DBS Offshore Wind

RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Marine Mammal Technical note:

Significance of Effect for disturbance from piling and cumulative underwater noise

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Contents

Tables

Glossary

Term	Definition
Cumulative effects	The combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource.
Cumulative Effects Assessment (CEA)	The assessment of the combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource.
Development Scenario	Description of how the DBS East and / or DBS West Projects would be constructed either In Isolation, sequentially or concurrently.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the value, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
Management Unit	Management units provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK.

Term	Definition
Project Change Request 1	The changes to the DCO application for the Projects set out in **Project Change Request 1 - Offshore & Intertidal Works** [AS-141] which was accepted into Examination on 21st January 2025.
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).

Acronyms

Term	Definition
CEA	Cumulative Effects Assessment
CES	Coastal East Scotland
DBS	Dogger Bank South
DCO	Development Consent Order
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
ES	Environmental Statement
GNS	Great North Sea
iPCoD	Interim Population Consequences of Disturbance
JNCC	Joint Nature Conservation Committee
KM	Kilometres
MMMP	Marine Mammal Mitigation Protocol
MU	Management Unit
OWF	Offshore Windfarm
SAC	Special Area of Conservation
SE	Southeast
SIP	Site Integrity Plan
SIMOP	Simultaneous Operations
SNS	Southern North Sea
TTS	Temporary Threshold Shift

1 Significance of Effect for Marine Mammal Disturbance from piling at the Projects (Response to REP2-067:4)

1. The Projects' Environmental Statement (ES) (**Chapter 11 Marine Mammals** [APP-095]) assesses for any potential disturbance to marine mammals from underwater noise during piling using a number of different methods, including documented Effective Deterrence Ranges (EDRs), dose response curves for harbour porpoise and seals; Temporary Threshold Shift (TTS) for dolphins, and population modelling for species, where possible. All assessments are presented in section 11.6.1.2 of **Chapter 11 Marine Mammals** [APP-095]. When determining the significance of effect, this is based on the population modelling presented in section 4 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143] to take account of **Project Change Request 1 –Offshore and Intertidal Works** [AS-141].

2. Written responses from Natural England at Deadline 2 in **Appendix F2 - Natural England's comments and advice on Marine Mammals** [REP2-067] stated that though "*the interim Population Consequence of Disturbance (iPCoD) modelling is a tool to support conclusions in the Impact Assessment. Owing to evidence gaps in the relationship between marine mammal ecology, sound, disturbance and population impacts, this modelling makes many assumptions, and caution should always be taken when interpreting the outputs of any model. Natural England therefore reiterates that although the model can be used as a tool alongside other methods for assessing the impacts of disturbance, it does not mean the results of the modelling can be viewed in isolation or should solely dictate the final significance conclusion. We also maintain our previous advice regarding Effective Deterrence Range (EDR), to use 26km for unabated monopile installation and 15km for pin piles and abated piling*".

3. In response to Natural England's comment referenced above, this document presents the sensitivity, magnitude and significance of effect based on all methods (EDRs (26km for unabated monopiles and 15km for jacket pin piles for harbour porpoise, 26km for seals and 30km for minke whale), dose response curves for harbour porpoise and seals; TTS for dolphins, and population modelling) used to assess for any potential disturbance from underwater noise during piling.

4. The Applicants maintain that population modelling is the most realistic tool to understand the cumulative disturbance as it considers the consequences of disturbance (and potential auditory injury) over the long term, taking into account various species specific demographic parameters, such as management units (MU); the age where the calf / pup become independent, age of first birth, juvenile and adult survival, fertility and growth rate as presented in Table 11-4-2 in **Appendix 11-4 iPCoD Modelling (Revision 2)** [AS-139]. The demographic parameters are statistical factors that can be used to measure population change, with a high importance for the population size (MU), density, age structure, fecundity and mortality (Dodge, 2006). If the significance of effect is solely based on the recommended EDRs or dose response curve, this highlights a snapshot of the number of animals disturbed and the percentage of their reference population at a single point in time, which formed the basis for determining the magnitude of effect. However, using this type of quantitative assessment does not look at disturbance over time, which is incorporated in to the population modelling.

