor adverse, therefore not significant in EIA terms**, in line with the overall conclusions presented in ES Chapter 11 Marine Mammals (APP-048).

72. In ES Chapter 11 Marine Mammals (APP-048), the effect was assessed as negligible adverse (not significant in EIA terms), therefore amending the sensitivity (in line with NE Ref. D21) increases the significance of effect to minor adverse (not significant in EIA terms).

Table 5.16 Assessment of significance of effect for disturbance of grey seal from cumulative effects of underwater noise (updates to ES are shown in red)

Assessment Method	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
Known disturbance range / DRC	Medium	Low	Not provided	Not Significant (Minor adverse)
iPCoD modelling	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.2.5 Harbour seal

73. **Table 5.17** provides a quantified assessment of cumulative disturbance to harbour seal due to piling overlap with other OWFs, utilising project-specific data from PEIRs and ESs for other OWFs as outlined in ES Appendix 11.2 Marine Mammal Information and Survey Data (APP-066), and results in a **minor adverse effect (not significant in EIA terms).** Despite the small number of harbour grey seal that could be at risk of potential disturbance, the assessment in **Table 5.17** assumes that all activities would occur simultaneously and does not consider the distances to the piling sites. Factors such as project schedules, technical and mechanical issues, port calls, and varying weather conditions affecting vessels and equipment contribute to this. Consequently, the Applicant used population modelling, which incorporates detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair et al., 2023). This method is considered the most appropriate for assessing potential cumulative disturbance and its population consequences for harbour seal.

Table 5.17 Quantified CEA for the potential disturbance for harbour seal during single piling at the OWF projects which could be piling at the same time as the Project

Harbour seal			
Project	**Harbour seal density (/km^2)**	**Impact area (km^2)**	**Maximum number of individuals potentially disturbed during single piling event**
The Project	0.00011	1963.5	0.22
Awel y Mor	0.00011*	1963.5*	0.22*
Mona Offshore Wind Project	0.00080	DRC	1
Morgan Offshore Wind Project Generation Assets	0.00005	DRC	1
Morgan and Morecambe Offshore Wind Farms: Transmission Assets[2]	0.00020	DRC	1
Erebus	0.00011*	1963.5*	0.22*
White Cross	0.00011*	1963.5*	0.22*
Total number of harbour seal			**3.88**
(without the Project)			***3.66***
Percentage of wider reference population			**0.33%**
(without the Project)			***0.32%***
Magnitude of cumulative effect			**Negligible**
(without the Project)			***Negligible***

**These projects did not assess harbour seal. As a precautionary approach the same values as the Project have been applied instead.*

74. **Table 5.18** presents the significance of effect for harbour seal from cumulative disturbance due to underwater noise from piling, and the significance of effect is **minor adverse, therefore not significant in EIA terms**, in line with the overall conclusions presented in ES Chapter 11 Marine Mammals (APP-048).

75. In ES Chapter 11 Marine Mammals (APP-048), the significance of effect was assessed as negligible adverse, (not significant in EIA terms), therefore amending the sensitivity (in line with NE Ref. D21) increases the significance of effect to minor adverse, but it remains not significant in EIA terms.

Table 5.18 Assessment of significance of effect for disturbance of harbour seal from cumulative effects from underwater noise (updates to ES are shown in red)

Assessment Method	Sensitivity (updated from low)*	Magnitude (temporary effect)	Significance of effect (as presented in ES Chapter 11 Marine Mammals (APP-048))	Significance of effect
Known disturbance range / DRC	Medium	Negligible	Not provided	Not Significant (Minor adverse)
iPCoD modelling	Medium	Negligible	Not Significant (Negligible adverse)	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.1.3 Cumulative effects from underwater noise due to other noisy activities (NE Ref. D50)

76. This section provides information in response to NE's comment (Ref. D50) which is linked to NE's RR Ref. D28:

"*The Applicant does not appear to have presented the number of animals impacted from all cumulative disturbance pathways (piling at other OWFs; construction activities (other than piling) at other OWFs; other industries and activities). This combined disturbance impact should be presented.*

Present the combined cumulative effect of disturbance from underwater noise, across the three pathways that are currently assessed only separately."

77. **Table 5.19** lists all noisy activities that could coincide with piling at the Project, including piling and construction activities at other OWFs, which are likely to coincide with construction of the Project as well as any other potential noisy activities mentioned in paragraph 11.812 in ES Chapter 11 Marine Mammals (APP-048). The Applicant would also like to highlight that the other noisy activities such as geophysical surveys, seismic surveys, aggregate extraction, dredging and UXO clearance are indicative as it is difficult to know when these projects may occur.

78. Therefore, taking this indicative approach determines the associated potential magnitude of cumulative effect of the listed noisy activities should they all occur at the same time. This table is an expanded version of Table 11.107 in ES Chapter 11 Marine Mammal (APP-048).

79. **Table 5.19** present the magnitude of the potential for cumulative disturbance taking account of all of the piling and other OWF construction activities

described in Section 11.7.3.1 in ES Chapter 11 Marine Mammals (APP-048) as well as other noisy activities (i.e. seismic, geophysical, UXO clearance and aggregates and dredging) indicatively as described in Section 11.7.3.2 in ES Chapter 11 Marine Mammals (APP-048). **Table 5.20** presents the same assessment as **Table 5.19** but uses the population modelling results to showcase the difference in magnitudes and effect significances, compared to those in **Table 5.19.** Only those species for which population modelling was conducted in the ES Chapter 11 Marine Mammals (APP-048) is presented in **Table 5.20.**

80. The significance of effect for these updated noisy activities (based both on data from other projects' published PEIRs and ESs only and on population modelling results) has then been evaluated in **Table 5.21**. It should be noted that following the change of sensitivity for dolphins and seals (in line with NE Ref. D21), the sensitivity levels (and therefore the associated significance of effect levels) presented in **Table 5.21** have been updated from those set out in ES Chapter 11 Marine Mammals (APP-048). **Table 5.21** represents an extended version based on Table 11.108 in ES Chapter 11 Marine Mammals (APP-048). It includes all disturbance assessments provided in the cumulative effects assessment.

81. Based on the assessment using other projects' published PEIRs and ESs only (**Table 5.21**), the results of the CEA for disturbance from all noisy activities including piling are major adverse for harbour porpoise and bottlenose dolphin and moderate adverse for grey seal (which is significant in EIA terms). However, for all three species, a large proportion of the number of individuals potentially disturbed is from piling at both the Project and other OWFs without any mitigation applied. These activities have been further investigated through population modelling, and the resultant magnitudes (taking into account the modelling results) indicate that the significance of effect would be major adverse for bottlenose dolphin, and moderate adverse for minke whale and grey seal (significant in EIA terms) (**Table 5.21**). All other species were assessed as having a minor adverse significance (not significant in EIA terms).

82. **Table 5.19** and **Table 5.20** both include an assessment of magnitudes, if the indicative activities (geophysical and seismic surveys, and UXO clearance) are removed from the overall assessment. These activities are included on a worst-case and precautionary approach, however, none are currently consented or applied for, and therefore their inclusion represents a currently unrealistic future prediction of activities. If these were to be removed from the assessments, the resultant significance would be reduced to minor adverse for harbour porpoise, minke whale and grey seal (when also taking account the population modelling results (**Table 5.21**)). Another factor to take into account is that not all activities are likely to occur at the same time, and this level of significance of effect does not include any mitigation.

83. The sensitivities presented in **Table 5.21** have been adjusted from low to medium for all dolphin and seal species. This change was requested by NE, within their RR (NE Ref. D21) who did not agree that the disturbance effects for these species are low. For harbour porpoise and minke whale, the sensitivities remained to be medium, as defined in Section 11.6.2 in ES Chapter 11 Marine Mammals (APP-048).