5. Therefore, the Applicants maintain that considering the overall evidence base, including the number of animals impacted at any one time and the duration of effects, the magnitude of the effect based on the population modelling is the most appropriate and proportional to determine the overall significance of effects. Other relevant offshore windfarms (OWFs) that have taken this approach include Awel Y Mor, Berwick Bank, Morgan, Sheringham Shoal Extension Project and Dudgeon Extension Project.

1.1 DBS East and DBS West In Isolation

6. The significance of effect for disturbance from piling at the Projects constructed in isolation was based on the results of the population modelling in section 11.6.1.2.5 of **Chapter 11 Marine Mammals** [APP-095] for:

- Harbour porpoise *Phocoena Phocoena*;
- Bottlenose dolphin *Tursiops truncatus*;
- Minke whale *Balaenoptera acutorostrata*;
- Grey seal *Halichoerus grypus;* and
- Harbour seal *Phoca vitulina.*

7. This assessment approach was taken as it is the most realistic assessment of the potential effect. Where it was not possible to undertake population modelling (i.e. for common dolphin *Delphinus delphis* and white-beaked dolphin *Lagenorhynchus albirostris*), the TTS fleeing response was used to inform the assessment.

8. The significance of effect for all marine mammal species from all assessment methods is presented in section 11.6.1.2. of **Chapter 11 Marine Mammals** [APP-095], and sections 2.3.1 and 3.1.1 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143] are presented in **Table 1-1**. The Projects' overall significance of effect for each marine mammal species is highlighted in bold. The boxes coloured grey in **Table 1-1** were presented in Table 11-59 of **Chapter 11 Marine Mammals** [APP-095]. The blank boxes are not applicable to that species, for example there are no parameters to carry out the population modelling for common dolphin and white beaked dolphin, and the dose response curve was only carried out on harbour porpoise and seals, which have very different hearing ranges and responses from dolphins. Due to differences in functional hearing groups, audiograms and behaviour, it would not be appropriate to extrapolate the findings of Graham *et al.* (2017) for harbour porpoise to other cetacean species. For grey seal, the harbour seal dose response curve has been used as a reasonable proxy since both species are of the same hearing group. However, behavioural response may vary between the species and the use of the dose response relationship for harbour seal from Whyte *et al.* (2020) applied to grey seals is considered overly conservative.

9. **Table 1-1** presents the significance of effect from various methods, however it isn't appropriate to use an additive approach to combine the assessments to conclude an overall significance. The Applicants maintain that population modelling is the most appropriate method for assessing disturbance as it incorporates the worst case disturbance numbers from the quantitative assessment. **Table 1-1** shows that significance of effect from the population modelling are the same as the other assessment methods with exception to grey seal.

Table 1-1 Assessment of Significance of Effect for the Potential for Disturbance from Monopiles for DBS East or DBS West In Isolation (The Projects Concluded Significance of effect is in bold) (Amendments to Table 11-59 of Chapter 11 Marine Mammals [APP-095]) *(Grey rows were presented in the ES)*

Marine mammal species	Sensitivity	Location	iPCoD		EDRs (TTS for dolphin species)		Dose response curve	
			Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
Harbour porpoise	Medium	DBS East & DBS West	Negligible	**Minor adverse**	Negligible	Minor adverse	Low	Minor adverse
Bottlenose dolphin	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Negligible	Negligible adverse	-	-
Common dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**	-	-
White-beaked dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**	-	-
Minke whale	Medium	DBS East & DBS West	Low	**Minor adverse**	Negligible	Minor adverse	-	-
Grey seal	Low	DBS East	Negligible (negligible)	**Negligible adverse**	Low (negligible)	Minor adverse	High (Medium)	Moderate adverse

Marine mammal species	Sensitivity	Location	iPCoD		EDRs (TTS for dolphin species)		Dose response curve	
			Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
Grey seal	Low	DBS West	Negligible (negligible)	**Negligible adverse**	Low (negligible)	Minor adverse	Medium (Low)	Minor adverse
Harbour seal	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Negligible	Negligible adverse	Negligible	Negligible adverse

** Magnitudes given in brackets are for the secondary MU assessed for the wider population for grey seal species*

1.2 DBS East and DBS West Together

10. The significance of effect for disturbance from underwater noise during piling for the Projects constructed together was based on the results of the population modelling presented in section 11.6.1.2.6 of **Chapter 11 Marine Mammals** [APP-095] and in section 3.3 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143].