84. Taking into account the population modelling results because the iPCoD takes the worst case numbers for disturbance and permanent auditory injury along with detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair *et al*., 2023), it is deemed as the most representative method. In addition, the indicative nature of some activities, and that it is unlikely that all activities would take place at the same time, the overall effect significance for all species would be **minor adverse (not significant in EIA terms**), in line with ES Chapter 11 Marine Mammals (APP-048)).

85. Further, while it is not considered commitments to specific additional mitigation is yet required, it is noted the Applicant will commit to the production of an Underwater Sound Management Strategy as a mechanism to consider further mitigation measures when further details of the Project and on other cumulative projects are developed. This approach of developing a Strategy is in line with the other Irish Sea Round 4 projects.

Table 5.19 Quantitative assessment for all overlapping piling and construction at other OWFs, as well as other industry noisy activities with the potential for cumulative disturbance effects for marine mammals, based on data from other Projects' published PEIRs and ESs only (activities in grey are indicative only; no formal application has been made) (magnitude levels are based on the percentage of the reference population affected, as set out in Table 11.10 in ES Chapter 11 Marine Mammals (APP-048))

Impact	Number of individuals (based on published PEIRs and ESs only)							
	Harbour porpoise	Bottlenose dolphin	Common dolphin	Risso's dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Worst-case disturbance from the Project (piling)	3,442.5	56.3	127.6	2.4	17.9	24.9	196.4	0.2
Piling at other offshore wind farms	9,233.8	51.0	2,387.0	333.0	0.0	252.0	226.5	3.66
Construction activities at other OWFs	146.7	35.5	15.8	0.5	2.4	14.5	40.5	0.0
Geophysical surveys	613.9	7.4	19.8	0.4	5.0	6.2	64.5	0.05
Aggregate extraction and dredging	0.035	-	1.9	0.01	-	0.02	0.2	-
Seismic surveys	872.6	15.8	42.5	3.3	10.6	11.9	405.4	0.3
UXO clearance	1,134.2	1.6	4.4	0.1	1.1	219.5	122.6	0.097
Total number of individuals	**15,439.5**	**167.6**	**2,599.0**	**339.7**	**37.0**	**529.0**	**1,056.1**	**4.3**
(without indicative activities)	*12,818.9*	*142.8*	*2,532.3*	*336.0*	*20.3*	*291.4*	*463.6*	*3.86*
Percentage of MU	**24.7%**	**57.2%**	**2.5%**	**2.8%**	**0.08%**	**2.6%**	**7.9%**	**0.4%**
(without indicative activities)	*20.5%*	*48.7%*	*2.4%*	*2.7%*	*0.05%*	*1.5%*	*3.5%*	*0.3%*

Impact	**Number of individuals (based on published PEIRs and ESs only)**							
	Harbour porpoise	**Bottlenose dolphin**	**Common dolphin**	**Risso's dolphin**	**White-beaked dolphin**	**Minke whale**	**Grey seal**	**Harbour seal**
Magnitude of cumulative effect	**High**	**High**	**Low**	**Low**	**Negligible**	**Low**	**Medium**	**Negligible**
(without indicative activities)	*High*	*High*	*Low*	*Low*	*Negligible*	*Low*	*Low*	*Negligible*

Table 5.20 Illustrative assessment for all overlapping piling and construction activities at other OWFs, as well as other industry noisy activities with the potential for cumulative disturbance effects for harbour porpoise, bottlenose dolphin, minke whale and seals based on population modelling results (activities in grey are indicative only; no formal application has been made) (magnitude levels based on the percentage of the reference population affected, as set out in Table 11.10 in ES Chapter 11 Marine Mammals (APP-048)

Impact	**Number of individuals (based on population modelling results)**				
	Harbour porpoise	**Bottlenose dolphin**	**Minke whale**	**Grey seal**	**Harbour seal**
Worst-case disturbance from the Project (piling) and piling at other projects*	0.74% reduction in population**	2.03% reduction in population**	3.2% reduction in population**	0% change in population**	0% change in population**
Construction activities at other OWFs	146.7	35.5	14.5	40.5	0.0
Geophysical surveys	*613.9*	*7.4*	*6.2*	*64.5*	*0.05*
Aggregate extraction and dredging	0.035	-	0.02	0.2	-
Seismic surveys	*872.6*	*15.8*	*11.9*	*405.4*	*0.3*
UXO clearance	*1,134.2*	*1.6*	*219.5*	*122.6*	*0.097*
Total number of individuals	**2,767.4**	**60.3**	**252.1**	**633.2**	**0.5**
(without indicative activities)	*146.7*	*35.5*	*14.5*	*40.7*	*0*
Percentage of MU	**4.4%**	**20.6%**	**1.3%**	**4.8%**	**0.04%**
(without indicative activities)	*0.2%*	*12.1%*	*0.07%*	*0.3%*	*0%*
Magnitude of cumulative effect	**Low**	**High**	**Low**	**Low**	**Negligible**
(without indicative activities)	*Negligible*	*High*	*Negligible*	*Negligible*	*Negligible*

Worst-case disturbance has been presented as the median ratio of unimpacted:impacted population change over 25 years taken from the tables and figures in **Section 5.3.2 or in Section 11.7.3.2 in ES Chapter 11 Marine Mammals (APP-048).*

***The percentages were not added to the calculations and are for illustrative purposes only as no value was assigned to it.*

Table 5.21 Updated Assessment of effect significance for the potential of a cumulative disturbance effect due to piling and other noisy projects and activities

Marine mammal species/receptor	Sensitivity	Results of assessment based on published PEIRs and ESs		Results of assessment based on population modelling	
		Magnitude	Significance of effect	Magnitude	Significance of effect
Harbour porpoise	Medium	High	Significant (Major adverse)	Negligible	Not significant (Minor adverse)
Bottlenose dolphin	Medium*	High	Significant (Major adverse)	Low	Not Significant (Minor adverse)
Common dolphin	Medium*	Low	Not Significant (Minor adverse)	n/a	n/a
Risso's dolphin	Medium*	Low	Not Significant (Minor adverse)	n/a	n/a
White-beaked dolphin	Medium*	Negligible	Not Significant (Minor adverse)	n/a	n/a
Minke whale	Medium	Negligible	Not Significant (Minor adverse)	Negligible	Not Significant (Minor adverse)
Grey seal	Medium*	Medium	Significant (Moderate adverse)	Negligible	Not Significant (Minor adverse)
Harbour seal	Medium*	Negligible	Not Significant (Minor adverse)	Negligible	Not Significant (Minor adverse)

**In response to RR-061-185, sensitivities have been updated since the ES from low to medium.*

5.2 Response to ID R9-13 (NE Ref. D26)

86. This section provides information in response to the ExA (ID R9-13; see **Table 3.1**), "*A review and update of collision risk rate calculations where relevant (NE Ref D26)".*

87. Ref D26 of NE's RR to the Applicant stated:

"*The values in the collision risk rate (%) do not appear correct. For example, for harbour porpoise: the number of deaths due to physical trauma of unknown cause (n=69) plus the deaths due to physical trauma following probable impact from vessel (n=14), totalling 83, is equivalent to 6.90% of the total necropsies where cause of death was established (n=1203); not the 5.6% presented. Review the numbers in this table and update, and/or clarify how the collision risk rate has been calculated"*.

88. The Applicant has reviewed data used to calculate the collision risk rate which has been updated in **Table 5.22.**

89. Discrepancies identified in Table 11.55 of ES Chapter 11 Marine Mammals (APP-048) were due to issues in the pivot table of the original datasheet. These discrepancies have not affected the collision risk rate, and therefore, the assessment outcomes remain unchanged. The risk rate was estimated by dividing the sum of the number of deaths due to physical trauma of unknown cause plus the deaths due to physical trauma from vessels with the number of necropsied animals with known causes of death.

90. Based on the information presented in ES Chapter 11 Marine Mammals (APP-048) and the amended values in **Table 5.1**, the Applicant considers that the assessment set out in ES Chapter 11 Marine Mammals (APP-048) is still valid.