11. The significance of effect for all marine mammal species from all assessment methods presented in section 11.6.1.2 of **Chapter 11 Marine Mammals** [APP-095], and sections 4.1 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143] are presented in **Table 1-2**. The Projects' overall significance of effect for each marine mammal species is highlighted in bold.

Table 1-2 Assessment of Significance of Effect for the Potential for Disturbance from Two concurrent Monopiles for DBS East and DBS West Together (The Projects Concluded Significance of effect is in bold) (Amendments to Table 11-60 of Chapter 11 Marine Mammals [APP-095]) *(Grey rows were presented in the ES)*

Marine mammal species	Sensitivity	Location	iPCoD		EDRs (TTS for dolphin species)		Dose response curve	
			Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
Harbour porpoise	Medium	DBS East & DBS West	Negligible	**Minor adverse**	Negligible	Minor adverse	Low	Minor adverse
Bottlenose dolphin	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Negligible	Negligible adverse	-	-
Common dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**	-	-
White-beaked dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**	-	-
Minke whale	Medium	DBS East & DBS West	Low	**Minor adverse**	Negligible	Minor adverse	-	-
Grey seal	Low	DBS East & DBS West	Negligible (negligible)	**Negligible adverse**	Low (negligible)	Minor adverse	High (Medium)	Moderate adverse
Harbour seal	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Negligible	Negligible adverse	Negligible	Negligible adverse

** Magnitudes given in brackets are for the secondary MU assessed for the wider population for grey seal species*

1.3 The Projects' Cumulative Assessment

1.3.1 Significance of Effect of Underwater Noise from Piling at other Offshore Windfarms

12. To determine the significance of effect for cumulative disturbance, the assessment looked at the worst case scenario which assumes all relevant OWFs will be piling at the same time as the Projects; whether the Projects were constructed separately or together. **Table 1-3** presents the sensitivity, magnitude and significance of effect for marine mammals using both a quantitative assessment and population modelling for the installation of monopiles. Tables 11-111 to 11-117 in section 11.7.3.1.1.2.1 of **Chapter 11 Marine Mammals** [APP-095] show the numbers for the quantitative assessment which were incorporated into the population modelling, presented in section 4 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143].

13. **Table 1-3** presents that the quantitative assessment based on EDRs, dose response curve and TTS (for dolphins) results in a significance of effect of major adverse (significant in EIA terms) for harbour porpoise and moderate adverse (significant in EIA terms) for grey seal for piling of monopiles. The recommended 26km for unabated monopiles and 15km EDR for jacket pin piles was used for harbour porpoise and a 25km EDR for seals (Russel *et al*. 2016). Using the EDR approach for harbour porpoise and seals, the significance of effect concluded is the same for both the installation of monopiles and jacket pin piles (**Table 1-3**).

14. However, it is considered that the cumulative assessment is over precautionary as it is highly unlikely that all relevant OWFs could be concurrently piling at the same time for various reasons such as vessel constraints, programme changes, technical issues, or weather delays. Prior to construction post consent, the Site Integrity Plan (SIP) for the Southern North sea (SNS) Special Area of Conservation (SAC) will be finalised once final design parameters are known. If the spatial and seasonal thresholds are exceeded because of cumulative OWF piling, scheduling of piling can be managed through a Simultaneous Operations (SIMOPs) procedure which is the case for the SNS SAC summer season 2025. Any mitigation measures in the final SIP and Marine Mammal Mitigation Protocol (MMMP) will reduce any disturbance to harbour porpoise and other marine mammals. Where driven or part-driven pile foundations are proposed to be installed, the final SIP submitted would include details of the noise reduction methods (primary methods) and / or noise abatement systems (secondary measures) that will be utilised to manage sound from those piling activities, if required.

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

16. The 25km EDR for seals stems from a single study on harbour seal response to piling at OWFs (Russel *et al*. 2016) and therefore assumes all animals will respond the same which is highly unlikely. The use of the 25km EDR to assess for disturbance to grey seal is also likely to be over precautionary due to a number of factors. This study did not account for variations in piling characteristics or the effects of bathymetry on sound propagation. Consequently, the displacement distance of seals could vary significantly across different OWF developments and further research is still required (Madsen *et al.* 2006, Russel *et al*. 2016). Although grey and harbour seal are similar in their hearing ranges, the two species differ in their reproduction cycles, their mating behaviour, how they respond to different threats (Scottish Seabird Organisation, 2025) and how they may react to disturbance events. It has been previously shown that harbour seals at haul-sites that are more susceptible to disturbance spend a greater percentage of their time being watchful and alert for any danger such as disturbance (Suryan and Harvey, 1999) compared to grey seals (Britton, 2012). Therefore, using the assessment method such as the 25km EDR based on harbour seal reactions as a proxy for grey seal is overly precautionary.

17. Based on the above, and the overly precautionary approach in the other methods of assessing disturbance, the Applicants maintain the population modelling is the best approach to assess for long term effects. This is due to it including the worst case numbers of marine mammals that could be potentially disturbed along with permanent auditory injury that is input into the model which runs a thousand scenarios to look at population effects on an annual and longer-term basis. The iPCoD model looks at repeated disturbances, taking into account species recovery as well as the fact that animals may incur some energetic cost during the construction period (e.g. Williams *et al*., 2006; Hastie *et al*., 2021; Frankish *et al.,* 2023). Therefore, considering the overall evidence base the Applicants still consider that use of iPCoD modelling is the appropriate and proportional approach to understanding the significance of effect of cumulative disturbance to help determine the overall significance of effects in comparison to EDRs and dose response curves which only look at short term disturbance.

Table 1-3 Assessment of effect of significance for the potential for cumulative disturbance due to other OWFs piling at the same time as DBS East and / or DBS West (The Projects Concluded Significance of effect is in bold) (Amendments to Table 11-124 of Chapter 11 Marine Mammals [APP-095]) *(Grey rows were presented in the ES)*

Marine mammal species	Sensitivity	Location	iPCoD		EDR / Dose response / TTS	
			Magnitude of impact	Potential effect significance	Magnitude of impact	Potential effect significance
Harbour porpoise	Medium	DBS East & DBS West	Negligible	**Minor adverse**	High	Major adverse
Bottlenose dolphin	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Medium	Minor adverse
Common dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**
White-beaked dolphin	Low	DBS East & DBS West	-	-	Medium	**Minor adverse**
Minke whale	Medium	DBS East & DBS West	Low	**Minor adverse**	Low	Minor adverse
Grey seal	Low	DBS East & DBS West	Negligible	**Negligible adverse**	High	Moderate adverse
Harbour seal	Low	DBS East & DBS West	Negligible	**Negligible adverse**	Low	Minor adverse

1.3.2 Significance of Effect of Underwater Noise from other Noisy Activities

18. **Table 1-5** provides an update of Table 11-131 in **Chapter 11 Marine Mammals** [APP-095], to include the worst-case numbers of harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal that could be potentially disturbed from the Projects to the cumulative assessment of disturbance to marine mammals. The potential number of animals affected was not presented in Table 11-131 of **Chapter 11 Marine Mammals** [APP-095], as only results from the iPCoD population modelling were shown for the Projects alone. In **Table 1-5**, the worst case numbers from EDRs and dose response curves have been used for the Projects taken from section 11.7.3.1.1.2.1 of **Chapter 11 Marine Mammals** [APP-095], and TTS for dolphins, where no EDRs or dose response curve are available. **Table 1-4** presents the Project scenario colour code to make the results more presentable.