Table 5.22 Summary of strandings in the whole of the UK and causes of death of marine mammals from physical trauma of unknown cause and physical trauma following possible collision with a vessel (updates in red)

Species	Number of strandings	Number of necropsies where cause of death established	Cause of death: physical trauma of unknown cause	Cause of death: physical trauma following probable impact from vessel	Collision risk rate: (deaths from vessel strikes or physical trauma) / (total known cause of death)	Collision risk rate (%)
Harbour porpoise	5582	1617	75	16	0.056	5.6
Bottlenose dolphin	152	45	1	0	0.022	2.2
Common dolphin	1805	628	17	13	0.048	4.8
Risso's dolphin	139	41	2	1	0.073	7.3
White-beaked dolphin	186	110	5	0	0.045	4.5
Minke whale	236	86	0	6	0.07	7.0
Grey seal	1909	417	18	0	0.043	4.3
Harbour seal	624	179	6	0	0.034	3.4

5.3 Response to ID R9-15 (NE Ref. D32)

91. This section provides additional information in response to the ExA (ID R9-15), "*Clarification of the values in the median impacted as percentage of unimpacted column in Table 11.39. These do not currently correspond to the difference between the un-impacted population mean and the impacted population mean. The difference between the two means in each table that presents iPCoD modelling results, including in the cumulative effects assessment should be presented or the difference between these figures explained. Information should be provided to support the value considered to be most appropriate (NE Ref D32*)".

92. Ref. D32 of NE's RR to the Applicant stated:

"*The values in the median impacted as percentage of unimpacted column of this table do not correspond to the difference between the un-impacted population mean and the impacted population mean. For example, 288 as a percentage of 293 is 98.29%, not 100.00%. Indeed, Plate 11.3 shows a visible difference in the population size between the two, which is not reflected in Table 11.39.*

We advise that the difference between the two presented means is included in the table, alongside the median values. The Applicant can provide information to support the value they consider to be most appropriate. Note this comment applies to all tables which present the iPCoD modelling results, including in the CEA. This is of particular importance in the CEA assessment of bottlenose dolphin, where in 2031 the impacted population mean is >5% lower than the un-impacted population mean, and so potentially significant.

Present the difference *between the two means in each table that presents iPCoD modelling results, including in the CEA. The Applicant can provide information to support the value they consider to be most appropriate".*

93. In relation to the assessment of the population consequences of pile driving noise disturbance on marine mammal receptors, further information and clarification is provided in this section. The iPCoD modelling results presented in Sections 11.6.3.2 and 11.7.3.2 in ES Chapter 11 Marine Mammals (APP-048) and Sections 9.4.2.1; 9.4.4.1; 9.5.2.1; 9.5.4.1; 9.7.2.1; 9.7.4.1 in the RIAA (APP-027) considered the median of the ratio of impacted:unimpacted population sizes for the relevant marine mammal populations as the key metric to determine effect significance using the iPCoD method. This is due to the fact that the median of the ratio of impacted:unimpacted population sizes is considered more statistically robust, to the effects of extreme outliers than the mean value, particularly with lower sample sizes (Sinclair *et al.*, 2019).

94. In addition, this metric is considered least sensitive to misspecification of demographic parameters, therefore enabling more robust assessment of

offshore renewable effects (Jital *et al*., 2017; Sinclair *et al*., 2019). Evaluations of the sensitivity of outputs to misspecification of demographic parameters have demonstrated that the ratio output metric of the counterfactual of population size (the median of the ratio of the impacted to un-impacted population size across all simulated matched replicate pairs) is a robust metric, and is therefore recommended for population viability type analyses that compare modelled populations with counterfactual populations in the context of offshore wind EIA (Jital *et al*., 2017; Sinclair *et al*., 2019). The approach taken in the ES Chapter 11 Marine Mammals (APP-048) and the RIAA (APP-027) is therefore in line with the guidance set out by the iPCoD developers (Sinclair *et al.*, 2019) and others (Jitlal *et al.*, 2017).

95. This rationale, developed by the authors of the iPCoD code, has resulted in the median of the ratio of impacted:unimpacted population sizes being used and accepted for other recent OWF EIAs, such as Moray West, Seagreen Alpha and Bravo Wind farms, the Sheringham and Dudgeon Extension Projects, North Falls and the Dogger Bank South Projects which all presented the median of the ratio of impacted to un-impacted population size.

96. It is important to note that iPCoD runs 1,000 permutations of a population growth projection for impacted and unimpacted populations. This results in 1,000 impacted:unimpacted population pairs for each time-point in the modelling period (often 25 years). Calculating the ratio between each pair and then taking the median of all ratios results in the "median of the ratio of impacted:unimpacted population sizes", which is expressed in percentage terms in the iPCoD results tables; Table 11.38 to Table 11.44 for Project alone assessment and Tables 11.86 to 11.92 for cumulative disturbance of ES Chapter 11 Marine Mammals (APP-048) and Table 9.9, Table 9.14, Table 9.21; Table 9.22; Table 9.26; Table 9.27; Table 9.52; Table 9.53; Table 9.57 and Table 9.58 in the RIAA (APP-027). Crucially, this is not the same process as taking the median of the 1,000 impacted populations sizes at a given time point, the median of the unimpacted population sizes, and then comparing the ratio between these two medians. In short, one method results in the median of all modelled population differences, (which is used in the ES and RIAA), whilst the other calculates the median of all impacted and unimpacted populations sizes and presents the difference between the two median (not used or presented in the ES or RIAA). Therefore – it is not possible to use the median population values presented within iPCoD tables to calculate the median of the ratio of impacted:unimpacted population sizes. These are different metrics that don't directly relate to each other.

97. For completeness, and at the request of NE in comment (NE Ref. D32), both the mean and median ratios of impacted:unimpacted population sizes are presented for the iPCoD simulation runs conducted for the Project-alone (**Section 5.3.1**) and cumulatively (**Section 5.3.2**) in relation to reference

populations used in ES Chapter 11 Marine Mammals (APP-048). Once again, it is important to note that it should not be expected that calculating the percentage difference between the mean impacted and unimpacted population sizes at a given timepoint presented in the result tables, will result in the same value as the mean ratio of impacted:unimpacted population sizes presented in the same tables.

98. As set out in ES Chapter 11 Marine Mammals (APP-048), if as a result of PTS, a population shows a continued decline of >1% per year (versus a modelled unimpacted reference population) over a set period of time (e.g., the first 6 years, based on the former Favourable Conservation Status (FCS) reporting period), then there is a high likelihood that a significant effect cannot be ruled out (Natural Resources Wales (NRW), 2023).

99. In terms of the Project-alone, the modelled impact of piling from the Project falls below the threshold of a 1% annual decline for the first six years in population for all marine mammal species assessed (regardless of whether median or mean values are used) which is considered not significant in ES Chapter 11 Marine Mammals (APP-048).

100. For the cumulative assessment, for all species assessed, the modelled impact of piling from the Project fell below the threshold of a 1% annual decline in population for the first six years (regardless of whether median or mean values are used) which is considered not significant. The greatest impact of cumulative disturbance using median values occurs for minke whale, with a predicted 3.2% decline in population size over a 25-year period, which is below the 1% annual decline mark within the first six years (as presented in Table 11.40 and Table 11.88 in ES Chapter 11 Marine Mammals (APP-048). When considering the mean values presented here, the greatest impact of cumulative disturbance for minke whale is a predicted 3.75% decline in population size over a 25-year period, which is also below the 1% annual decline mark during the first six years (**Table 5.32**),and not materially different to the median values presented in ES Chapter 11 Marine Mammals (APP-048).

101. When considering the mean population sizes, the greatest impact of cumulative disturbance occurs for bottlenose dolphin, with a predicted 4.73% decline in population size over a 25-year period (**Table 5.31**), which is below the 1% annual decline mark.

102. For the reasons set out above, comparison of the median ratio of impacted:unimpacted populations is considered to be a measure more robust to the influence of outliers and misspecification of demographic parameters than the mean. However, the additional information presented in this section demonstrates that the choice of using median or mean values to compare population sizes does not materially affect the outcomes of the assessment

presented in ES Chapter 11 Marine Mammals (APP-048), with all modelling results showing less than 1% annual decline for the first six years, whether the mean or median values are used.

5.3.1 Clarifications to the project-alone from underwater noise due to piling

5.3.1.1 Harbour porpoise

103. For harbour porpoise, iPCoD results were presented for Project-alone effects in Section 11.6.3.2 in the ES Chapter 11 Marine Mammals (APP-048). The results have been presented again here, with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. The results show a less than 1% annual decline in the first six years and over the 25 year period for both the mean and median, assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, in line with the results presented within ES Chapter 11 Marine Mammals (APP-048).

Table 5.23 Results of the iPCoD modelling for the Project, giving the mean population size of the harbour porpoise population (CIS MU) for years up to 2052 for both impacted and un-impacted populations, in addition to the mean and median ratio between their population sizes (clarifications to Table 11.38 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	62,516	62,516	100.00%	62,516	62,516	100.00%
End 2028	62,451	62,451	100.00%	62,590	62,590	100.00%
End 2029	62,424	62,268	99.75%	62,431	62,304	99.89%
End 2032	62,524	62,403	99.81%	62,317	62,191	99.89%
End 2037	62,307	62,180	99.80%	61,858	61,698	99.89%
End 2047	62,036	61,908	99.80%	61,274	61,197	99.89%
End 2052	61,876	61,750	99.80%	60,910	60,745	99.89%

5.3.1.2 Bottlenose dolphin

104. For bottlenose dolphin, iPCoD results were presented for Project-alone effects in Section 11.6.3.2 in the ES Chapter 11 Marine Mammals (APP-048). The results have been presented again here, with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. The results show a less than 1% annual decline in the first six years and over the 25 year period for both mean and median, assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, in line with the results presented within ES Chapter 11 Marine Mammals (APP-048).

Table 5.24 Results of the iPCoD modelling for the Project, giving the mean population size of the bottlenose dolphin population (IS MU) for years up to 2052 for both impacted and un-impacted populations in addition to the mean and median ratio between their population sizes (clarifications to Table 11.39 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	296	296	100.00%	296	296	100.00%
End 2028	295	295	100.00%	296	296	100.00%
End 2029	293	288	98.30%	294	290	100.00%
End 2032	287	283	98.69%	288	284	100.00%
End 2037	278	275	98.85%	278	274	100.00%
End 2047	262	259	98.75%	258	256	100.00%
End 2052	255	252	98.73%	252	250	100.00%

5.3.1.3 Minke whale

105. For minke whale, iPCoD results were presented for Project-alone effects in Section 11.6.3.2 in the ES Chapter 11 Marine Mammals (APP-048). The results have been presented again here, with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. The results show a less than 1% annual decline in the first six years and over the 25 year period for both mean and median, assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, in line with the results presented within ES Chapter 11 Marine Mammals (APP-048).

Table 5.25 Results of the iPCoD modelling for the Project, giving the mean population size of the minke whale population (CGNS MU) for years up to 2052 for both impacted and un-impacted populations in addition to the mean and median ratio between their population sizes (clarifications to Table 11.40 of ES Chapter 11 Marine Mammals (APP-048)

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	20,120	20,120	100.00%	20,120	20,120	100.00%
End 2028	20,188	20,188	100.00%	20,256	20,256	100.00%
End 2029	20,222	20,203	99.91%	20,236	20,217	99.94%
End 2032	20,193	20,145	99.76%	20,148	20,078	99.81%
End 2037	20,189	20,114	99.63%	20,032	19,944	99.70%
End 2047	20,115	20,026	99.56%	19,857	19,784	99.63%
End 2052	19,976	19,887	99.56%	19,407	19,320	99.63%

5.3.1.4 Grey seal

106. For grey seal, iPCoD results were presented for Project-alone effects in Section 11.6.3.2 in the ES Chapter 11 Marine Mammals (APP-048). The results have been presented again here, for both the smaller ‘combined population’ (NW England MU and IoM population) (**Table 5.26**) and for the wider reference population (**Table 5.27**), with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. The results show no annual decline in the first six years and over the 25 year period for both mean and median, and is assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, in line with the results presented within ES Chapter 11 Marine Mammals (APP-048).

Table 5.26 Results of the iPCoD modelling for the Project, giving the mean population size of the grey seal combined population (NW England MU and IoM population) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.42 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	1,592	1,592	100.00%	1,592	1,592	100.00%
End 2028	1,605	1,605	100.00%	1,612	1,605	100.00%
End 2029	1,617	1,617	100.00%	1,620	1,617	100.00%
End 2032	1,650	1,649	100.00%	1,654	1,649	100.00%
End 2037	1,701	1,701	100.00%	1,692	1,701	100.00%
End 2047	1,814	1,814	100.00%	1,806	1,814	100.00%
End 2052	1,876	1,876	100.00%	1,868	1,876	100.00%

Table 5.27 Results of the iPCoD modelling for the Project, giving the mean population size of the grey seal population (wider population (see Section 11.5.9 of ES Chapter 11 Marine Mammals (APP-048)) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.41 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	13,288	13,288	100.00%	13,288	13,288	100.00%
End 2028	13,388	13,388	100.00%	13,454	13,454	100.00%
End 2029	13,443	13,444	100.00%	13,501	13,501	100.00%
End 2032	13,735	13,736	100.00%	13,811	13,811	100.00%
End 2037	14,202	14,203	100.00%	14,243	14,244	100.00%
End 2047	15,116	15,118	100.00%	15,011	15,015	100.00%
End 2052	15,583	15,585	100.00%	15,431	15,434	100.00%

5.3.1.5 Harbour seal

107. For harbour seal, iPCoD results were presented for Project-alone effects in Section 11.6.3.2 in the ES Chapter 11 Marine Mammals (APP-048), the results have been presented again here for both the North West (NW) MU (**Table 5.28**) and the NW and Northern Ireland (NI) MU (**Table 5.29**), with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. The results show no annual decline in the first six years and over the 25 year period for both mean and median, and are assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, in line with the results presented within ES Chapter 11 Marine Mammals (APP-048).

Table 5.28 Results of the iPCoD modelling for the Project, giving the mean population size of the harbour seal population (NW MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.44 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	4	4	100.00%	4	4	100.00%
End 2028	3	3	100.00%	4	4	100.00%
End 2029	3	3	100.00%	4	4	100.00%
End 2032	3	3	100.00%	4	4	100.00%
End 2037	3	3	100.00%	2	2	100.00%
End 2047	3	3	100.00%	0	0	100.00%
End 2052	3	3	100.00%	0	0	100.00%

Table 5.29 Results of the iPCoD modelling for the Project, giving the mean population size of the harbour seal population (NW England MU and NI MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.43 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	1,412	1,412	100.00%	1,412	1,412	100.00%
End 2028	1,413	1,413	100.00%	1,416	1,416	100.00%
End 2029	1,413	1,413	100.00%	1,414	1,414	100.00%
End 2032	1,417	1,417	100.00%	1,412	1,412	100.00%
End 2037	1,425	1,425	100.00%	1,421	1,421	100.00%
End 2047	1,428	1,428	100.00%	1,406	1,406	100.00%
End 2052	1,426	1,426	100.00%	1,406	1,406	100.00%

5.3.2 Clarifications to cumulative effects from underwater noise due to piling

108. Section 11.7.3.2 in ES Chapter 11 Marine Mammals (APP-048) presents the assessment of the potential cumulative effects of other projects that could occur at the same time as the Project. Population modelling was deemed the best tool to use to assess the potential impacts of cumulative disturbance as it considers the consequences of disturbance and hearing damage (worst-case numbers) that might result from the construction of the Project and other projects.