Table 1-4 Protect scenario colour code (Table 11-110 of Chapter 11 Marine Mammals [APP-095])

With DBS East	Green
With DBS West	Blue
DBS Projects together	Dark blue
Without DBS Projects	Orange

19. **Table 1-6** presents the significance of effect for the potential cumulative disturbance due to other noisy activities at the same time as the Projects.

Table 1-5 Quantitative assessment for other noisy activities with the potential for cumulative disturbance effects for marine mammals (Amendments to Table 11-131 of Chapter 11 Marine Mammals [APP-095]) *(Grey rows were presented in the ES; Changes to magnitudes are in red)*

Impact	Harbour porpoise	Bottlenose dolphin	Common dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Worst case disturbance at DBS East	4,295.5	0.13	0.06	0.11	65	3,124.2	8.1
Worst case disturbance at DBS West	5,097.7	0.10	0.04	0.09	162	2,378.7	7.0
DBS East & DBS West concurrently	10,195.4	8.4	3.4	8.2	324	6,248.4	15.1
Geophysical surveys	94.7	Great North Sea (GNS): 7.7 Coastal East Scotland (CES): 3.9	0.5	2.3	1.1	46.5	10.2
Aggregates and dredging	4.1	GNS: 0.3	0.02	0.1	0.05	1.7	0.4
Seismic survey	545.3	GNS: 37.3	2.4	11.3	38.5	537.1	117.5
Sea Link	30.3	GNS: 2.5	0.2	0.7	0.3	14.9	3.3
UXO clearance (HO)	1,280.0	0.05	0.003	0.02	258.5	449.8	98.4
UXO clearance (LO)	47.3	0.0003	0.00003	0.0001	0.2	0.3	0.07

Impact	Harbour porpoise	Bottlenose dolphin	Common dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Total number with DBS East in isolation *Magnitude*	**1.8% of the North Sea (NS) MU** *Low*	**2.4% of the GNS MU** *Low*	**0.003% of the Celtic Great North Sea (CGNS) MU)** *Negligible*	**0.03% of the CGNS MU** *Negligible*	**1.8% of the CGNS MU** *Low*	**13.6% of the SE England MU** *High*	**4.9% of the SE England MU** *Medium*
Total number with DBS East in isolation *Magnitude*	**< 1.58% of the NS MU** *Low*	**< 3.37% of the GNS MU** *Low*	**0.03% of the CGNS MU** *Negligible*	**0.3% of the CGNS MU** *Negligible*	**< 2.48% of the CGNS MU** *Low*	**< 4.43% of the SE England MU** *Low*	**< 5.72% of the SE England MU** *Medium*
Total number with DBS West in isolation *Magnitude*	**2.0% of the NS MU** *Low*	**2.4% of the GNS MU** *Low*	**0.003% of the CGNS MU** *Negligible*	**0.03% of the CGNS MU** *Negligible*	**2.3% of the CGNS MU** *Low*	**11.2% of the SE England MU** *High*	**4.9% of the SE England MU** *Medium*
Total number with DBS West in isolation *Magnitude*	**< 1.58% of the NS MU** *Low*	**< 3.37% of the GNS MU** **MU)** *Low*	**0.03% of the CGNS MU** *Negligible*	**0.3% of the CGNS MU** *Negligible*	**< 2.48% of the CGNS MU** *Low*	**< 4.43% of the SE England MU** *Low*	**< 5.72% of the SE England MU** *Medium*
Total number with DBS Projects together *Magnitude*	**3.5% of the NS MU** *Low*	**2.8% of the GNS MU** *Low*	**0.006% of the CGNS MU** *Negligible*	**0.05% of the CGNS MU** *Negligible*	**3.1% of the CGNS MU** *Low*	**23.9% of the SE England MU**	**5.0% of the SE England MU** *Medium*