109. The results have been presented again here, with both median and mean population sizes, and the mean and median ratios of impacted:unimpacted population sizes. A greater than 1% annual decline is not found for any species, regardless of whether mean or median metric are used, and therefore the conclusions within ES Chapter 11 Marine Mammals (APP-048) remain valid.

5.3.2.1 Harbour porpoise

110. For harbour porpoise, iPCoD modelling resulted in no significant impact on the population (**Table 5.30**). Whether the mean or median value is used to inform the results, the results show a less than 1% annual decline in the first six years and over the 25 year period for both the mean and median. Therefore, disturbance from cumulative underwater noise from piling is assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms, therefore there is no significant effect on the harbour porpoise population due to piling, and the conclusions of ES Chapter 11 Marine Mammals (APP-048) remain valid.

Table 5.30 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the harbour porpoise population (CIS MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.86 of the ES)

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	62,516	62,516	100.00%	62,516	62,516	100.00%
End 2027	62,574	62,569	99.99%	62,730	62,721	100.00%
End 2028	62,509	62,278	99.63%	62,837	62,508	99.78%
End 2031	62,389	61,703	98.91%	62,426	61,650	99.22%
End 2036	62,482	61,818	98.95%	62,299	61,505	99.26%
End 2046	62,436	61,770	98.95%	61,605	60,900	99.27%
End 2051	62,564	61,897	98.95%	61,739	61,130	99.26%

5.3.2.2 Bottlenose dolphin

111. For bottlenose dolphin, iPCoD modelling resulted in no significant impact on the population (**Table 5.31**). Whether the mean or median value is used to inform the results, the results show a less than 1% annual decline for the first six years and over the 25 year period in both the mean and median. Hence, disturbance from cumulative underwater noise from piling is assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms. Therefore, there is no significant effect on the bottlenose dolphin population due to piling, and the conclusions of ES Chapter 11 Marine Mammals (APP-048) remain valid.

Table 5.31 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the bottlenose dolphin population (IS MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.87 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	296	296	100.00%	296	296	100.00%
End 2027	295	289	98.13%	296	292	100.00%
End 2028	292	281	96.14%	294	284	98.61%
End 2031	286	271	94.85%	288	272	97.71%
End 2036	277	264	95.64%	276	262	97.87%
End 2046	261	249	95.32%	260	245	97.80%
End 2051	254	242	95.27%	250	236	97.97%

5.3.2.3 Minke whale

112. For minke whale, iPCoD modelling resulted in no significant impact on the population (**Table 5.32**). Whether the mean or median value is used to inform the results, the results show a less than 1% annual decline in the first six years and over the 25 year period for both the mean and median. Hence, disturbance from cumulative underwater noise from piling is assessed as negligible magnitude. Therefore, minor adverse significance of effect, not significant in EIA terms and therefore there is no significant effect on the minke whale population due to piling, and the conclusions of ES Chapter 11 Marine Mammals (APP-048) remain valid.

Table 5.32 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the minke whale population (CGNS MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.88 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	20,118	20,118	100.00%	20,118	20,118	100.00%
End 2027	20,125	20,123	99.99%	20,293	20,289	100.00%
End 2028	20,185	20,140	99.78%	20,378	20,348	99.87%
End 2031	20,226	19,885	98.31%	20,406	20,129	98.75%
End 2036	20,270	19,691	97.13%	20,451	19,834	97.63%
End 2046	20,472	19,724	96.33%	20,513	19,746	96.88%
End 2051	20,525	19,757	96.25%	20,355	19,707	96.80%

5.3.2.4 Grey seal

113. For grey seal, iPCoD modelling resulted in no significant impact on the population (**Table 5.33** (*NW England and IoM MU*)) and (**Table 5.34** (*wider population*)). Whether the mean or median value is used to inform the results, the results show a less than 1% annual decline in the first six years and over the 25 year period for both the mean and median. Hence, disturbance from cumulative underwater noise from piling is assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms. Therefore, there is no significant effect on the grey seal population due to piling, and the conclusions of ES Chapter 11 Marine Mammals (APP-048) remain valid.

Table 5.33 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the grey seal combined population (NW England MU and IoM population for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.90 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	1,592	1,592	100.00%	1,592	1,592	100.00%
End 2028	1,603	1,603	100.00%	1,608	1,608	100.00%
End 2029	1,612	1,611	99.98%	1,616	1,616	100.00%
End 2032	1,645	1,642	99.82%	1,654	1,652	99.88%
End 2037	1,711	1,708	99.78%	1,708	1,706	99.86%
End 2047	1,834	1,830	99.77%	1,826	1,822	99.96%
End 2052	1,896	1,892	99.78%	1,872	1,870	100.00%

*Table 5.34 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the grey seal population (wider reference population (see **Section 11.5.9**) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.89 of ES Chapter 11 Marine Mammals (APP-048))*

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted*
Start	13,288	13,288	100.00%	13,288	13,288	100.00%
End 2027	13,393	13,393	100.00%	13,458	13,458	100.00%
End 2028	13,473	13,475	100.02%	13,547	13,548	100.01%
End 2031	13,727	13,732	100.04%	13,759	13,767	100.04%
End 2036	14,192	14,197	100.04%	14,148	14,154	100.04%
End 2046	15,049	15,054	100.04%	14,984	14,986	100.03%
End 2051	15,557	15,563	100.03%	15,450	15,448	100.03%

** Note that the marginal increase in the impacted population in comparison to the un-impacted population is a result of the environmental stochasticity built into the model*

5.3.2.5 Harbour seal

114. For harbour seal, iPCoD modelling resulted in no significant impact on the population (**Table 5.35** (*NW England MU*) and **Table 5.36** (*NW England and NI MU*)). Whether the mean or median value is used to inform the results, the results show a less than 1% annual decline in the first six years and over the 25 year period for both the mean and median. Hence, disturbance from cumulative underwater noise from piling is assessed as negligible magnitude, therefore minor adverse significance of effect, not significant in EIA terms. Therefore, there is no significant effect on the harbour seal population due to piling, and the conclusions of ES Chapter 11 Marine Mammals (APP-048) remain valid.

Table 5.35 Results of the iPCoD modelling for the Project, giving the mean population size of the harbour seal population (NW MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.92 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	4	4	100.00%	4	4	100.00%
End 2028	3	3	100.00%	4	4	100.00%
End 2029	3	3	100.00%	4	4	100.00%
End 2032	3	3	100.00%	4	4	100.00%
End 2037	3	3	100.00%	2	2	100.00%
End 2047	3	3	100.00%	0	0	100.00%
End 2052	3	3	100.00%	0	0	100.00%

Table 5.36 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the harbour seal population (NW MU and NI MU) for years up to 2052 for both impacted and un-impacted populations in addition to the median and mean ratio between their population sizes (clarifications to Table 11.91 of ES Chapter 11 Marine Mammals (APP-048))

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start	1,412	1,412	100.00%	1,412	1,412	100.00%
End 2027	1,415	1,415	100.00%	1,418	1,418	100.00%
End 2028	1,413	1,413	100.00%	1,414	1,414	100.00%
End 2031	1,416	1,416	100.00%	1,416	1,416	100.00%
End 2036	1,420	1,420	100.00%	1,414	1,414	100.00%
End 2046	1,430	1,430	100.00%	1,420	1,420	100.00%
End 2051	1,436	1,436	100.00%	1,420	1,420	100.00%

6 Update to the UXO Assessment

6.1 Response to ID R9-10 (NE Ref. D12)

115. This section presents the Applicant's justification of the underwater noise modelling of a nominal 353.6kg UXO charge weight, presented in Appendix 11.3 Marine Mammal UXO Assessment (APP-067), submitted for information as part of the ES, noting a separate UXO marine licence application will be made separate to the DCO Application for any UXO clearance if required.

116. This justification is provided at the request of the ExA (ID R9-10; see **Table 3.1**), "*Modelling of a nominal 750kg Unexploded Ordnance (UXO) charge weight for the assessment of underwater UXO noise impacts, unless clear evidence is available to demonstrate that a lesser charge weight represents the actual worst-case (NE Ref D12)".*

117. Ref. D12 of NE's RR to the Applicant stated:

"*The Applicant has used a maximum charge weight of 353.5kg for UXO, which is contrary to Natural England's Best Practice Advice to use a nominal 750 kg weight. The donor charge for high order clearance is also typically greater than 0.5 kg and should be added to the total NE. When applying for the UXO licence post- consent, ensure that an appropriate maximum UXO charge weight plus donor charge is modelled".*

118. As detailed in Table 2.1 of Appendix 11.3 Marine Mammal UXO Assessment (APP-067), the worst-case type and size of UXO used to inform the assessment was the 18" British Mark XVII Torpedo (Net Explosive Quantity (NEQ) of 353.6kg. This was informed by a desk-based UXO risk assessment undertaken in 2024 by specialist contractors on behalf of the Applicant and summarised below.

119. Based on significant desk-based archival research of the windfarm site (using historical records, charts, Admiralty records and anecdotal reports) it is noted that the windfarm site is highly unlikely to be a potential source for the following:

- Aerial bombing
- Naval engagements
- Naval minefields
- Coastal armaments
- Munitions related shipwrecks and aircraft
- Munitions dumping (within 10km of the windfarm site)

120. The research did however highlight that the windfarm site does overlap with one historic naval training area (designated as "*N130 Inskip Outer*"), which is potentially associated with UXO threats such as aerial torpedoes, rockets and depth charges. An analysis of Admiralty charts found that the naval training area was used for anti-submarine bombing exercises.

121. It is believed that the naval training area was associated with the "*Royal Naval Air Station Inskip*", which was known to undertake "torpedo workshops", which could therefore also mean that aerial torpedoes may have been fired within the N130 Inskip Outer Practice and Exercise Area. This was corroborated by anecdotal accounts from former service personnel.

122. The UXO anticipated to be found within the site, along with their expected NEQ, was as follows:

- Aerial rockets (3" Rocket Projectile): 5.45kg NEQ
- Depth Charges:
  - 250lb Mark XI Depth Charge: 103.2kg NEQ
  - 250lb Mark VIII Depth Charge: 72.6kg NEQ
- Aerial torpedoes:
  - 18" Mark XVII torpedo: 353.6kg NEQ
  - 18" Mark XV torpedo: 321.1kg NEQ
  - 18" Mark XII torpedo: 176kg NEQ

123. The largest UXO (aerial torpedo of 353.5kg) was used to inform the worst-case for the marine mammal UXO assessment.

124. Given the archival research, and the maximum size of the UXO anticipated to be present within the windfarm site, it is therefore not considered necessary to remodel for a nominal 750kg UXO charge weight. It is noted that the assessment within the DCO Application is for information only and UXO clearance (if required) would be undertaken as part of a separate future marine licence application. At that point, further survey work will have been undertaken to provide more details of any UXO to be cleared and their charge weights. This process aligns with the Marine Management Organisation's (MMO)'s preferred licencing process whereby speculative UXO assessments are not undertaken. In this way, no clearance of UXO would be undertaken without a detailed assessment based on a refined list of UXO, and their charge weights, generated by UXO identification and investigation surveys. As set out in Section 5.6.2.2 of ES Chapter 5 Project Description (APP-042), the Applicant's hierarchy of preference is to firstly to avoid UXO, then to use low-noise techniques such as deflagration, with high order clearance only retained as a last resort option.

125. Regardless, the Applicant would undertake further consultation with the MMO and NE to agree the underwater noise modelling required as part of a separate future UXO clearance marine licence application.

6.2 Response to ID R9-16 (NE Ref. E11 and F9)

126. This section presents further detail of the Applicant's worst-case assessment for benthic ecology, physical processes, and marine sediment water quality impacts due to UXO clearance for the Project (noting a separate UXO marine licence application will be made separate to the DCO Application for any UXO clearance if required).

127. This assessment is provided at the request of the ExA (ID R9-16; see **Table 3.1**), "*Confirmation of the worst-case assessment for benthic ecology, physical processes, marine sediment and water quality impacts due to UXO (NE Ref E11, F9)*"

128. Ref. E11 and Ref. F9 of NE's RR to the Applicant stated:

"*Natural England notes that Unexploded Ordnance (UXO) clearance has not been considered for impacts in (APP-044) or (APP-045) on the basis that UXO clearance activities for the Project would be considered as part of a separate licence application. UXO clearance can lead to pressures such as abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids, smothering etc…*

In addition, there appears to be no consideration given to boulder clearance activities. And it is unclear whether boulder clearance will be required. However, to have confidence in assessments of physical processes and water quality impacts it is important to understand these requirements and provide assessments for activity if it is to take place.

We advise that the Application should provide sufficient information to assess the potential impacts from seabed preparation activities.

Natural England advises that physical process, marine sediment and water quality impacts due to UXO clearance and boulder clearance should be considered and assessed within updated Application documents."

129. As noted in ID R9-16 in **Table 3.1**, boulder clearance is encompassed within the 25m maximum width of disturbance for inter-array and platform link cables (as detailed in Table 5.18 of ES Chapter 5 Project Description (APP-042)). This is assessed as the maximum width of disturbance of the seabed in ES Chapter 9 Benthic Ecology (APP-046).

130. A high-level assessment of UXO clearance was provided in Table 7.1 of ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044), which stated:

"Unexploded Ordnance (UXO) clearance for the Project and for other projects in the region can cause increased suspended sediment concentrations (SSCs) and indentations on the seabed. However, these effects would be local, temporary and recoverable and, as such, effects are negligible and not considered to cause cumulative effects. UXO clearance activities for the Project would be considered as part of a separate licence application prior to any works. A more detailed assessment would be undertaken as part of this separate licence when the scale of UXO clearance required is better understood through detailed surveys and upon refinement of the layout. It would however be expected that in the case of UXO (high order) detonation, craters in the seabed would be formed. While the size of craters would be specific to the UXO and sediment type, it would be expected that craters would be backfilled via tidal currents which would begin following the UXO detonation."

131. In ES Chapter 9 Benthic Ecology (APP-046), Paragraph 9.203 stated:

"*UXO clearance campaigns would be subject to a separate licence (once the need for clearance is identified) and are not considered as part of this assessment."*

And Paragraph 9.380, which stated:

"*While Unexploded Ordnance (UXO) clearance for the Project and for other projects in the region can cause habitat disturbance and increased SSCs, effects would be highly localised, temporary and recoverable and as such UXO clearance activities are not considered to cause cumulative effects."*

132. While UXO clearance would be subject to a separate marine licence, further information is provided below for information to support the findings of ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044) and ES Chapter 9 Benthic Ecology (APP-046).

6.2.1 Description of impact

133. As outlined in Section 5.6.2.2 of ES Chapter 5 Project Description (APP-042), micro-siting of Project infrastructure would be adopted to avoid UXO where possible. Where avoidance is not possible for any reason, clearance activities may be required to safely remove or detonate any UXO that present a hazard to the construction activities, or the ongoing operation of the windfarm. Such clearance techniques could involve detonation, relocation or retrieval, with the implementation of appropriate safety zones. Low impact clearance techniques would be used where possible, e.g. low order deflagration.

134. In the case of any required need for UXO (high order) detonation within the windfarm site, it would be expected that craters in the seabed would be formed. While the size of craters would be specific to the UXO and sediment

type, it would be expected that craters would be backfilled via tidal currents which would begin following the UXO detonation. The following paragraphs provide further information on expected crater sizes for a range of UXOs, and reference to post-UXO clearance survey results from an OWF site with similar seabed conditions (fine sand (Dogger Bank Wind Farm, 2014))to show infilling and a basis for assessment.