Impact	Harbour porpoise	Bottlenose dolphin	Common dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
						High	
Total number with DBS Projects together *Magnitude*	**< 1.58% of the NS MU** *Low*	**< 3.37% of the GNS MU** *Low*	**0.06% of the CGNS MU** *Negligible*	**0.5% of the CGNS MU)** *Negligible*	**< 2.48% of the CGNS MU** *Low*	**< 4.43% of the SE England MU** *Low*	**< 5.72% of the SE England MU** *Medium*
Total number without DBS Projects *Magnitude*	**0.6% of the NS MU** *Low*	**GNS: 2.4% of the GNS MU** *Low* **CES: 1.79% of the CES MU (4 animals)** *Low*	**0.003% of the CGNS MU** *Negligible*	**0.03% of the CGNS MU** *Negligible*	**1.5% of the CGNS MU** *Low*	**3.4% of the SE England MU** *Low*	**4.7% of the SE England MU** *Low*
Total number without DBS Projects together *Magnitude*	**0.58% of the NS MU (2,001.7 animals)** *Negligible*	**GNS: 2.37% of the GNS MU (47.9 animals)** *Low* **CES: 1.79% of the CES MU (4 animals)** *Low*	**0.03% of the CGNS MU** *Negligible*	**0.3% of the CGNS MU** *Negligible*	**1.48% of the CGNS MU (298.7 animals)** *Low*	**3.43% of the SE England MU (1,050.3 animals)** *Low*	**4.72% of the SE England MU (229.9 animals)** *Low*

Table 1-6 Assessment of effect of significance for the potential for cumulative disturbance due to other noisy activities at the same time as piling DBS East and / or DBS West (The Projects Concluded Significance of effect is in bold) (Amendments to Table 11-132 of Chapter 11 Marine Mammals [APP-095]) *(Grey rows were presented in the ES)*

Marine mammal species	Sensitivity	Location	iPCoD		EDR/Dose response	
			Magnitude of impact	Potential effect significance	Magnitude of impact	Potential effect significance
Harbour porpoise	Medium	DBS East & DBS West	Low	**Minor adverse**	Low	Minor adverse
Bottlenose dolphin	Low	DBS East & DBS West	Low	**Minor adverse**	Low	Minor adverse
Common dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**
White-beaked dolphin	Low	DBS East & DBS West	-	-	Negligible	**Negligible adverse**
Minke whale	Medium	DBS East & DBS West	Low	**Minor adverse**	Low	Minor adverse
Grey seal	Low	DBS East & DBS West	Low	**Minor adverse**	High	Moderate adverse
Harbour seal	Low	DBS East & DBS West	Medium	**Minor adverse**	Medium	Minor adverse

1.4 Conclusion

20. Sections 1.1 and 1.2 presented the significance of effect for all marine mammal species from all assessment methods to assess for potential disturbance from the Projects constructed either in isolation or together. There is no change in the Projects' significance of effect presented in **Table 1-1** and **Table 1-2.**

21. In section 1.3, the worst case numbers of animals potentially disturbed from the Projects and other relevant OWFs have resulted in a major adverse effect (significant in EIA terms) for harbour porpoise and moderate adverse (significant in EIA terms) for grey seal. The worst case numbers of animals potentially disturbed from the Projects and other noisy activities have also resulted in moderate adverse (significant in EIA terms) for grey seal. However, this is very precautionary, as it is unlikely that all projects and/or activities could be occurring at exactly the same time.

22. Findings from Moray West OWF found evidence of a 10km EDR from monopiles with a 10m diameter and with no noise mitigation (Benhemma-Le Gall *et al.* 2024), therefore supporting that the unabated 26km EDR for monopiles and 15km EDR for jacket pin piles EDRs for harbour porpoise is likely to be overestimated. Graham *et al.* (2017) dose response curve for pile driving predicts that almost 100% of the population will respond at received levels of 160 dB re 1 μPa^2s SEL_{ss}, up to 70% response at 150 dB re 1 μPa^2s SEL_{ss} and only 50% response at 145 dB re 1 μPa^2s SEL_{ss}. Therefore, the assumption that 100% of the animals are disturbed is likely to be highly over-precautionary (Sinclair *et al.* 2023). Therefore, the Applicants do not feel that the 26km EDR is the most reliable method to assess for cumulative disturbance.