135. Dogger Bank B, located in the North Sea, undertook a UXO clearance campaign in February – March 2023 (Dogger Bank Wind Farm, 2023). During the survey, six confirmed UXO were neutralised by high-order detonation. The project was required as per the marine licence to monitor any craters left by the UXO clearance to report on crater size. A technical note was published in July 2023 (Dogger Bank Wind Farm, 2023) which reported on the crater size. The results of five of the six craters are presented in **Table 6.1**.

Table 6.1 UXO weights and crater dimensions post-clearance (Feb '23) and during survey in June '23 (Dogger Bank Wind Farm, 2023)

UXO ID	Target weight (kg)	Crater dimensions post-high-order clearance (February 2023)	Crater depth during monitoring survey (June 2023)
DBB_013	<400	3.4m x 3.0m x 0.5m (depth)	0.1m
DBB_025	295	4.9m x 4.0m x 0.6m (depth)	0
DBB_027	<400	4.3m x 4.4m x 0.8m (depth)	0.4
DBB_047	227	3.3m x 3.3m x 0.6m (depth)	0.3
DBB_174	Unknown	5.3m x 5.8m x 0.7m (depth)	0.2
DBB_035	N/A	3.3m x 3.7m x 0.6m (depth)	Not surveyed

136. Between February 2023 and June 2023, as shown in **Table 6.1**, the UXO craters were largely infilled, with one crater being entirely infilled (DBB_025). Infilling is expected to continue as time progresses to further infill the remaining craters.

137. In 2018, Vattenfall commissioned Ordtek to provide guidance on UXO blast calculations from detonations for a range of UXO that were potentially present in the Norfolk Boreas Offshore Wind Farm. This data was used to inform an assessment of the effects on the seabed during Explosive Ordnance Disposal (EOD).

138. This report states that "*there is very limited open-source information available on crater sizes produced by detonations underwater and we are not aware of any comprehensive figures, tables or research on this subject*". The Ordtek report (2018) presented estimates of theoretical crater sizes (**Table 6.2**). For

the smallest UXO (55kg NEQ[3]) the likely crater diameter was estimated to be 8.91m with a depth of 1.3m (Vattenfall Wind Power Limited/Norfolk Boreas Limited, 2018). For the largest UXO (700kg NEQ), the likely crater diameter was estimated to be 21.11m with a depth of 3.30m (Vattenfall Wind Power Limited/Norfolk Boreas Limited, 2018).

Table 6.2 Crater calculation for UXO likely to be found at Norfolk Boreas (Vattenfall Wind Power Limited / Norfolk Boreas Limited, 2018)

UXO item	NEQ (kg)	Likely diameter of crater (m)	Likely depth of crater (m)
German Luftmine B (LMB) (Mine Type GC) Ground Mine (Hexanite)	700	21.11	3.30
British A Mk6 Ground Mine	430	21.09	2.25
WWI German E series submarine-laid buoyant mine (Wet Gun Cotton) / Trinitrotoluene (TNT) - worst-case)	150	12.61	1.8
Buoyant mine (British MK14)	227	15.75	2.0
250lb HE Bomb (Amatol / TNT)	55	8.91	1.3
500lb HE Bomb (Amatol / TNT)	12	11.97	1.6
1000lb HE Bomb (Amatol / TNT)	250	14.56	2.25

6.2.2 Impact on physical processes receptors

6.2.2.1 Indentations on the seabed due to UXO clearance

139. As stated in Paragraph 7.132 of ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044), the maximum extent of the Zone of Influence (ZoI)[4] only overlaps with the Fylde Marine Conservation Zone (MCZ) (8km from the windfarm site), Shell Flat and Lune Deep Special Area of Conservation (SAC) (10km from the windfarm site) and Annex I sandbanks (8km from the windfarm site) and there is no pathway for effect to other receptors, namely the West of Walney MCZ, West of Copeland MCZ,

[3] NEQ is the actual weight of the explosives without the weight of the packaging.

[4] Potential construction-related impacts have been translated into a ZoI based on an understanding of the tidal excursion ellipses in the study area (Section 7.5.4 of Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044)). The ZoI is based on the knowledge that effects arising from the Project on the hydrodynamic and sedimentary regime are relatively small in magnitude and restricted to within the distance that a sediment or water particle could travel during one spring tidal cycle (i.e. the distance of a spring tidal excursion ellipse: 10km for the Project windfarm site).

Morecambe Bay SAC, Fylde coast, Ribble Estuary Site of Special Scientific Interest (SSSI), Ribble and Alt Estuaries Ramsar and Sefton Coast SAC.

140. As detailed in **Section 6.2.1**, studies on the potential size of depressions left behind after UXO clearance found that, in the worst-case the detonation of a 700kg German LMB (Mine Type GC) Ground Mine (Hexanite) would lead to a crater 21.1m in diameter and 3.3m deep (Dogger Bank Wind Farm, 2018). While such a detonation would lead to a temporary loss of habitat (addressed further in **Section 6.2.3**), due to the dynamic nature of the underlying sediment and strong tidal currents within the windfarm site (see Section 7.5.4, ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044)), craters would be expected to refill with sediment over the course of days to months, depending on sedimentary and hydrodynamic conditions at the site (see Section 7.6.2.8 in ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044) for further information on seabed recoverability regarding indentations). Further, as detailed in **Section 6.1**, UXO of this size (700kg) are unlikely to be found at the site and therefore this is a precautionary assumption.

141. Due to the temporary, episodic and relatively localised nature of the impact, the impact is considered to be of **negligible** magnitude. Since the Fylde MCZ, Annex I sandbanks and Shell Flat and Lune Deep SAC are located at least 8km from the windfarm site, there is no pathway for effect, therefore there would be **no change** on these receptors.

6.2.2.2 Changes in SSCs due to UXO clearance

142. Any UXO clearance would cause a temporary increase in suspended sediment concentrations (SSCs) within the immediate area, with suspended sediment being transported by tidal currents beyond the windfarm site. However, this would be episodic, and would be far less than the increases in SSCs caused by sandwave clearance and clearance of seabed sand features for foundation installation or cable installation, or drilling for foundation installation, which have been assessed in Sections 7.6.2.1, Section 7.6.2.2 and Section 7.6.2.5 of ES Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044). SSCs are expected to return to within the range of natural variability within hours to days.

143. The receptors for marine geology, oceanography and physical processes within the ZoI (Fylde MCZ, Annex I sandbanks and Shell Flat and Lune Deep SAC) would not be impacted by increases in SSCs because they are characterised by processes that are active along the seabed and not affected by sediment suspended in the water column.

6.2.2.3 Changes in seabed level due to UXO clearance

144. The increases in SSCs associated with UXO clearance have the potential to result in changes in seabed levels as the suspended sediment deposits. Due to the episodic nature of UXO clearance and the amount of suspended sediment expected to be generated, changes in seabed level are anticipated to be significantly less than that caused by the settling of suspended sediment from sandwave clearance/clearance of seabed sand features and/or drilling activities (which was assessed as being in the order of millimetres).

145. While the value of Fylde MCZ, Shell Flat and Lune Deep SAC and Annex I sandbanks is high, the sensitivity of these receptors was assessed to be **negligible** because the receptors are naturally exposed and tolerant to sediment redistribution.

146. Given the lack of coarse sediment at the Project windfarm site, it was considered that most of the sediment disturbed during UXO clearance would form a passive plume and deposit farther afield within a spring tidal excursion. As shown by the modelling for Awel y Mor, Morgan and Mona OWF projects, changes in seabed level would be mostly in the order of millimetres over the affected area (within approximately 10km of disturbance) and would be indistinguishable from background levels.

147. Disturbance would be temporary and intermittent over an UXO clearance campaigns. It is likely that fine sediments would be remobilised and redistributed within a short period of time. The magnitude was considered **negligible** in the far-field and **low** in the near-field.