23. The dose response curve for harbour seal (Whyte *et al.* 2020) was applied to grey seal in sections 11.6.1.2.2.2 and 11.6.1.2.3.2 of **Chapter 11 Marine Mammals** [APP-095]) as a specific dose response curve for grey seal does not exist. This approach has its limitations given the different sensitivities to disturbance events and behavioural responses between grey and harbour seal (see section 1.3.1 for further details), which can result in overestimates of disturbance, therefore resulting in an overly precautionary approach. Looking at pinniped hearing ranges, Richardson *et al.* (1995) documented published audiograms. Ridgeway and Joyce (1975) indicated that in response to pulsed sounds, grey seal are most sensitive to sounds at 20 to 25 kHz in water as compared with 32 kHz in water for harbour seal (Mohl, 1968). This shows that although there are some similarities, the frequencies of best sensitivity for the two seals species differ. In general, marine mammals are most susceptible to auditory injury at the frequency they hear best in (i.e. the greatest sensitivity). This shows that the harbour seal dose response curve applied to grey seal could be over precautionary, due to it being based on the hearing sensitivity of harbour seal.

24. As the dose response curve assessment produced the highest number of grey seals disturbed by any single piling event, the number of animals disturbed produced by this method has been incorporated into the population modelling.

25. The Applicants maintain that population modelling is the best tool to understand the cumulative disturbance as it considers the consequences of disturbance (and potential auditory injury) over the long term, taking into account various species-specific demographic parameters. Results from the population modelling for grey seal results is negligible adverse (not significant in EIA terms) as presented in section 4.1.2.4 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143]. Population modelling has been used in other Development Consent Orders (DCO) applications and accepted in Sheringham Shoal Extension Project, Dudgeon Extension Project and Awel Y Mor OWFs. This is currently the approach taken forward in other DCO applications including North Falls, Morecambe, Berwick Bank and Morgan OWFs.

26. If the significance of effect is solely based on EDRs or dose response curve (a quantitative approach), this highlights a snapshot of the number of marine mammals disturbed and the percentage of their reference population at a single point in time.

27. Although the quantitative approach assesses disturbance of a single event, the duration of effects has also been considered. Repeated disturbance events are not expected to have a sustained significant effect on the wider population, as the effects of disturbance are not permanent and are recoverable. This is shown in the results of the iPCoD modelling that considers piling disturbance over time. Whilst it is important to note that animals may incur some energetic cost during the construction period (e.g. Williams *et al.*, 2006; Hastie *et al.*, 2021; Frankish *et al.*, 2023), it is very likely they will recover. Studies such as Benhemma-Le Gall *et al.* (2024) and others presented in section 11.6.1.2.1 of **Chapter 11 Marine Mammals** [APP-095] found that harbour porpoises and other marine mammals return to the area after piling. Stone (2023) documented that the minimum time recorded for harbour porpoise to return to an area after piling was 4 hour and 45 minutes, and 5 hour and 58 minutes for grey seal, with recordings from OWF in UK waters over a decade.

28. It is important to note that the significance of effect is solely based on piling without any noise mitigation and is therefore deemed over precautionary. Where driven or part-driven pile foundations are proposed to be installed, the final SIP submitted for the SNS SAC and MMMP would include details of the noise reduction methods (primary methods) and / or noise abatement systems (secondary measures) that will be utilised to manage sound from those piling activities, if required. The final suite of mitigation measures will be determined post-consent once project design parameters are finalised. Although the measures presented in the SIP are to reduce the disturbance effects on the harbour porpoise population of the SNS SAC, these measures would also reduce potential disturbance effects for all marine mammal species including grey seals.

29. Considering the overall evidence base, including the predicted number of animals impacted at any one time and the duration of effects, the magnitude of the effect has been deemed appropriate and proportional to help determine the overall significance of effects. Therefore, the Applicants maintain that the significance of effect as presented in sections 11.6.1.2.5; 11.6.1.2.6; 11.7.3.1.1.3 and 11.7.3.2.10 of **Chapter 11 Marine Mammals** [APP-095], and section 3 of **Appendix B Marine Mammal Environmental Statement Update** [AS-143] remain valid.

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