148. Receptors are remote from the windfarm site and as such, based on a **negligible** sensitivity and **negligible** magnitude, changes in seabed level due to UXO clearance would have a **negligible adverse** effect on the receptors, which is not significant in EIA terms.

6.2.3 Impact on benthic receptors

149. Given the direct nature of this impact, only habitats and biotopes present within the windfarm site itself would be affected. Habitats and biotopes outside the site are therefore not considered in the assessment of this impact (given the limited effects identified above in relation to increased SSC's and indirect effects).

6.2.3.1 Physical disturbance to seabed habitat

150. Habitats present within the site (Figure 9.7 and Figure 9.8 submitted as part of the DCO Application; ES Chapter 9 Benthic Ecology Figures (APP-093)) are almost exclusively comprised of A5.2 sublittoral sand and A5.3 sublittoral mud. Biotopes identified, albeit classified with a lesser degree of certainty than

broadscale habitat, are A5.252 ‘*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand’ and A5.351 ‘*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud’. The Feature of Conservation Interest (FOCI) ‘sea-pens and burrowing megafauna communities’ may be present at the site given the density of burrows, hence impact on A5.361 ‘sea-pens and burrowing megafauna in circalittoral fine mud’ is also considered.

151. The sensitivity of these habitats/biotopes has been assessed in relation to Marine Evidence Based Sensitivity Assessment (MarESA) pressures relevant to construction phase temporary habitat loss/physical disturbance. These are:

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

152. The sensitivity of identified habitats and biotopes to temporary habitat loss/disturbance pressures are summarised in **Table 6.3** and range from low to high.

Table 6.3 Biotope sensitivities to pressures associated with direct construction, operation and maintenance and decommissioning phase impacts

	MarESA sensitivity rating					
Biotope	**Removal of substratum**	**Abrasion/ disturbance**	**Substratum penetration/ disturbance**	**Smothering and siltation rate changes (heavy)**	**Physical change (to another seabed type)**	**Temperature increase (local)**
Subtidal sands and gravels (A5.2 sublittoral sand)						
A5.252 *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	Low	Low	Medium	High	Low
Subtidal mud / mud habitats in deep water (A5.3 sublittoral mud)						
A5.351 *Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud	Medium	Medium	Medium	Medium	High	Not sensitive
A5.361 Sea pens and	High	Medium	High	Not sensitive	High	Medium

Biotope	MarESA sensitivity rating Removal of substratum	Abrasion/ disturbance	Substratum penetration/ disturbance	Smothering and siltation rate changes (heavy)	Physical change (to another seabed type)	Temperature increase (local)
burrowing megafauna in circalittoral fine mud						

153. The dominant sublittoral mud habitat and associated biotope A5.351 is classified as having **medium** sensitivity to all pressures. The sublittoral sand habitat and associated biotope A5.252 is classified as having **medium** sensitivity to the process of substrate removal, but **low** sensitivity to abrasion/disturbance of the seabed and substrate penetration.

154. The FOCI 'sea-pens and burrowing megafauna communities' and associated biotope A5.361 has **medium** sensitivity to sediment abrasion and disturbance but is **highly** sensitive to the removal and/or penetration of the substratum. However, the MarESA assessment attributes this sensitivity specifically to the sensitivity of sea-pen species to substrate removal and seabed penetration, which would result in the loss of these species. Given that sea-pens are understood to be absent from the site (see Section 9.5.5.4 of ES Chapter 9 Benthic Ecology (APP-046) for detail), and whilst acknowledging that other burrowing megafauna would still be affected, it is considered that, in this instance, a sensitivity of **medium** would be appropriate.

155. Post-construction monitoring at the nearby Walney OWF (CMACS, 2014) indicated that, for muddy sand, the associated biotopes (particularly A5.351) were generally recorded at similar stations in the Year 1, Year 2 and Year 3 post-construction surveys as they were in the pre-construction baseline survey, with only a few exceptions where characteristic taxa of the A5.351 biotope decreased in abundance. This suggests that recovery of this biotope is possible within a relatively small timeframe (i.e. within two to three years), which supports the MarESA sensitivity assessment of resilience/recovery and low to medium sensitivity.

156. The post-construction monitoring at Walney OWF (CMACS, 2014) looked specifically at trends in burrow density before and after construction. Burrow numbers were seen to decrease following construction, particularly in the windfarm and near-field locations, where the decrease was statistically significant. However, in this instance it was noted that this did reflect a wider scale reduction, which may have partly explained the trend.

157. Given the above, a worst-case sensitivity rating of **medium** has been assigned to the receptor groups (subtidal sands and gravels, subtidal mud, sea-pens and burrowing megafauna communities) present at the site.

158. Disturbance would be temporary and intermittent over the construction period. As detailed in **Section 6.2.1**, studies on the potential size of depressions left behind after UXO clearance found that a crater with a diameter of 21.1m could be generated (Dogger Bank Wind Farm, 2018). While such a detonation would lead to a temporary loss of habitat, as described in **Section 6.2.2.1**, due to the dynamic nature of the underlying sediment and strong tidal currents within the windfarm site, craters would be expected to refill with sediment over the course of days to months, depending on sedimentary and hydrodynamic conditions at the site . 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 windfarm site and wider Irish Sea.

159. 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 is considered to be of **negligible** magnitude.

160. Based on a **medium** sensitivity and **negligible** magnitude, physical disturbance and habitat removal due to UXO clearance would have a **minor adverse** effect on the biotopes and habitats that are present at the windfarm site, which is not significant in EIA terms.

6.2.4 Impact on marine sediment and water quality receptors

6.2.4.1 Changes in SSCs due to UXO clearance

161. Seabed sediments and shallow near-bed sediments within the windfarm site would be disturbed during UXO clearance and would cause localised and short-term increases in SSCs.

162. Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044) uses a conceptual evidence-based approach to assess the effects of increases in SSCs within the water column. It is expected that medium and coarse-grained sand across the windfarm site (22.2% of PSA samples collected) disturbed by UXO clearance would remain close to the seabed and settle back to the bed rapidly. The finer sand and clay fraction (fine sand: 30.6%, very fine sand: 30.6% and silt: 16.7% of samples) disturbed across the windfarm site would likely stay in suspension for longer and form a passive plume which would become advected by tidal currents in west-east orientation.

163. It is anticipated that the increases in SSCs caused by UXO clearance would be significantly less than that caused by sandwave clearance/clearance of

sand features, as described in Section 8.6.1.1 of Chapter 8 Marine Sediment and Water Quality (APP-045). Therefore, SSCs resulting from UXO clearance are expected to be in the order of tens of mg/l for around half a tidal cycle (around six hours). Sediment would settle to the seabed in proximity to its UXO clearance (within a few hundred metres up to around a kilometre along the axis of tidal flow) within a short period of time (hours to days). Whilst lower SSCs would extend further from the dredged area, along the axis of predominant tidal flows, the magnitudes would be indistinguishable from background levels (noting that concentrations during storm conditions can exceed 300mg/l (Section 8.5.1.1 of Chapter 8 Marine Sediment and Water Quality (APP-045)).

164. This assertion is supported by the modelling undertaken by Awel y Môr Offshore Wind Farm Ltd. (2022), Morgan Offshore Wind Limited (2023) and Mona Offshore Wind Limited (2023), detailed further in Section 7.6.21 of Chapter 7 Marine Geology, Oceanography and Physical Processes (APP-044) and Section 8.6.1.1 of Chapter 8 Marine Sediment and Water Quality (APP-045).

165. Water quality in the study area was assessed as **low** sensitivity because it is not within a confined area and therefore would have a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

166. The scale of this impact would be relatively localised for coarser sediments (due to settling out) and further afield for finer sediments (up to one spring tidal excursion of approximately 10km), but SSCs would be expected to return to baseline conditions within days, due to dispersion and dilution. The magnitude of the impact was assessed as **low**.

167. A **minor adverse** effect was identified, which is not significant in EIA terms.

MORECAMBE

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